BS 5546:2010

BSI Standards Publication

Specification for installation and maintenance of gas-fired water-heating appliances of rated input not exceeding 70 kW net

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Contents

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Foreword

Publishing information

This British Standard is published by BSI and came into effect on 30 June 2010. It was prepared by 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.

Supersession

This British Standard supersedes BS 5546:2000+A1:2005, which is withdrawn.

Information about this document

The structure follows the approach used in other gas installation standards. Requirements, with corresponding commentary and recommendations, cover equipment selection and pre-installation, installation and post-installation, to which maintenance has been added as a specific detail.

In line with BS 5440-1, this revision has acknowledged that European work on chimney standards has brought about the need in British Standards to redefine chimney concepts and adopt common terminology consistent with the range of products used across the whole European community (the general requirements for which are given in BS EN 1443) where a chimney is treated as a structure containing a flue (the passageway) and might include a liner (inner wall), insulation and an outer wall. The common terminology in UK industry, which has regarded a chimney as a masonry structure generally associated with solid fuel appliances, has been superseded.

The requirements of this specification are supported by recommendations. To comply with this specification, it is necessary to comply with all its requirements. The operative may depart from recommendations, but would be expected to have good reasons for doing so.

This standard allows manufacturers' instructions to specify a method of installation, testing, commissioning or maintenance which differs in points of detail from this standard. This reference to manufacturers' instructions is allowed only where it will result in at least an equivalent level of safety. In such circumstances, it is important that the manufacturer's instructions are followed.

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 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 a 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 Building Regulations 2000 (for England and Wales), as amended [2];
- The Building (Amendment) Regulations (Northern Ireland) 2010 [3];
- The Building (Scotland) Regulations 2004, as amended [4];
- The Building Regulations 2007 (for the Isle of Man) [5].

In this document, the following national regulations are referred to as the "Water Fittings Regulations [6]":

- The Water Supply (Water Fittings) Regulations 1999, in England & Wales;
- The Water Byelaws 2004 (Scotland), in Scotland;
- The Water Supply (Water Fittings) Regulations (Northern Ireland) 2009, in Northern Ireland.

1 Scope

This British Standard specifies requirements for the selection, installation, inspection, commissioning and maintenance of gas-fired water-heating appliances, which have a rated heat input not exceeding 70 kW, based on net calorific value.

It applies to water-heating appliances utilizing 1st, 2nd or 3rd family gases designed to operate in the condensing or non-condensing mode for the supply of hot water for domestic purposes in domestic dwellings or domestic dwellings in commercial premises.

This standard does not apply to:

a) water-heating appliances with a rated input of over 70 kW;

b) hot water supply systems in multiple dwellings supplied from a central source.

NOTE 1 Groups of water-heating appliances with individual ratings of less than 70 kW but with a maximum aggregate input of 70 kW may be installed to this Standard but specialist advice on the system design, installation and control needs to be sought from the appliance manufacturer.

It does not cover the detailed design and installation of the whole hot water distribution system, which was specified in BS 5449.

NOTE 2 With the publication of EN 12828, EN 12831 and EN 14336, BS 5449 has been withdrawn. These European standards, which have now been adopted as British Standards, are not aligned to UK design and installation practices; they cover commercial as well as domestic heating systems and exclude hot water. Consequently, they have been amended to include national annexes covering all the relevant material from BS 5449.

This standard applies to water-heating appliances which carry a CE mark and also to previously used water-heating appliances which do not carry the CE mark (see **5.3.1**).

NOTE 3 In this standard, heat input is expressed in terms of net calorific values (CV), unless stated otherwise. The ratio of gross to net heat input is approximately 1.11:1 for natural gas, 1.09:1 for propane, and 1.08:1 for butane.

*NOTE 4 It is essential that persons carrying out the installation of any gas appliance be competent to do so (see Clause **4**).*

NOTE 5 Some parts of this standard might be appropriate for the installation of pool and spa water-heating appliances. The manufacturer's instructions may advise which parts are not appropriate.

2 Normative references

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

BS 476-4, *Fire tests on building materials and structures – Part 4: Non-combustibility test for materials*

BS 476-22, *Fire tests on building materials and structures – Part 22: Methods for determination of the fire resistance of non-loadbearing elements of construction*

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

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

BS 1566-2, *Copper indirect cylinders for domestic purposes – Part 2: Specification for single fed indirect cylinders*

BS 2879, *Specification for draining taps (screw-down pattern)*

BS 3198, *Specification for copper hot water storage combination units for domestic purposes*

BS 5422, *Method for specifying thermal insulating materials for pipes, tanks, vessels, ductwork and equipment operating within the temperature range –40 °C to +700 °C*

BS 5440-1:2008, *Flueing and ventilation for gas appliances of rated input not exceeding 70 kW net (1st, 2nd and 3rd family gases) – Part 1: Specification for installation of gas appliances to chimneys and for maintenance of chimneys*

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

BS 5482-1, *Code of practice for domestic butane- and propane-gas-burning installations – Part 1: Installations at permanent dwellings, residential park homes and commercial premises, with installation pipework sizes not exceeding DN 25 for steel and DN 28 for corrugated stainless steel or copper*

BS 5482-2, *Code of practice for domestic butane- and propane-gas-burning installations – Part 2: Installations in caravans and non-permanent dwellings*

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

BS 5970, *Code of practice for thermal insulation of pipework and equipment in the temperature range of –100 °C to +870 °C*

BS 6283-2, *Safety and control devices for use in hot water systems – Part 2: Specifications for temperature relief valves for pressures from 1 bar to 10 bar*

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

BS 6798:2009, *Specification for installation and maintenance of gas-fired boilers of rated input not exceeding 70 kW net*

BS 6891, *Installation of low pressure gas pipework of up to 35 mm (R1¼) in domestic premises (2nd family gas) – Specification*

BS 7671, *Requirements for electrical installations – IEE Wiring Regulations*

BS EN 1490, *Building valves – Combined temperature and pressure relief valves –Tests and requirements*

BS EN 12828, *Heating systems in buildings – Design for water-based heating systems*

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BS EN 12897, *Water supply – Specification for indirectly heated unvented (closed) storage water heaters*

BS EN 50379-3, *Specification for portable electrical apparatus designed to measure combustion flue gas parameters of heating appliances – Part 3: Performance requirements for apparatus used in non-statutory servicing of gas fired heating appliances*

NOTE BS EN 50379-3 has superseded BS 7927; see bibliography.

PD 5482-3, *Code of practice for domestic butane- and propane-gas-burning installations – Part 3: Installations in boats, yachts and other vessels*

IGEM/UP/2, Edition 2, *Installation pipework on industrial and commercial premises* [1)]

UKLPG, *Code of Practice 22 – LPG Piping System Design and Installation* [2)]

3 Terms and definitions

For the purposes of this British Standard, the terms and definitions given in BS 1179, BS 1179-6 and the following apply.

3.1 air vent
non-adjustable purpose-provided unit or assembly that is designed to allow permanent ventilation

3.2 back circulator unit
appliance with a rated net input of less than 6 kW designed for the production of stored sanitary hot water by gravity circulation, and which is designed to fit into a fireplace recess or a builder's opening

3.3 circulator
appliance with a rated net input of less than 6 kW which is designed for the production of stored sanitary hot water by gravity circulation

3.4 cistern
fixed container for holding water at atmospheric pressure

3.5 chimney
structure consisting of a wall or walls enclosing a flue or flues

NOTE This includes chimneys of all materials (e.g. metal, masonry, plastic, etc) for use with either open-flued or room-sealed appliances.

3.6 cold feed pipe
pipe that connects from a feed cistern to a cylinder, storage vessel, or to the primary side of a closed circuit

3.7 combination boiler
boiler designed to provide domestic hot water and hot water for central heating without the need for additional secondary storage

NOTE A combination boiler may include primary or secondary storage.

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1) INSTITUTION OF GAS ENGINEERS AND MANAGERS (IGEM). *Installation pipework on industrial and commercial premises*. IGEM/UP/2, Edition 2. Kegworth: IGEM, 2008.

2) UKLPG. *LPG Piping System Design and Installation.* Code of Practice 22. Kenilworth: UKLPG, 2002.

3.8 compartment
enclosure specifically designed or adapted to house an appliance, and which is not a habitable space

3.9 condensing appliance
appliance designed to make use of the latent heat in the combustion products by condensing water vapour within the appliance

3.10 cylinders

3.10.1 cylinder (hot water storage vessel)
vessel for storing hot water under pressure greater than atmospheric

3.10.2 direct cylinder
vessel for storing hot water that has been directly heated in a boiler or circulator

3.10.3 indirect cylinder
vessel in which stored water feeding a secondary circuit is heated by hot water in the primary circuit via a heat exchanger, without mixing of the primary or secondary water

3.10.4 double-feed indirect cylinder
indirect cylinder that requires separate feed cisterns to the primary and the secondary circuits

3.10.5 single-feed indirect cylinder
indirect cylinder which has only one cold feed pipe connection to supply both the primary and secondary circuits, so designed that the formation of an air seal during filling prevents mixing and accommodates the expansion of the primary water

3.11 distributing pipe
pipe, other than a warning pipe, overflow pipe or flush pipe, which conveys water from a cistern or from hot water apparatus supplied from a feed cistern, the water being under pressure from that cistern

3.12 domestic dwelling
self-contained unit designed to accommodate a single household

3.13 domestic water
water supplied by a water supplier for drinking, washing, cooking or sanitary purposes, including hot water supplied through any outlet

3.14 draining tap
tap fitted to drain water from a water system pipe or vessel

3.15 feed cistern
cistern used for supplying cold water to hot water apparatus, cylinder or tank

3.16 float-operated valve
valve for controlling the flow of water into a cistern, the valve being operated by the vertical movement of a float

3.17 flow pipe
pipe, in a primary hot water circuit, in which water moves away from the boiler or circulator

3.18 flue
passage for conveying combustion products to the outside air

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3.19 flue duct
duct containing the flue of a chimney configuration

3.20 flueless appliance
appliance designed for use without connection to a flue, the products of combustion being allowed to mix with the air of the room or space in which the appliance is situated

NOTE This type of appliance is designated as "type A" in PD CEN/TR 1749.

3.21 gas installation pipework
pipework or fittings from the outlet of the meter installation 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].

3.22 greywater
water originating from the mains water supply that has been used for bathing or washing, washing dishes or laundering clothes

3.23 hot water storage combination unit
either:

a) hot water storage vessel with a cold water feed cistern immediately above it, the two being fabricated together as a compact unit; or

b) hot water storage vessel with a cold water feed cistern beside it or inside it

3.24 instantaneous water-heating appliance
appliance in which water is heated only as it is drawn off

3.25 open-flued appliance
appliance designed to be connected to an open-flue chimney

NOTE 1 This type of appliance is designated as "type B" in PD CEN/TR 1749.

NOTE 2 These appliances are sometimes referred to as non-room-sealed appliances in European installation standards.

3.26 open-flue chimney
chimney that evacuates the products of combustion to the outside air, the combustion air being drawn directly from the room, space or enclosure containing the water-heating appliance

3.27 operative
person who installs, commissions, services or maintains a gas-fired water-heating appliance

3.28 pluming
visible cloud formed when products of combustion exit from a chimney and are cooled below the dew point by mixing with external air

3.29 plume management kit
chimney component designed to manage the discharge of the products of combustion such that any plume will not cause a nuisance

3.30 primary circuit
assembly of water fittings in which water circulates between a boiler or other source of heat and a water-to-water heat exchanger

3.31 return pipe
pipe, in a primary hot water circuit, in which water returns to the boiler or circulator

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3.32 room-sealed appliance
appliance whose combustion system is sealed from the room in which the appliance is located and which obtains air for combustion from a ventilated uninhabited space within the premises, or from the open air outside the premises, and which vents the products of combustion directly to open air outside the premises

NOTE This type of appliance is designated as "type C" in PD CEN/TR 1749.

3.33 secondary circuit
assembly of water fittings in which water circulates between a water-to-water heat exchanger and draw-off branches

3.34 servicing valve
valve for stopping the flow of water in a pipe connected to a water fitting, to facilitate the maintenance or servicing of that fitting

3.35 stop valve
valve, other than a servicing valve, fitted in a pipeline to stop the flow of water

3.36 storage water-heating appliance
appliance in which a volume of water is heated under thermostatic control and stored, to be drawn off when required

3.37 storage system
system in which water is heated and held in a storage vessel

NOTE The water can be heated either directly in a water-heating appliance or circulator, or heated and stored in an indirect cylinder.

3.38 supply pipe (water)
pipe conveying wholesome water, from the public mains or other source, within a dwelling

3.39 terminal
fitting installed at the outlet of a chimney

NOTE These are fitted to assist products of combustion to escape, minimize downdraught and prevent entry of material which might block the flue.

3.40 vent pipe
pipe connecting a water system to the atmosphere

3.41 warning pipe
overflow pipe positioned so that the discharge of any water from its outlet, whether inside or outside a building, is conspicuous

3.42 water-jacketed tube heater
appliance in which water for domestic purposes, in a secondary circuit, is heated inside a coil located within stored primary hot water

NOTE The primary hot water can also be used for space-heating.

4 Competence

Persons carrying out design, installation, servicing or maintenance associated with and/or impacting on gas work, electrical installation, water supply and drainage or the ventilation provision for gas appliances shall be competent.

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*COMMENTARY AND RECOMMENDATIONS ON CLAUSE **4***
It is a statutory requirement in the United Kingdom, Isle of Man and Guernsey (see Table 1) 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 1) to operate and maintain such a register.

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.

Table 1 **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) Order 1996 [7]
Northern Ireland	Health and Safety Executive Northern Ireland (HSENI)	Gas Safety (Installation and Use) Regulations (Northern Ireland) 2004 [8]
Guernsey	Health and Safety Executive for the States of Guernsey [HSE (Guernsey)]	Health and Safety (Gas) (Guernsey) Ordinance 2006 [9]

Guidance on the individual competency required for gas work is given in the Health and Safety Commission's Approved Code of Practice (ACOP) (COP 20) "Standards of training in safe gas installation" [10]. Persons deemed to be competent to carry out gas work are those who hold:

a) a current certificate of competence in the type of activity issued under the Nationally Accredited Certification Scheme for Individual Gas Fitting Operatives (ACS) in line with ACOP (COP20); or

b) a National/Scottish Vocational Qualification (N/SVQ) aligned in matters of gas safety.

Persons therefore have a statutory duty to ensure that they are working to the appropriate competency standards.

5 Selection of equipment and pre-installation

5.1 Exchange of information and planning

Those concerned with the selection of the appliance and the design of the system shall collaborate with the operative, both at the planning stage and during the execution of the work.

*COMMENTARY AND RECOMMENDATIONS ON **5.1***
Liaison between the various trades carrying out the work is essential for the safe and efficient installation of a water-heating appliance.

Particular matters that should be considered when carrying out new or replacement installations are:

a) the availability and suitability of gas, electrical and water supplies;

b) the physical size, design and position of the water-heating appliance, and its relationship to structural support and to combustible materials;

NOTE 1 Some installations will involve preliminary structural work which needs to be completed at the building carcass stage. Suitable bases will be required for floor-standing water-heating appliances.

c) the type of building, form of construction (e.g. timber framed), and the probable position of fixtures, furniture and curtains;

NOTE 2 Information on gas installations in timber framed and light steel framed buildings is given in IGE/UP/7, Edition 2 [11].

NOTE 3 Information on gas installations in flats and other multi-dwelling buildings is given in IGE/G/5 [12].

d) the size, height, type, support and route of the chimney and the position of termination, including the possible consequences of any pluming;

*NOTE 4 Particular notice is drawn to the advice in BS 5440-1:2008, Clause **12**, on the connection to SE-duct, U-duct and shared chimneys.*

NOTE 5 Some modern room-sealed fanned draught water-heating appliances are designed for long flue ducts which enable builders to site water-heating appliances away from external walls and conceal the flue ducts and air-supply ducts within voids. Attention is drawn to the Gas Safety (Installation and Use) Regulations 1998 [1] concerning the need for inspection throughout the length of the flue duct. Detailed information is given in Gas Safe Register Technical Bulletin 008 [13].

e) the provision of adequate air for combustion and ventilation;

f) the position of any drains for condensate or pressure/temperature relief valve discharge;

g) the manufacturer's instruction regarding water hardness. Unless the manufacturer's instructions say otherwise, where the mains water total hardness (as $CaCO_3$) exceeds 200 ppm, provisions should be made to treat the feed water to the hot water circuit of combination boilers to reduce the rate of accumulation of limescale;

h) whether the system pipework is adequately sized.

Consultation with official bodies

Attention is drawn to the Water Fittings Regulations [6] which require that the water supply company is notified regarding the proposed installation and its consent obtained.

In addition, the following official bodies might need to be consulted for the reasons given:

1) the local authority, with regard to building regulations and planning application requirements;

2) the fire authority, to establish compliance with relevant fire precautionary requirements; and the fire insurers, for notification of any proposed changes in the means of water heating;

3) the Health and Safety Executive (HSE), to establish compliance with health and safety requirements in commercial premises, particularly with regard to safety requirements which are not fulfilled as an integral part of the installation.

5.2 Selection of water-heating system

5.2.1 The system shall be selected to suit the requirements of the user, taking account of locations, the quantity and temperature of the hot water required, costs (including maintenance and fuel costs), water delivery rates and the characteristics of the different water-heating systems.

The manufacturer's instructions shall be consulted for performance data.

*COMMENTARY AND RECOMMENDATIONS ON **5.2.1***

Instantaneous appliances

*In appliances without a thermal store, water is heated after the draw-off tap is turned on. As a consequence, there might be a short delay between the demand for hot water and its delivery. (See **5.3.2**.)*

Storage

In systems with primary water storage, water to be drawn off passes through a coil immersed in the stored hot water (a water-jacketed tube heater). This gives a rapid response, but initially water might be delivered at a temperature close to that of the stored water (which could be the central heating flow temperature of 82 °C).

*In such cases, in hard water areas, it might be necessary to take precautions against scaling. (See **6.7.7**.)*

In systems without primary storage, water for domestic purposes is stored and its temperature can be controlled according to delivery conditions.

Combination boilers

Combination boilers with no water storage capacity have typical hot water delivery rates between 6 L/min and 11 L/min with a 45 °C temperature rise. If the combination boiler incorporates primary water storage, the delivery rate depends on the pressure and flow rate available to the appliance, e.g. from the water mains, and the pipework resistance.

5.2.2 Where a water storage system is selected, the water capacity shall be sufficient for its intended use (see BS 6700).

*COMMENTARY AND RECOMMENDATIONS ON **5.2.2***
Where only a sink or basin is to be supplied, a water-heating appliance of small storage capacity (up to about 10 L) may be used.

Where a storage system is required to supply a bath or a number of draw-off points, a water-heating appliance which has a large water storage capacity should be used. Typical storage capacities range from 45 L to 120 L.

Where a suitable hot water storage vessel exists already, a circulator or back circulator unit might be most appropriate.

Where a water storage system is selected and a rapid recovery rate is required, a boiler should be used. The rated heat output of a boiler is not normally less than 10 kW, and it is therefore capable of providing a faster recovery rate than a circulator. This type of appliance is frequently used to provide a combined space-heating and hot water service (see BS 6798).

Where a higher flow rate or delivery pressure is sought, direct connection to the mains, pump-assisted systems or a high-head cistern should be used. Before any water-heating appliance is connected directly to the mains water supply, it should be ascertained that the mains water supply to the property is adequate to satisfy the expected demand.

Where a pump boosting system is to be used, refer to BS 6700.

5.3 Selection of water-heating appliance

5.3.1 A new water-heating appliance selected for installation shall carry a CE mark.

A previously used water-heating appliance selected for installation shall either carry a CE mark, or shall conform to an appropriate British Standard.

The water-heating appliance shall only be connected to and supplied with the gas for which it was designed and shall be installed in such a way as to prevent danger to any person.

Conversion to another gas, if necessary, shall be carried out strictly in accordance with the appliance manufacturer's instructions, using the manufacturer's supplied kit of parts.

*COMMENTARY AND RECOMMENDATIONS ON **5.3.1***
The HSE publication, Safety in the installation and use of gas systems and appliances *[14] should be consulted.*

For CE-marked appliances

The operative should ensure that the water-heating appliance carries the CE mark on the data plate and that the data plate and the packaging are marked with at least the following information:

a) the letters "GB";

b) the type of gas and the pressure of utilization indicated as follows:

1) "G20 and/or natural gas 20 mbar" for a water-heating appliance adjusted for natural gas;

2) "G31 and/or propane 37 mbar" for a water-heating appliance adjusted for propane;

3) "G30 and/or butane 29 mbar" for a water-heating appliance adjusted for butane;

4) "G30, G31 and/or butane/propane 29/37 mbar" for a water-heating appliance which will burn either butane or propane at the correct pressure.

The data plate of a CE-marked water-heating appliance will carry the designation I2H, I3P, I3B, or I3+ respectively for items 1), 2), 3) or 4). Where a water-heating appliance's data plate carries the letters "Cat II" or "II", followed by the gas type designations P, B, then the appliance can be used for propane or butane when adjusted and converted to do so.

Previously used (e.g. second hand) appliances without a CE mark

If a previously used water-heating appliance which does not carry the CE mark is to be installed, the operative should be satisfied that the appliance is safe in construction and can be used without constituting a danger. The appliance should be fitted in accordance with the manufacturer's instructions. If these instructions are not available, the operative should contact the manufacturer and obtain a copy before fitting the appliance.

A previously used water-heating appliance conforming to BS 5258-1, BS 5258-7, BS 5258-8 or BS 5258-15, or BS 5386-1, BS 5386-2 or BS 5386-5, as appropriate, may be considered safe to install.

For all water-heating appliances

If there is any doubt as to the suitability of a water-heating appliance for a particular gas, the appliance manufacturer should be consulted.

The operative should check the data provided with the appliance to confirm that the appliance is appropriate for the installation, and should confirm the basis on which the heat input rating is quoted, i.e. gross or net. The ratio of gross to net heat input is approximately 1.11:1 for natural gas, 1.09:1 for propane and 1.08:1 for butane.

Further information on the labelling of gas appliances is given in DD 221.

5.3.2 A flueless instantaneous water-heating appliance shall only be selected if the draw-off tap or other equipment (such as a washing machine) to be supplied is within the room or space in which the water-heating appliance is installed.

*COMMENTARY AND RECOMMENDATIONS ON **5.3.2***
Flueless instantaneous water-heating appliances should have a label, attached in a prominent place, advising that the water-heating appliance should not be used continuously for more than five minutes.

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Small flueless instantaneous water-heating appliances, with an output of between 8 kW and 10 kW, will provide approximately 2.6 L/min of water raised through 50 °C. They normally supply hot water through a swivel spout. Some models have the additional facility for making a direct connection to a draw-off point.

5.3.3 No instantaneous water-heating appliance, whether new or used, shall be installed unless it is room-sealed or it incorporates a safety control designed to shut down the appliance before there is a dangerous build-up of products of combustion in the room concerned.

5.3.4 Water-heating appliances selected for installation in a bathroom or shower room shall be room-sealed.

*COMMENTARY AND RECOMMENDATIONS ON **5.3.4***
Large instantaneous water-heating appliances have an output within the range of 17 kW to 35 kW, which provides approximately 5 L/min to 10 L/min respectively, raised through 50 °C. They are appropriate for supplying hot water to a bath or to a number of draw-off points.

5.3.5 Water-heating appliances selected for installation in a room intended to be used for sleeping accommodation shall be of a type which can be installed in accordance with **6.4.2.2**.

6 Installation and location of water-heating appliances (general)

6.1 Air supply for combustion and ventilation

A water-heating appliance shall have an air supply for combustion and ventilation which conforms to BS 5440-2.

*COMMENTARY AND RECOMMENDATIONS ON **6.1***
BS 5440-2 specifies the air supply requirements of open-flued and room-sealed appliances installed in compartments and in rooms.

For premises insulated against external noise (e.g. noise of traffic, aircraft), attention is drawn to local noise insulation regulations.

6.2 Chimney system

With the exception of flueless appliances, the products of combustion shall be conducted to the outside air. The chimney system shall conform to BS 5440-1.

*COMMENTARY AND RECOMMENDATIONS ON **6.2***
*The plume from a chimney outlet might cause a nuisance to the user or neighbouring properties. Further guidance is given in **7.2**.*

Guidance on chimneys for permanently sited mobile homes, caravans and boats is given in BS 5482-2 and PD 5482-3.

Chimneys for residential park homes conforming to BS 3632 should be installed following the guidance given in BS 5440-1.

Information on chimneys for timber framed and light steel framed buildings is given in IGE/UP/7, Edition 2 [11].

Information on room-sealed fanned draught flue systems concealed within voids is given in Gas Safe Register Technical Bulletin 008 [13].

6.3 Materials and components

All materials and components used in the installation shall conform to the applicable British or European Standard if such a standard exists.

Materials containing asbestos shall not be used. High-melting-point solders incorporating cadmium shall not be used.

NOTE Attention is drawn to the Water Fittings Regulations [6], which require that materials in contact, or likely to come in contact, with wholesome water (water supplied for such domestic purposes as exist in or include, cooking, drinking, food preparation or washing) do not constitute a toxic hazard, do not contribute to microbiological growth and do not give rise to unpleasant taste or odour, cloudiness or discolouration of the water. For example, solder containing lead is not to be used in pipework conveying water which is required to be wholesome.

*COMMENTARY AND RECOMMENDATIONS ON **6.3***
Where no British or European Standard exists, materials and components should be of a suitable quality, and should be designed, constructed and installed to fulfill their intended purpose and so as not to put the safety of persons at risk.

Products for installation in the United Kingdom should be selected from those which have been verified and listed in the Water Fittings and Materials Directory published by the Water Regulations Advisory Scheme (WRAS). (See www.wras.co.uk/directory.)

6.4 Location

6.4.1 General

Provision shall be made, on installation, for access to all components that require servicing, adjustment or periodic replacement. The space around the water-heating appliance shall be at least the minimum specified in the manufacturer's installation instructions.

The floor or wall on which the water-heating appliance is to be mounted shall be protected as detailed in the manufacturer's instructions.

For any room or internal space which falls into more than one of the categories covered in **6.4.2** and **6.4.3**, the more stringent requirements shall apply.

A flueless water-heating appliance shall not be fitted in any room of volume less than 5 m^3.

*COMMENTARY AND RECOMMENDATIONS ON **6.4.1***
The space around the water-heating appliance should be adequate:

a) to ensure sufficient air circulation for any draught diverter to operate;

b) to ensure sufficient air for combustion and cooling;

c) for maintenance and servicing.

BS 6400, Parts 1 to 3, refers to separation distances and guarding between gas and electric services.

Water-heating appliances should not be located above gas or electricity meters.

Where a water-heating appliance is located in an exposed position, such as an external location, roof space or an unheated garage, consideration should be given to frost protection.

There is no restriction on the type of water-heating appliance that can be installed in a private garage except where the manufacturer states otherwise. Great care is required in the location of a water-heating appliance in any premises where concentrations of flammable vapour could accumulate, e.g. commercial garages and associated workshops.

6.4.2 Room installations

6.4.2.1 Bathrooms and shower rooms

Water-heating appliances installed in a room containing a fixed bath or shower shall be room sealed. (See also **6.6**.)

The electrical installation shall conform to BS 7671.

The electrical supply to the water-heating appliance shall be provided via a switched fused connection unit; however, socket-outlets are allowed in rooms containing a bath or shower as long as they are 3 m from the edge of Zone 1 and RCD protected.

*COMMENTARY AND RECOMMENDATIONS ON **6.4.2.1***
Installation in a bathroom or shower room should only be considered if there is no alternative location.

Particular attention is drawn to BS 7671 with regard to zoning requirements in locations containing a bath or shower and to the requirement for RCD protection and protective equipotential bonding (if applicable).

6.4.2.2 Bedrooms and bed-sitting rooms

For water-heating appliances to be installed in a room used, or intended to be used, for sleeping accommodation, the following conditions shall apply.

a) Any appliance of heat input greater than 14 kW gross (12.6 kW net) shall be room sealed.

b) An appliance of 14 kW gross (12.6 kW net) heat input or less may:

   1) be room sealed; or

   2) be open flued, and incorporate a safety control which shuts down the appliance before there is a dangerous quantity of products of combustion in the room concerned; or

   3) be flueless, if the appliance heat input is 12 kW gross (10.8 kW net) or less, and incorporate a safety control which shuts down the appliance before there is a dangerous quantity of products of combustion in the room concerned and have any permanent ventilation required communicating directly with outside air. Such water heating appliances shall only be installed in a room with an openable window or equivalent as specified in BS 5440-2.

c) An appliance installed in a bedroom or bed-sitting room where the volume of the room is less than 20 m^3 shall be room sealed.

The conditions in item a), item b1) and item b2) shall also apply to installations in cupboards or compartments in bedrooms or bed-sitting rooms, or cupboards, compartments or spaces adjacent to bedrooms or bed-sitting rooms.

*COMMENTARY AND RECOMMENDATIONS ON **6.4.2.2***
Installation in a bedroom or bed-sitting room should only be considered where there is no alternative location.

*See **6.4.3** for further information on compartments and cupboards.*

When planning a bedroom or bed-sitting room installation, consideration should be given to factors affecting amenity, such as noise of operation and the need for servicing.

6.4.2.3 Cloakrooms and/or toilets

Flueless water-heating appliances shall not be installed in cloakrooms and/or toilets where the volume of the room is 5 m^3 or less.

*COMMENTARY AND RECOMMENDATIONS ON **6.4.2.3***
Any air vent in a toilet or cloakroom should communicate directly with the outside air.

6.4.2.4 Basement rooms

A water-heating appliance for use with 3rd family gases shall not be installed in a room or internal space below ground level, e.g. in a basement or a cellar.

*COMMENTARY AND RECOMMENDATIONS ON **6.4.2.4***
This does not preclude the installation of such appliances into rooms or internal spaces which are basements with respect to one side of the building but open to ground level on the opposite side.

6.4.2.5 Living rooms, kitchens, utility rooms, halls and passageways

Where water-heating appliances and circulators designed for installation in fireplaces are used, the installation shall conform to BS 5871-1.

*COMMENTARY AND RECOMMENDATIONS ON **6.4.2.5***
All types of water-heating appliance are permitted in living rooms, kitchens, utility rooms, halls and passageways. Attention is drawn to fire regulations.

When a living room installation is planned, careful consideration should be given to factors affecting amenity, such as noise of operation, condensation, appearance and the need for servicing.

6.4.3 Compartment and cupboard installations

6.4.3.1 General

Flueless water-heating appliances shall not be installed in compartments or cupboards.

6.4.3.2 Compartments

6.4.3.2.1 The water-heating appliance compartment shall be a fixed rigid structure, the internal surfaces of which conform to the appliance installation instructions.

*COMMENTARY AND RECOMMENDATIONS ON **6.4.3.2.1***
If the appliance manufacturer's installation instructions do not give specific advice, any internal surface of the compartment which is of combustible material should either be at least 75 mm from any part of the appliance or be lined with non-combustible material. Methods of determining whether a material can be described as combustible or non-combustible are given in BS 476-22. For further advice, see HSE publication, Safety in the installation and use of gas systems and appliances *[14].*

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6.4.3.2.2 The compartment shall permit access for inspection and servicing of the water-heating appliance and any ancillary equipment. A notice shall be fixed in a prominent position within the compartment to warn against its use as a storage cupboard. The compartment shall be fitted with a door that will permit withdrawal of the appliance and any ancillary equipment.

6.4.3.2.3 If the compartment houses an open-flued water-heating appliance, neither the door nor the air vents shall communicate with a bedroom or bed-sitting room or a room containing a bath or shower (see **6.4.2.1** and **6.4.2.2**).

6.4.3.2.4 Open-flued water-heating appliances installed in compartments communicating directly with a room used, or intended to be used, for sleeping accommodation shall have a heat input of less than 14 kW gross (12.6 kW net) and shall include a safety control designed to shut down the water-heating appliance before a dangerous quantity of the products of combustion accumulates in the room concerned (see **6.4.2.2**).

6.4.3.2.5 Where necessary, according to manufacturer's instructions, the compartment shall incorporate air vents for cooling and air for combustion and correct operation of the chimney (see **6.1** and **6.2**).

6.4.3.2.6 An appliance installed in an understairs cupboard shall conform to the following requirements.

a) Where the premises in which the cupboard is located is no more than two storeys above ground level, the cupboard shall conform to **6.4.3.2.1** to **6.4.3.2.5**.

b) Where the premises in which the cupboard is located is more than two storeys above ground level, all the internal surfaces of the cupboard, including the base, shall either be non-combustible in accordance with BS 476-4 or be lined with non-combustible material. The walls, roof and base of the cupboard shall have a fire resistance of not less than 0.5 h when determined in accordance with BS 476-22, and the air vents shall be direct to outside air.

*COMMENTARY AND RECOMMENDATIONS ON **6.4.3.2.6***
An understairs cupboard installation should only be considered if no practicable alternative location is available.

Whenever possible, the water-heating appliance in an understairs cupboard should be room sealed.

6.4.3.3 Cylinder/airing cupboard installations

An airing cupboard adapted to house a circulator shall conform to **6.4.3.2**.

The airing spaces shall be separated from the appliance compartment by a non-combustible partition, which may be perforated, if necessary, by apertures having a major dimension no greater than 13 mm.

Any flue duct which passes through the airing space shall be double-walled or thermally insulated, unless the duct is surrounded by an air inlet duct.

Where the water-heating appliance is open flued, the draught diverter and the air vents shall be in the appliance compartment and shall connect to the room and not the airing space. The air vents shall be in accordance with BS 5440-2.

A label shall be provided warning the user that the appliance compartment should not be used for storage, drying or airing.

The surface of the cylinder insulation adjacent to any part of an open-flued circulator shall be made of or protected by non-combustible material.

*COMMENTARY AND RECOMMENDATIONS ON **6.4.3.3***
Figure 1 illustrates a typical circulator installation in a cylinder/airing cupboard.

For a double-wall chimney conforming to BS EN 1856-1, or for a flue duct concentric with an air inlet duct provided that there is a 25 mm gap between the inner and outer surfaces, the external skin and the air gap provide sufficient insulation and no extra precautions are necessary other than normal installation tolerances.

A single-wall chimney should be protected by an air gap of at least 25 mm. This air gap can be provided by a non-combustible guard which forms an annular space around the chimney of not less than 25 mm.

Any clearance between the chimney guard and the compartment partition where the chimney passes through should not exceed 13 mm.

Expanded metal or rigid wire meshes are suitable materials for the partition and guard.

6.4.4 Roof space installations

6.4.4.1 Roof spaces incorporating water-heating appliance installations shall meet the following requirements.

a) Vertical clearances shall be provided so that any static head required by the manufacturer can be met.

b) The installation site (reinforced, as necessary) shall be capable of supporting the load of the water–heating appliance and the associated pipework and equipment when filled with water.

*COMMENTARY AND RECOMMENDATIONS ON **6.4.4.1**b)*
Where the floor is of combustible material and supports the water-heating appliance, a non-combustible insulating base at least 12 mm thick should be provided directly under the appliance.

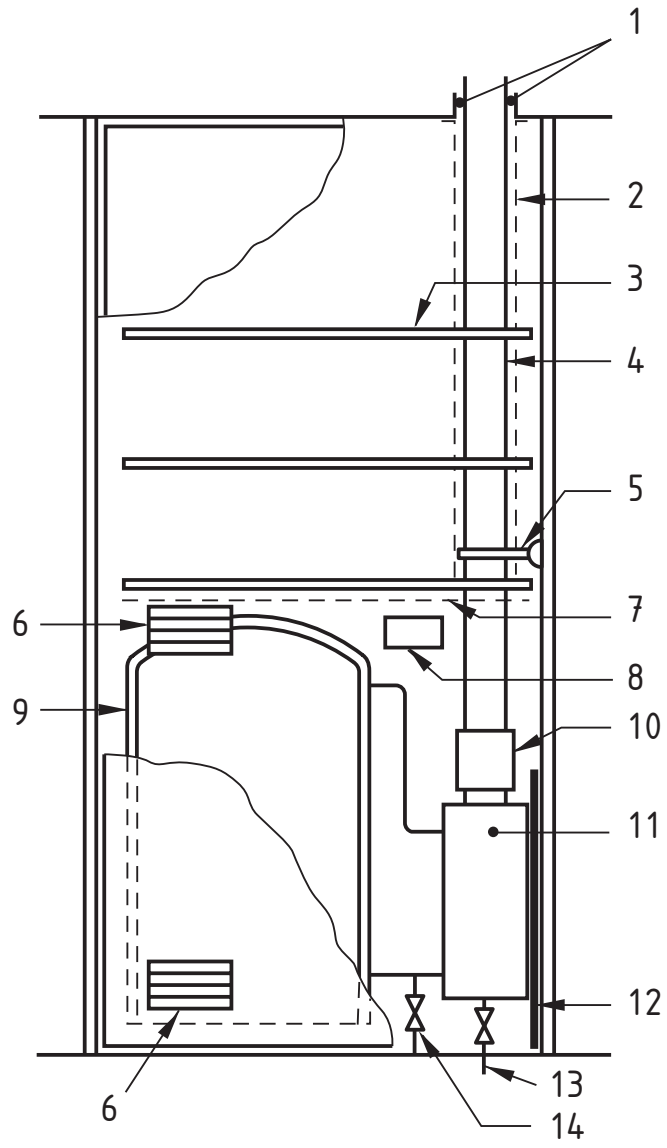
c) A purpose-designed means of access to the installation shall be provided.

*COMMENTARY AND RECOMMENDATIONS ON **6.4.4.1**c)*
A permanently fixed retractable roof ladder is considered to satisfy the requirement for a purpose-designed means of access. A safety guard should be provided around the roof space access opening.

d) Fixed lighting for the installation and the means of access shall be provided.

e) A guard shall be provided to prevent contact between stored articles and the water-heating appliance, its associated pipework and chimney.

Figure 1 **Circulator installation in cylinder/airing cupboard**



Key

1	25 mm annular gap	8	Warning notice
2	Annular guard	9	Insulation
3	Linen shelf	10	Disconnection collar
4	Flue pipe	11	Circulator
5	Flue pipe clip	12	Non-combustible panel
6	Air vent	13	Gas supply
7	Compartment partition	14	Draining tap

6.4.4.2 When a water-heating appliance is connected to an existing brick chimney at a level higher than the connection for a previous installation, the lower section of the chimney shall not be used. The unused lower portion of the chimney shall be sealed from the used portion by means of a plate inserted below the water-heating appliance connection to the chimney but ensuring that other flues in the same chimney stack are not sealed off. Where the chimney is unlined, the plate shall be inserted to form a void extending approximately 250 mm below the water-heating appliance connection to the chimney.

*COMMENTARY AND RECOMMENDATIONS ON **6.4.4.2***
Consideration should be given to providing access to the void immediately below the water-heating appliance connection to the chimney. Any openings into the lower portion of an internal flue, i.e. the sealed-off section, should be permanently closed off. For a chimney with at least one external face, the lower disused section should be ventilated to the external air at high and low level to prevent damp penetration.

6.4.5 External installations

6.4.5.1 An instantaneous water-heating appliance shall not be installed in an external location. A water-heating appliance installed in an external location shall either:

a) be specifically designated in the manufacturer's literature as being suitable for external installation without the need for additional protection; or

b) incorporate protection against frost and be installed in an enclosure capable of providing permanent weather protection.

*COMMENTARY AND RECOMMENDATIONS ON **6.4.5.1**b)*
The enclosure should be waterproof.

6.4.5.2 If an enclosure is necessary, it shall conform to **6.4.3**. In addition, there shall be fitted within the enclosure an accessible waterproof, switched fused connection unit to completely isolate the water-heating appliance and all associated equipment, e.g. pumps, motorized valves. The enclosure shall be fitted with air vents direct to outside air, at both high and low level, as specified in **6.1**.

*COMMENTARY AND RECOMMENDATIONS ON **6.4.5.2***
The lowest part of the low-level vent should be not less than 300 mm above ground level. Any permanent openings to the enclosure, including those in the air vents, should have a minor dimension not greater than 10 mm in order to prevent the entry of birds or rodents. However, this dimension should not be less than 5 mm in order to minimize the risk of blockage. A means should be incorporated to prevent access by unauthorized persons to the water-heating appliance enclosure.

Attention is drawn to the building regulations (see foreword), which can apply to such enclosures.

6.4.5.3 Water-heating appliances installed in an external enclosure shall be provided with a chimney as specified in **6.2**.

6.4.5.4 External gas installation pipework shall be protected against corrosion and damage in accordance with BS 6891 or IGEM/UP/2, Edition 2, as appropriate.

6.4.5.5 Water-carrying pipework shall be insulated against freezing in accordance with BS 5422 and installed in accordance with BS 5970.

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6.4.6 Other installations

A water-heating appliance installed in locations other than those described in **6.4.2**, **6.4.3**, **6.4.4** and **6.4.5** shall be installed in accordance with the manufacturer's instructions.

*COMMENTARY AND RECOMMENDATIONS ON **6.4.6***
Information on chimneys for timber-framed and light-steel-framed buildings is given in document IGE/UP/7, Edition 2 [11].

Information on gas installations in flats and other multi-dwelling buildings is given in IGE/G/5 [12].

Guidance on installations using 3rd family gases is given in BS 5482-1, BS 5482-2 and PD 5482-3.

6.5 Gas supplies and pipework

6.5.1 First and second family gases

6.5.1.1 The gas supply pressure to the water-heating appliance shall be controlled in accordance with the manufacturer's instructions.

6.5.1.2 Where a service pipe exists, the operative shall confirm with the gas supplier or public gas transporter that the pipe is of sufficient size for the maximum gas rate of the whole installation.

*COMMENTARY AND RECOMMENDATIONS ON **6.5.1.2***
Attention is drawn to the high gas rate of large instantaneous water-heating appliances and the necessity for ensuring that the gas service pipe, meter and installation pipes are adequate for installations that include such an appliance or to which such an appliance is to be added. The operative should contact the gas supplier or public gas transporter to ensure that the service and meter are suitable.

6.5.1.3 When a meter is fitted by a gas supplier or public gas transporter, the operative shall confirm that the meter is of sufficient capacity for the maximum gas rate of the whole installation.

*COMMENTARY AND RECOMMENDATIONS ON **6.5.1.3***
A credit meter is preferred, and its installation should conform to BS 6400, Parts 1 or 2, or IGE/GM/6 [15], as appropriate. The use of a prepayment meter could cause considerable inconvenience to the user and for this reason is not considered to be good practice.

A prepayment meter should only be adopted at the insistence of the user or the gas supplier.

6.5.1.4 All gas installation pipework shall be sized and installed in accordance with BS 6891 or IGEM/UP/2, Edition 2, as appropriate.

*COMMENTARY AND RECOMMENDATIONS ON **6.5.1.4***
When replacing an existing water-heating appliance and reusing the existing gas installation pipework, the operative should confirm that the pipework is of adequate size to supply the new water-heating appliance before fitting the appliance.

In addition to the requirements of BS 6891 on protection, attention should be given to the protection of pipes within fireplace openings from corrosion and damage by debris such as soot or parging that might fall from the chimney. A suitable method of protection is to wrap the pipe with a compatible tape. See BS 5871-1 or BS 5871-2, as appropriate, for further guidance.

6.5.1.5 All water-heating appliances shall be provided with an adjacent isolating valve if this is not already supplied with the water-heating appliance.

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6.5.2 Third family gases

6.5.2.1 The gas storage vessels shall not be installed or stored in the water-heating appliance compartment or inside the premises.

6.5.2.2 All gas installations shall be sized and installed in accordance with BS 5482-1, BS 5482-2, PD 5482-3, IGEM/UP/2, Edition 2 or UKLPG Code of Practice 22, as appropriate.

*COMMENTARY AND RECOMMENDATIONS ON **6.5.2.2***
Unless supplied from a central storage system, 3rd family gas installations do not normally incorporate a gas meter.

6.5.2.3 When a meter is already in place, the operative shall confirm that the meter and pipework is of sufficient capacity for the maximum gas rate of the whole installation.

*COMMENTARY AND RECOMMENDATIONS ON **6.5.2.3***
A credit meter is preferred and its installation should conform to BS 6400-3. The use of a prepayment meter could cause considerable inconvenience to the user and for this reason is not considered to be good practice.

A prepayment meter should only be adopted at the insistence of the user or the gas supplier.

6.6 Electricity supplies and wiring

6.6.1 The electrical installation shall conform to BS 7671.

6.6.2 Electricity supplies to the water-heating appliance and any ancillary controls shall be installed in accordance with the manufacturer's instructions. All electrical components shall be designed for the electrical supply voltage and shall be of a rating sufficient to carry the electrical current required by the operation of the equipment. The water-heating appliance and its controls shall be suitably IP (ingress protection) rated for use in the intended location.

6.6.3 The point of connection to the mains electricity shall be readily accessible and the method of connection shall provide electrical isolation of the water-heating appliance and all ancillary electrical controls by either:

a) a double-pole switched fused connection unit; or

b) a fused three-pin plug and an unswitched shuttered socket outlet (refer to **6.4.2.1** if the water-heating appliance is to be installed in a bathroom).

*COMMENTARY AND RECOMMENDATIONS ON **6.6.3***
The Institution of Electrical Engineers' Electrician's Guide to the Building Regulations *[16] advises that a minimum of 300 mm should be allowed from the edge of kitchen sinks and draining boards to the water-heating appliance's point of connection to the mains electricity to reduce the risk of being splashed.*

6.6.4 All fuses shall be in accordance with the water-heating appliance manufacturer's instructions.

6.7 Water supply

*COMMENTARY AND RECOMMENDATIONS ON **6.7***
Attention is drawn to the Water Fittings Regulations [6] which apply to the design and installation of all hot water systems to be supplied with water derived from a public supply. Water fittings that have been accepted by WRAS and published in the Water Fitting and Materials

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Directory (www.wras.co.uk/directory) are acceptable under these regulations provided they are installed in accordance with any installation conditions associated with their listing in the Directory and are generally in compliance with the Water Fittings Regulations [6].

Where it is permissible to connect a water-heating system directly to the water mains, reference should be made to BS 6700.

6.7.1 Supply from a cistern

6.7.1.1 Every storage cistern for water supplied for domestic purposes shall be installed in a place or position which prevents the entry of water which is unfit for human consumption. The storage cistern shall be insulated against heat and frost. When it is made of a material which contaminates or is likely to contaminate stored water, the storage cistern shall be lined or coated with an impermeable material designed to prevent such contamination.

The cistern shall have a rigid, close-fitting and securely fixed cover. The cover shall not be airtight, shall exclude light and insects and shall fit closely round any vent or expansion pipe. It shall be made of materials which do not shatter or fragment when broken and which will not contaminate any water which condenses on its underside.

All materials in normal contact with the water, and the cover, shall be capable of withstanding a temperature of 100 °C without detrimental effect.

Every pipe for conveying water from a cold water storage cistern, the capacity of which exceeds 18 L, shall be fitted with a servicing valve. A servicing valve shall not be fitted in a feed pipe to a primary circuit.

No warning pipe shall be connected to any other warning or overflow pipe (see Figure 2). The warning pipe shall be not less than 19 mm internal diameter and properly supported throughout its full length. It shall have a continuous fall in gradient from the cistern to a visible external termination point. If the material of the pipe is not capable of withstanding a temperature of 100 °C without detriment, it shall have continuous support to avoid sagging.

*COMMENTARY AND RECOMMENDATIONS ON **6.7.1.1***
For further information, see BS 6700.

The servicing valve in a pipe for conveying water from a cold water storage cistern should be located as close to that cistern as is reasonably practicable.

6.7.1.2 A cistern shall be capable of accommodating the thermal expansion of water such that the water level cannot rise to within 25 mm of the overflow warning pipe under normal operating conditions.

*COMMENTARY AND RECOMMENDATIONS ON **6.7.1.2***
When water is heated, it expands in volume and this expansion should be catered for because, in normal operating conditions, water should not be discharged to waste. Between 4 °C and 100 °C it expands by approximately 4% of its volume, e.g. an installation which holds 115 L when cold would need to have provision built in to accommodate an extra 4.5 L of water on heating up.

6.7.1.3 Every storage cistern shall be installed in a position such that the inside can be readily inspected and cleansed and that any float-operated valve or other device used for controlling the inflow of water can be readily installed, repaired, renewed or adjusted.

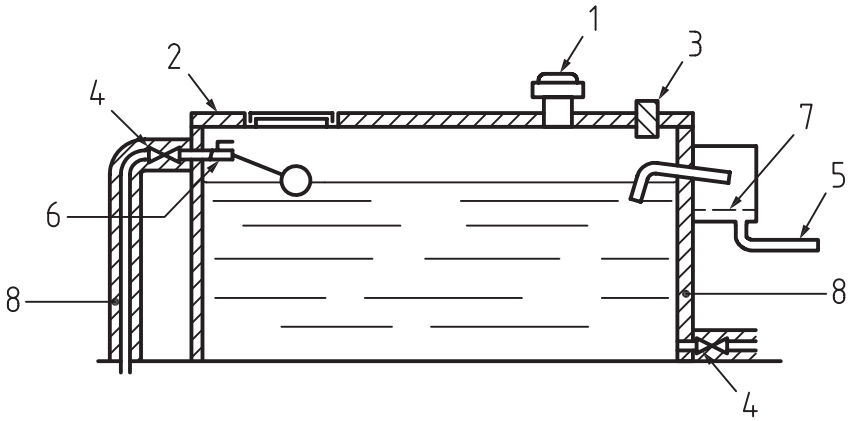
Every storage cistern shall be adequately supported to avoid distortion or damage to it or any water fitting connected to it. The cistern shall be supported over the full area of the underside in accordance with the storage cistern manufacturer's recommendations. The support base shall be level and shall extend not less than 150 mm in all directions beyond the edge of the maximum dimensions of the cistern.

*COMMENTARY AND RECOMMENDATIONS ON **6.7.1.3***
The position of the storage cistern would be accepted as being satisfactory if it has an unobstructed space above it of not less than 350 mm. In the case of deep and narrow cisterns, e.g. hot water combination units, access for cleaning via a hand hole might be required. The hand hole should be circular or elliptical, of area not less than 7 850 mm^2, and its centre should be not more than 125 mm above the lowest horizontal surface of the cistern or unit.

In the case of small cisterns, the overhead unobstructed space may be reduced to 225 mm provided no dimension of the cistern exceeds 450 mm in any plane.

These recommendations are illustrated in Figure 3.

Figure 2 **Example of a cistern conforming to 6.7.1.1**



Key

1 Screened air inlet of corrosion-resisting mesh (0.65 mm max. opening)
2 Securely fixed cover
3 Sleeve for vent pipe
4 Servicing valve
5 Warning pipe
6 Float-operated control valve
7 Screen (0.65 mm max. opening) to prevent ingress of insects etc., sized to pass the same amount of water as the warning pipe
8 Insulation against frost

6.7.1.4 The capacity of a non-integral cistern supplying a hot water storage vessel shall be at least equal to the capacity of the hot water storage vessel.

*COMMENTARY AND RECOMMENDATIONS ON **6.7.1.4***
When deciding on the size of the cistern required, consideration should be given to the number of outlets supplied by that cistern. For example, in addition to the hot water storage vessel, the cistern could supply cold water to sinks, basins and baths. Where two cisterns are used to provide the necessary capacity, they should be interconnected so as to function as one cistern.

In general for small houses, it is usual for a cold water storage cistern supplying cold water fittings to have a capacity of 100 L to 150 L and double this capacity if supplying all water outlets, hot and cold. In

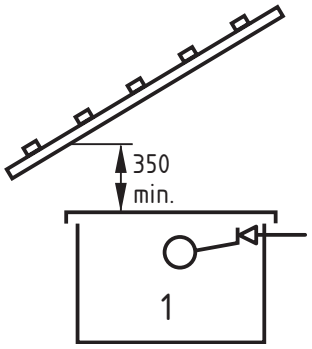
large houses, a total storage capacity of 100 L for each bedroom is recommended (see also BS 6700).

6.7.1.5 A feed cistern supplying water to the primary circuit of an indirect hot water system shall be used for no other purpose.

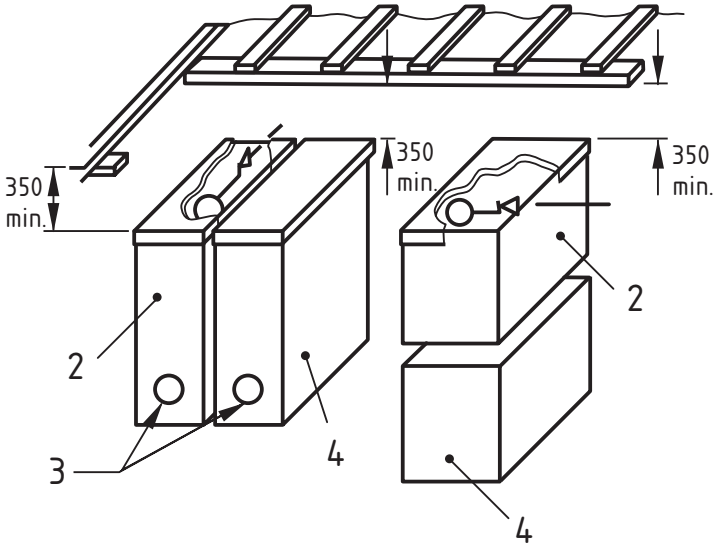
6.7.1.6 Any cistern whether or not integral with the water-heating appliance, and used to supply cold water to a water-heating appliance or system, shall be located at a height sufficient to ensure the design rate of water flow at the highest draw-off taps.

Figure 3 **Examples showing the clear space needed above storage cisterns**

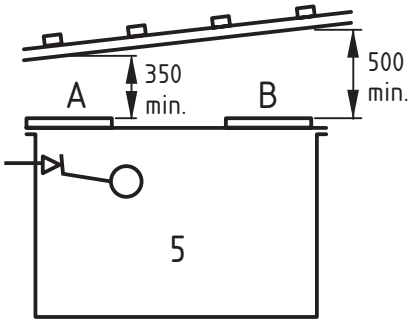
Dimensions in mm



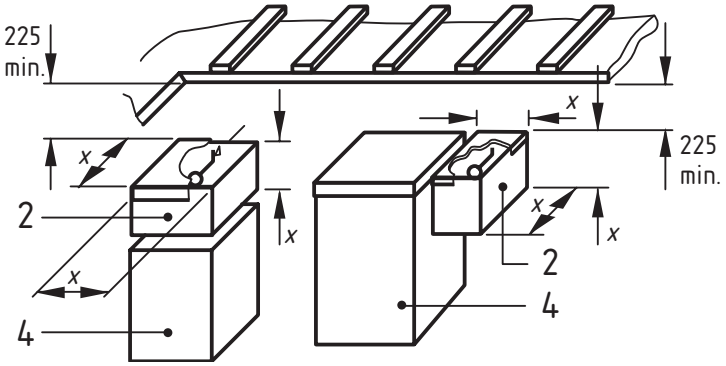
a) Conventional shaped cistern



b) Large hot water storage combination units



c) Large-capacity cistern with bolt-on lid



NOTE Dimension x should not exceed 450 mm.

d) Small-capacity hot water storage combination units

Key

1 Up to 1 000 L
2 Cold cistern
3 Hand holes
4 Hot cistern
5 Greater than 1 000 L

A Access to float valve
B Access for inspection

6.7.2 Valves

The water supply to each water-heating appliance and the cold feed pipe to a hot water storage vessel shall be fitted with a servicing valve, in order to facilitate isolation for servicing purposes, unless the appliance incorporates an integral valve which fulfils such a function.

*COMMENTARY AND RECOMMENDATIONS ON **6.7.2***
Where a cold feed pipe supplies the primary circuit of an indirect circulating system, a servicing valve should not be fitted except where the capacity to the water line of the feed cistern exceeds 18 L.

Stop valves and service valves should conform to BS 1010-2 or be listed under the Water Byelaws Scheme.

Float-operated valves should conform to BS 1212-2 or BS 1212-3, or be listed under the Water Byelaws Scheme.

6.7.3 Pipe sizes

Water pipes to or from any instantaneous or storage water-heating appliance shall be at least the same size as the integral water connection on the appliance.

*COMMENTARY AND RECOMMENDATIONS ON **6.7.3***
It might be necessary in some instances to calculate the pipe sizes, depending upon the length of the pipe runs, the number and type of fittings involved, and the head available. Reference can be made to Table 2 and Table 3 for guidance, but full details of such calculations are given in BS 6700.

6.7.4 Thermal efficiency

Except for any pipe or part of a pipe that is designed to contribute to the space heating of a building, all pipes forming part of a primary or secondary circulation system for heating or supplying domestic hot water, and all pipes carrying hot water to a tap or other outlet that are longer than the maximum length given in Table 2, shall be thermally insulated in accordance with BS 6700.

Table 2 **Maximum lengths of uninsulated hot water pipes**

Outside diameter	**Maximum length**
mm	m
Up to and including 12	20
Over 12 up to and including 22	12
Over 22 up to and including 28	8
Over 28	3

*COMMENTARY AND RECOMMENDATIONS ON **6.7.4***
To promote maximum economy and minimum delay in operation, the length of a distributing pipe to a hot water draw-off tap should be as short as is practicable.

6.7.5 Hot water distributing (draw-off) pipes

6.7.5.1 With the exception of an installation that meets the conditions stated in **6.7.5.2**, every draw-off tap or similar fitting shall be installed in a manner that prevents back-siphonage or backflow.

The vertical distance between the point of discharge of a draw-off tap or other fixed water fitting, and the spillover level of the bath, sink or other appliance shall be not less than the distance given in Table 3.

Table 3 **Vertical distance between draw-off tap and spillover level**

Nominal size of tap or combination fitting in	**Minimum vertical distance of point of outlet above spillover level of receiving appliance** mm
Up to and including ½	20
Over ½ up to and including ¾	25
Over ¾	70

*COMMENTARY AND RECOMMENDATIONS ON **6.7.5.1***
Attention is drawn to the Water Fittings Regulations [6] regarding the installation of bidets and shower hose pipes.

6.7.5.2 The requirements of **6.7.5.1** do not apply to any draw-off tap or other water fitting where:

a) the tap or fitting draws water by gravity only from a cistern, cylinder or tank having a vent pipe open at all times to the atmosphere; and

b) the vertical distance between the point at which the pipe supplying water to that tap or other fitting connects to cistern, cylinder or tank and the spillover level of the relevant bath, sink or other appliance is not less than 25 mm; and

c) the pipe supplying water to the tap or other fitting does not supply water to any other tap or fitting (other than a draining tap) at a lower level.

6.7.5.3 The draw-off pipe and fittings shall be sized to give the design rate of water flow (see BS 6700).

6.7.6 Pipe support and fixings

6.7.6.1 Pipes shall be secured by purpose-designed pipe supports at the intervals specified in BS 6700, and shall be fitted in a manner which allows free movement for expansion and contraction.

6.7.6.2 Where piping has to be attached to the inside face of an external wall, it shall not be in contact with the wall.

6.7.6.3 Where piping is to be laid in floors or walls, it shall be installed in accordance with BS 6700.

*COMMENTARY AND RECOMMENDATIONS ON **6.7.6.1, 6.7.6.2** AND **6.7.6.3***
Suitable allowance for expansion and contraction is particularly important on long runs. The pipe supports should be fitted so as to prevent damage from any air lock or reverberation. Piping should be located so that it is not unduly exposed to accidental damage, and fixed so as to avoid accumulations of dirt and to facilitate cleaning.

6.7.6.4 Pipes which are laid across the joists in ceiling or roof spaces fitted with floor boards shall be located in purpose-made notches or circular holes.

Notches shall not be made in joists of less than 100 mm height. The depth of any notch shall be sufficient to fully accommodate the pipe or fittings but shall not exceed 15 % (approximately one-sixth) of the joist height. The notch shall be located not further than one-quarter of the span from an end support; it shall be U-shaped and of the minimum width necessary to accommodate the pipe without restricting its movement.

*COMMENTARY AND RECOMMENDATIONS ON **6.7.6.4***
Care should be taken when refixing floor boards to prevent damage to the pipes by nails or screws. Where possible, the boards should be appropriately marked to warn others.

6.7.6.5 Pipes that would otherwise be in contact with material likely to cause corrosion shall be protected by wrapping or coating with a corrosion-resistant material or by encasement in a sleeve.

6.7.7 Scale formation

*COMMENTARY AND RECOMMENDATIONS ON **6.7.7***
Measures to prevent the formation of scale should be considered.

Hard water can deposit scale in pipes, fittings and the waterways of appliances, but does not normally cause corrosion. Excessive deposits cause restriction of water flow in pipes and fittings and might lead to overheating in appliances. The amount of scale deposited depends upon the temporary hardness present in the water and the temperature to which it is raised. Scale deposit can be minimized by the use of a chemical treatment or other devices acceptable to the water supplier. The appliance manufacturer can usually offer further advice.

6.7.8 Corrosion

*COMMENTARY AND RECOMMENDATIONS ON **6.7.8***
Water fittings should be constructed from materials which will prevent, as far as is reasonably practicable, damage from corrosion.

Waters other than hard waters, in which there is a certain relationship between chloride content and temporary hardness, give rise to a form of corrosion known as meringue dezincification when in contact with fittings made from duplex (alphabeta) brass. This process removes zinc, thereby converting the brass to porous copper, weakening the fittings and causing leakage. The corrosion products form a white bulky mass which could obstruct the waterways. Where a supply of water is known to promote this form of corrosion, the water fittings should be of copper, gunmetal or other copper alloy which is resistant to dezincification. All concealed water fittings, except terminal fittings, (including those buried underground), together with backflow prevention devices and safety devices (e.g. temperature and pressure relief valves), are required by the Water Fittings Regulations [6] to be manufactured from gunmetal or other dezincification-resistant materials.

Electrolytic corrosion tends to occur wherever dissimilar metals are in contact with water, the severity of the corrosion depending on the nature of the water and the temperature conditions. By similar process, where the supply of water is cuprosolvent, i.e. capable of taking copper into solution, traces of copper from supply pipes and fittings might be deposited on galvanized or unprotected steel surfaces causing pitting corrosion. In hard water supply areas, the rapid deposition of a layer of scale can protect the underlying metal. Galvanized steel and copper may be used together in the same system provided the direction of flow is from galvanized steel to copper.

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Another cause of corrosion in galvanized water storage vessels is the presence of solid foreign matter lying on the bottom. This could consist of drilling swarf from the vessel, solid particles from the water supply or builders' debris. Such foreign matter should therefore be carefully removed.

The experience and recommendations of the local water supplier should be taken into account.

6.7.9 Frost precautions

Water storage vessels and all pipes fixed externally or in the roof space or a similarly exposed position shall be protected against frost and cold draughts by an adequate thickness of suitable insulating material or by other means, e.g. the installation of a frost thermostat. (See also BS 6700.)

*COMMENTARY AND RECOMMENDATIONS ON **6.7.9***
Where cisterns are more than 300 mm above the joists, they should be insulated fully (i.e. including the base). Where they are 300 mm or less above the joists, the loft insulation should meet the cistern so that heat from the habitable room below provides some level of frost protection.

6.7.10 Draining

Provision shall be made to allow complete draining of the system.

6.8 Installation of instantaneous water-heating appliances

*COMMENTARY AND RECOMMENDATIONS ON **6.8***
Instantaneous water-heating appliances should be installed in a position which is convenient for the user and for servicing.

6.8.1 A flueless water-heating appliance shall be fitted at a height which gives clearance between the combustion products outlet and the ceiling in accordance with the appliance manufacturer's instructions. If these instructions are not specific in this respect, the minimum clearance shall be 300 mm. If the appliance is fitted beneath a shelf, the minimum clearance between the outlet for combustion products and the underside of the shelf (including any protection) shall be 150 mm. If the clearance is less than 300 mm, the underside of the shelf immediately above the outlet shall be protected by a sheet of non-combustible material.

*COMMENTARY AND RECOMMENDATIONS ON **6.8.1***
Where the underside of the shelf is protected by a non-insulating material, e.g. metal, there should be a 5 mm air gap between the shelf and the material.

Where a small water-heating appliance is to be flued, the fixing height should allow adequate clearance beneath the ceiling to allow the fitting of the draught diverter and an effective flue system.

6.8.2 A water-heating appliance supplying water through a swivel spout outlet shall be fitted in such a position that the outlet of the spout terminates as specified in **6.7.5.1**.

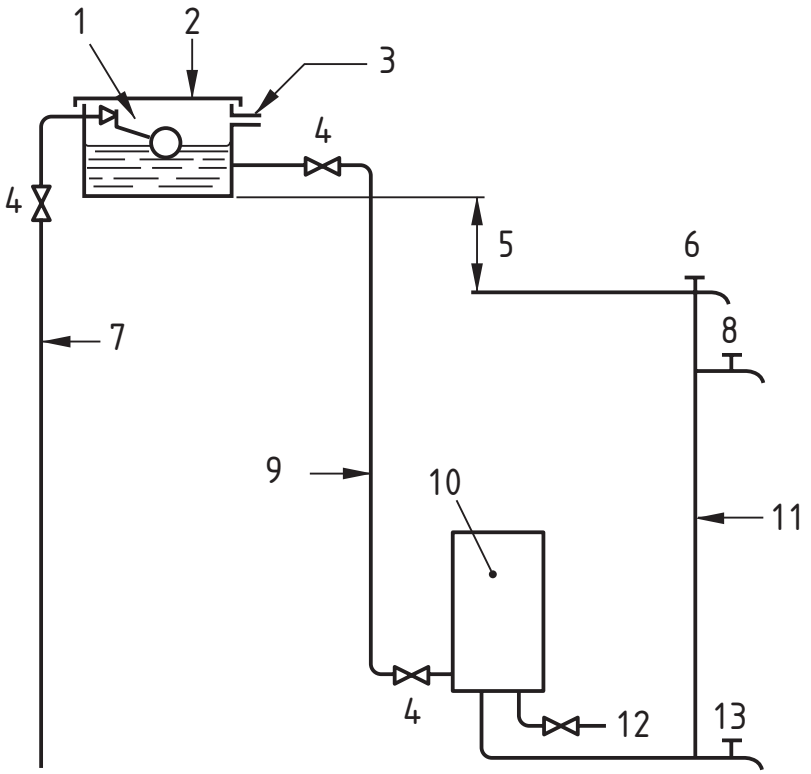
6.8.3 The length of draw-off pipe from a small water-heating appliance on any one draw-off point shall not exceed 3 m.

*COMMENTARY AND RECOMMENDATIONS ON **6.8.3***
The length of the draw-off pipe should be as short as possible in order to avoid undue delay before water is delivered at an acceptable temperature.

6.8.4 The head of water available at the highest draw-off tap shall be adequate to give correct operation of the appliance in accordance with the appliance manufacturer's instructions (see Figure 4).

6.8.5 The minimum clearances between the appliance and adjacent obstructions shall conform to the appliance manufacturer's instructions.

Figure 4 **Typical large instantaneous water-heating appliance installation on cistern supply**



Key

1 Feed cistern
2 Removable cover
3 Warning pipe
4 Servicing valve
5 Available head of water
6 Basin
7 Water service pipe
8 Bath
9 Cold feed pipe
10 Large instantaneous water-heating appliance
11 Hot water distributing pipe
12 Gas supply
13 Sink

6.9 Installation of combination boilers

*COMMENTARY AND RECOMMENDATIONS ON **6.9***
Combination boilers should be installed in a position that is convenient for the user and for servicing.

6.9.1 Combination boilers shall be installed in accordance with BS 6798.

6.9.2 A combination boiler shall be installed with an open vent on the primary circuit only when so permitted in the installation instructions provided by the manufacturer, and only in accordance with those instructions.

6.10 Installation of vented storage water-heating appliances

*COMMENTARY AND RECOMMENDATIONS ON **6.10***
A storage water-heating appliance should be installed in a position that is convenient for the user and for servicing.

The mass of the appliance when full of water should be taken into account when deciding on its location and means of support.

Attention is drawn to the Water Fittings Regulations [6] and the Gas Safety (Installation and Use) Regulations 1998 [1].

Further detailed advice is given in BS 6700 and, for the treatment of open vent pipes and other safety devices when installing in England and Wales, in the Building Regulations for England and Wales, Approved Document G(3) [17]. It is noted that other countries/regions of the UK might have different requirements in their building regulations for these aspects of installation.

6.10.1 A flueless storage water-heating appliance shall be fitted at a height that gives clearance between the combustion products outlet and the ceiling in accordance with the appliance manufacturer's instructions. If these instructions are not specific in this respect, the minimum clearance shall be 300 mm. If the appliance is fitted beneath a shelf, the minimum clearance between the outlet for combustion products and the underside of the shelf (including any protection) shall be 150 mm. If the clearance is less than 300 mm, the underside of the shelf immediately above the outlet shall be protected by a sheet of non-combustible material.

*COMMENTARY AND RECOMMENDATIONS ON **6.10.1***
Where the underside of the shelf is protected by a non-insulating material, e.g. metal, there should be a 5 mm air gap between the shelf and the material.

6.10.2 A storage water-heating appliance supplying water through a swivel spout outlet shall be fitted in such a position that the outlet of the spout terminates in accordance with **6.7.5.1**.

6.10.3 Where the water-heating appliance is connected to a feed cistern, whether integral to, or separate from, the appliance, the height of the cistern shall be such that the design flow of water is available at the highest draw-off tap.

6.10.4 Where an independent open vent pipe is required, it shall rise continuously from the water-heating appliance by the shortest practicable route to a point above the top of the feed cistern.

6.11 Installation of unvented storage systems

*COMMENTARY AND RECOMMENDATIONS ON **6.11***
Attention is drawn to the Water Fittings Regulations [6] and the Gas Safety (Installation and Use) Regulations 1998 [1].

Further detailed advice is given in BS 6700 and in the Building Regulations for England and Wales, Approved Document G(3) [17]. In Scotland, advice is given in the Building (Scotland) Regulations 2004 [4]. In Northern Ireland, advice is given in the Building Regulations (Northern Ireland), Technical Booklet P [18].

The British Board of Agrément (BBA) and WRc-NSF Ltd operate certification schemes for units and packages, which ensure compliance.

For installations greater than 45 kW of the unvented type, BBA certification might not be appropriate.

Figure 5 shows an example of an indirect unvented storage system.

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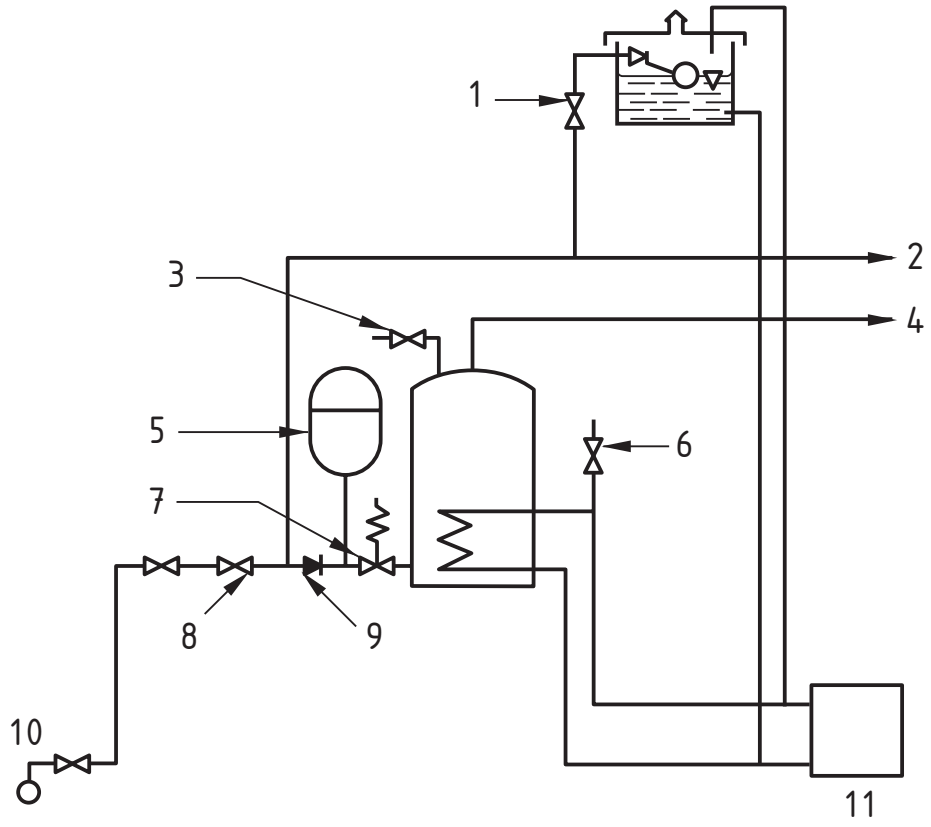
Figure 5 **Example of an indirect unvented (vented primary) storage system**



Key

1 Servicing valve
2 Cold water supply pipe
3 Temperature relief valve
4 Hot water supply pipe
5 Expansion vessel
6 Vent valve
7 Expansion relief valve
8 Pressure-reducing valve, if required
9 Check valve
10 Stop valve
11 Circulator

6.11.1 General

Unvented hot water storage systems shall be in the form of a proprietary "unit" or "package" which conforms to BS EN 12897.

6.11.2 Temperature control

6.11.2.1 All systems shall be fitted with the following controls:

a) a cylinder thermostat for general operating control;

b) a thermal energy cut-out device, positioned to detect the maximum stored water temperature, which cuts off the supply of heat to the cylinder when the temperature of the stored water reaches a preset value, and which requires manual resetting once its cut-out has operated;

c) a temperature relief valve, conforming to either BS 6283-2 or BS EN 1490, positioned within the top 20% of the water in the cylinder. (See BS 6700 for further details.)

*COMMENTARY AND RECOMMENDATIONS ON **6.11.2.1***
Attention is drawn to the Building Regulations [2]–[5], as relevant for the country/territory where the system is installed, regarding item b) and item c), where alternative approaches might be allowed if they provide an equivalent degree of safety.

The temperature relief valve should preferably be positioned within 150 mm of the top of the cylinder.

6.11.2.2 Thermostats, energy cut-out devices and temperature relief valves shall be set so that:

a) they operate in the following sequence as temperature increases:
   1) thermostat;
   2) thermal energy cut-out device;
   3) temperature relief valve;
b) they operate such that the highest water temperature does not exceed 100 °C at any time at any point in the water store.

6.11.3 Other functional controls

The following items shall be fitted:

a) a pressure-reducing valve to limit the water pressure to the system design pressure;

   NOTE A typical design pressure is 2 bar[3)].

b) a check valve to prevent any backflow of hot water either into the water mains or into any cold water draw-off pipes;
c) an expansion vessel to accommodate expansion of the stored water when heated;
d) an expansion relief valve to discharge excess pressure if either the expansion vessel or the pressure-reducing valve fails.

6.11.4 Discharge pipes

6.11.4.1 Any pipe discharging water from a temperature or expansion relief valve shall fall continuously throughout its length.

6.11.4.2 The discharge pipe shall be of metal up to the point of any tundish. After the tundish, if the material used is non-metallic, it shall have been demonstrated to be capable of safely withstanding the temperatures of the water discharged and shall be clearly and permanently marked to identify the product and performance standard (e.g. as specified in the relevant part of BS 7291).

6.11.4.3 The discharge pipe shall discharge to a safe visible position.

6.11.4.4 The pipe diameter shall be not smaller than the diameter of the valve outlet.

*COMMENTARY AND RECOMMENDATIONS ON **6.11.4***
Since the discharge pipe is intended to be able to discharge water at temperatures of up to 99 °C, the following points should be observed.

a) A vertical tundish (air break) should be fitted as close as is practicable to the relief valve in the same compartment as the unvented hot water storage vessel.

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3) 1 bar = 100 kPa.

b) If the total equivalent hydraulic length does not exceed 9 m, the discharge pipe downstream of the air break should be one nominal pipe size greater than that upstream; e.g. if valve outlets to tundish are 15 mm, then tundish to discharge point should be 22 mm. If the total equivalent hydraulic length is between 9 m and 18 m, the pipe size should be two nominal sizes above that of the valve outlet, and so on. Further advice on calculating equivalent hydraulic lengths and diameters where a single common discharge pipe serves more than one system can be obtained from the Building Regulations for England and Wales, Approved Document G(3) [17], or from BS 6700.

c) Discharge pipes from two valves, e.g. expansion relief and temperature relief valves, may be joined together into a single pipe of the same size, provided that the recommendations given in a) and b) are followed.

d) Ideally, discharges should be visible both at the tundish and at the final point of discharge. Where this is not possible or causes practical difficulty, clear visibility at one or other of these locations is acceptable. For non-metallic discharge pipes, the identification of the material specification should be visible at some point.

e) The final point of discharge should be in a location where there is no risk to persons, e.g. above the trap seal but below a fixed grating in an external gully.

f) Discharges at low level, i.e. at a level 100 mm to 150 mm above external surfaces such as car parks, grassed areas, hard standings etc., are acceptable provided that, in areas where children could come into contact with discharges, a wire cage or similar protection is fitted to prevent contact while maintaining visibility.

6.12 Circulator installations

*COMMENTARY AND RECOMMENDATIONS ON **6.12***
In areas where the water supply is known to cause problems due to scale formation, an indirect cylinder of the single- or double-feed type should be used in circulator installations.

The advice of the water supplier should be sought if the quality of the water is in doubt.

The circulation head and the size of flow and return pipes should be such that they do not give rise to inadequate stored water temperature or noisy operation of the circulator.

The water circulation rate is an important factor in achieving satisfactory service from a circulator and storage vessel, and is dependent upon the circulation head and the size of the flow and return pipes.

Manufacturers normally provide information in their instructions regarding the minimum circulation head, and also indicate the measures necessary to restrict the circulation rate where an excessive circulation head is unavoidable, e.g. the provision of a restrictor in the return pipe.

If a circulator is to be connected to an existing hot water storage system to provide an alternative independent service, e.g. for summer use, account should be taken of local water quality and of the effects of excessive water temperature, especially where the existing source is a solid fuel boiler without thermostatic control. If there is any doubt, the water supplier should be consulted.

A typical direct circulating system is shown in Figure 6.

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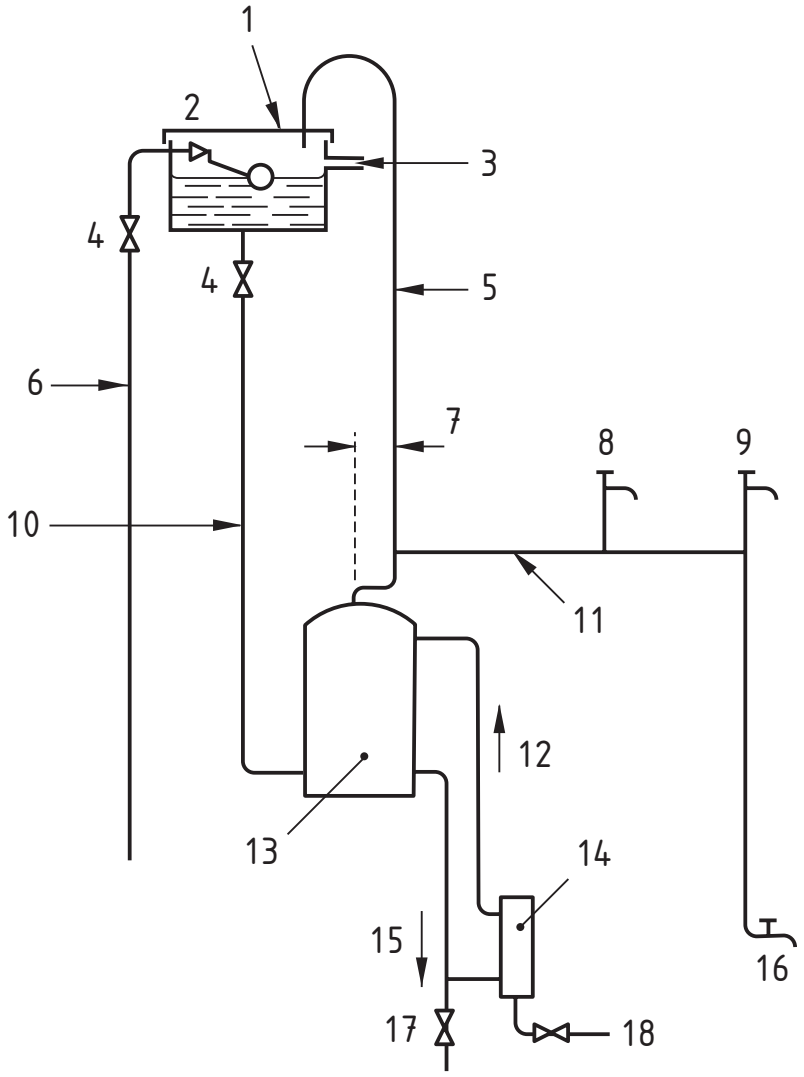
6.12.1 Where the thermostat is separate from the circulator, it shall be fitted to the cylinder in the position recommended in the manufacturer's instructions.

6.12.2 The circulating system into which the circulator and storage vessel are incorporated shall be in accordance with **6.15**.

Figure 6 **Example of direct circulating system**



Key

1	Removable cover	10	Cold water feed pipe
2	Feed cistern	11	Distributing pipe
3	Warning pipe	12	Flow
4	Servicing valve	13	Hot water cylinder
5	Open vent pipe	14	Circulator
6	Water service pipe	15	Return
7	Offset	16	Sink
8	Wash basin	17	Draining tap
9	Bath	18	Gas supply

6.13 Boiler installations

6.13.1 A means of controlling the domestic hot water temperature shall be provided.

*COMMENTARY AND RECOMMENDATIONS ON **6.13.1***
Where a boiler is used to provide domestic hot water only, it is desirable to use a cylinder thermostat to control the temperature of the stored hot water. A boiler thermostat should be used only to limit the flow temperature. A cylinder thermostat should switch off the boiler and also the pump where a pumped primary circuit is used.

A combined space heating and domestic hot water system should have independent temperature control of the heating and the hot water services. Any instructions provided by the boiler manufacturer should be followed.

6.13.2 The boiler shall be installed in accordance with BS 6798.

6.13.3 Make-up water to the primary circuit of a closed (unvented) system shall be supplied:

a) from a separate feed cistern used for no other purposes connected to mains water. The static head provided by the cistern should be a minimum of 300 mm measured to the highest point of the heating system. The supply pipe from the cistern shall include a double check valve assembly and stop valve on the return side of the heat emitter and/or hot water storage vessel; or

b) for a system in purely domestic premises, or for a single appliance or combination of appliances rated at not more than 45 kW heat input (gross) in other types of premises, from a supply pipe, either:

   1) temporarily connected through a double-check valve assembly and removed after use. The double-check valve assembly shall be permanently connected at the upstream (supply pipe) end; or

   2) permanently connected and incorporating a type CA non-verifiable pipe disconnector backflow prevention device; or

c) for a system of greater than 45 kW heat input in non-domestic premises, from a connection made by one of the following methods:

   1) via a Type BA verifiable backflow preventer with reduced pressure zone (RPZ valve);

   2) by a fully automatic sealed system filling device that satisfies the "Regulators specification for backflow prevention arrangements and devices" under the Water Fittings Regulations [6]; or

   3) via a storage cistern which incorporates a suitable air gap rated for fluid category four or five.

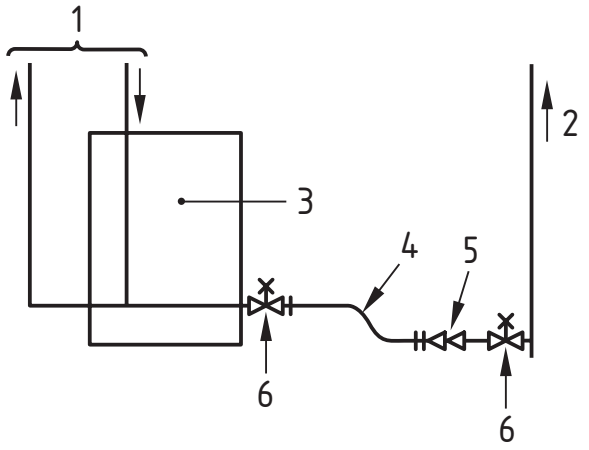
*COMMENTARY AND RECOMMENDATIONS ON **6.13.3***
*As water in primary circuits of heating systems often contains additives and can be heavily contaminated, direct connections to the supply pipe are prohibited under the Water Fittings Regulations [6], except in the circumstances given in **6.13.3**b) and c).*

There should be no cross connection between a primary circuit and a secondary circuit from which water is drawn off for use.

*Figure 7a) shows a temporary connection to a primary circuit, i.e. **6.13.3**b1), and Figure 7b) shows the permanent connection described in **6.13.3**b2).*

*Further information on the alternatives listed in **6.13.3**c) should be sought from WRAS at www.wras.co.uk.*

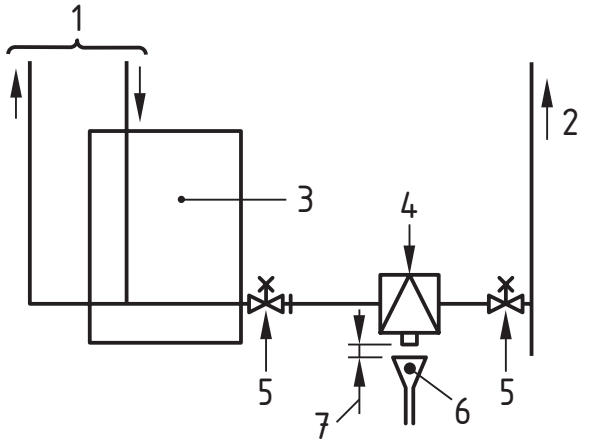
Figure 7 **Temporary and permanent connections to a primary circuit**



a) Temporary connection to a primary circuit

Key

1 Primary flow and return
2 Supply pipe
3 Boiler
4 Temporary connection to be removed immediately after filling
5 Double check valve assembly
6 Control valve



b) Permanent connection to a primary circuit

Key

1 Primary flow and return
2 Supply pipe
3 Boiler
4 Type CA backflow prevention device
5 Resilient seat control valve
6 Tundish
7 Air gap

6.14 Water-jacketed tube heater installations

Water-jacketed tube heaters shall be installed in accordance with the manufacturer's instructions.

*COMMENTARY AND RECOMMENDATIONS ON **6.14***
Water-jacketed tube heaters are normally supplied as a packaged unit.

6.15 Open-vented system installations

6.15.1 Feed cisterns

6.15.1.1 Except when a single-feed indirect cylinder is used, a cistern storing water for domestic purposes shall not be used to feed the primary circuit of an indirect system. The feed cistern for water for domestic purposes shall conform to **6.7.1**.

*COMMENTARY AND RECOMMENDATIONS ON **6.15.1.1***
A cold water storage cistern that supplies draw-off points may be used as a feed cistern for a secondary circuit, provided that its capacity is adequate for the requirements of the open-vented circulating system.

If a separate cistern is used to feed only the hot water system, the cistern capacity should be at least equal to that of the hot water storage vessel.

A direct circulating system requires a feed cistern that is connected directly to the hot water storage vessel.

6.15.1.2 An indirect circulating system incorporating a double-feed cylinder shall have two separate feed cisterns, one connected to the primary circuit and the other connected directly to the hot water storage vessel (see Figure 8). The cistern connected directly to the hot water storage vessel shall conform to **6.7.1.1**.

*COMMENTARY AND RECOMMENDATIONS ON **6.15.1.2***
The feed cistern connected to the primary circuit also acts as an expansion cistern.

*An indirect circulating system incorporating a single-feed cylinder (self-priming cylinder) requires only one feed cistern (see **6.7.1**), which is connected directly to the hot water storage vessel (see Figure 8).*

*In a combined central heating and domestic hot water system incorporating a sealed expansion vessel in the primary circuit, only one feed cistern (see **6.7.1**) is required, connected directly to the hot water storage vessel.*

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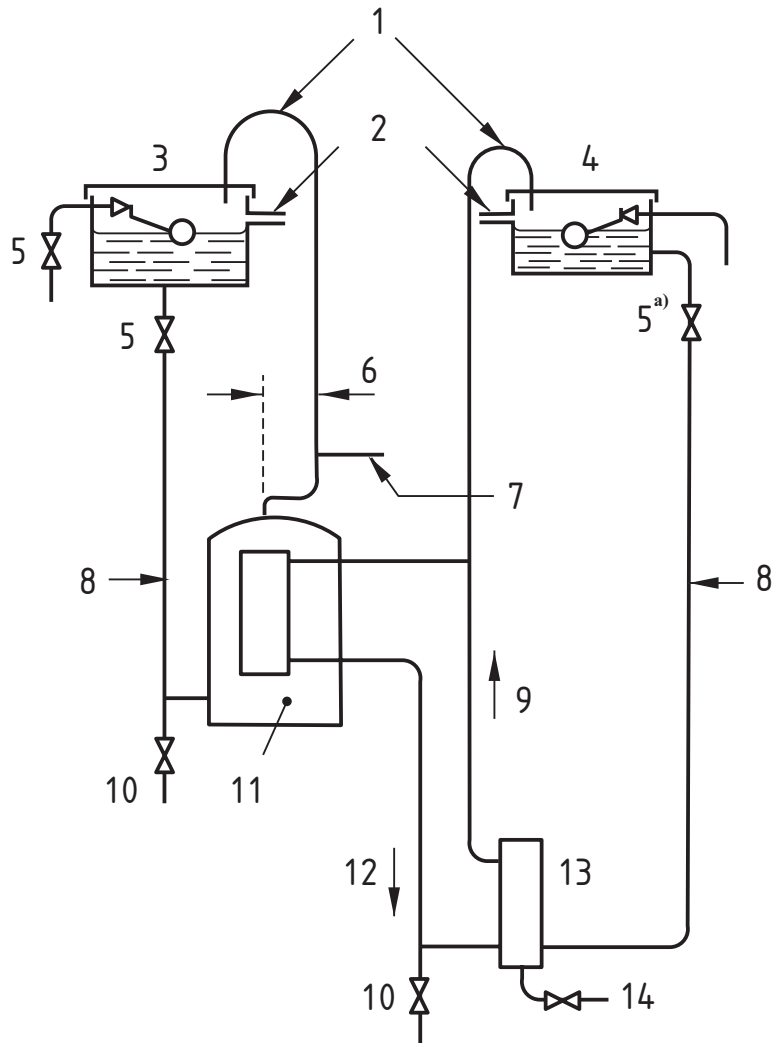
Figure 8 **Example of indirect circulating system**



a) Only permitted if the circulator has storage >18 L.

Key

1	Open vent pipe	8	Cold water feed pipe
2	Warning pipe	9	Flow
3	Feed cistern	10	Draining tap
4	Feed and expansion cistern	11	Indirect water storage vessel
5	Servicing valve	12	Return
6	Offset	13	Circulator
7	Hot water distributing pipe	14	Gas supply

6.15.2 Hot water storage vessels

*COMMENTARY AND RECOMMENDATIONS ON **6.15.2***
The usage pattern and the type of system should be taken into account when determining the capacity of the hot water storage vessel.

Preferred sizes of cylinders for domestic purposes are given in BS 1566-1 or BS 1566-2. The size of cylinder chosen depends upon a number of factors, some of which are:

a) size of premises;

b) number of bedrooms;

c) number of bathrooms;

d) number of occupants and mix in the house, i.e. adults and children;

e) rate of recovery of the cylinder;

f) whether instantaneous heaters or water-jacketed tube heaters are included in the system.

Storage of 115 L to 140 L of hot water is adequate for most domestic dwellings. (See also BS 6700.)

6.15.2.1 No single-feed indirect cylinder shall be connected directly to any supply pipe. Every single-feed indirect cylinder shall have a direct vent to atmosphere and shall conform to BS 1566-2.

6.15.2.2 Vessels shall be installed in a vertical position and their vertical height shall be greater than their width, unless they are specifically designed to be installed otherwise.

6.15.2.3 The mean temperature of the stored water shall be controlled (see **6.11.2** and **6.17**).

*COMMENTARY AND RECOMMENDATIONS ON **6.15.2.3***
The mean temperature of the stored water should not normally exceed 60 °C, and, in a combined central heating and domestic hot water system, the stored water temperature should be controlled independently from that of the primary circuit.

Special provisions might be necessary for combined gas and solar systems where the stored hot water temperatures can be in excess of 60 °C.

6.15.2.4 Where the domestic hot water system is combined with a wet central heating system, an indirect cylinder shall be used.

6.15.2.5 If a hot water storage combination unit is to be used, the unit shall conform to BS 3198.

*COMMENTARY AND RECOMMENDATIONS ON **6.15.2.5***
The mounting height of a hot water storage combination unit should be such as to give an acceptable flow at the highest draw-off tap whilst giving adequate access for servicing the float-operated valve. (See Figure 3.)

6.15.3 Primary circuits

No gravity circulation pipe shall be installed at an angle of less than 5° above the horizontal. Gravity circulation pipes shall rise towards the cylinder.

*COMMENTARY AND RECOMMENDATIONS ON **6.15.3***
The primary circuit should be designed to optimize the hot water supply from a water-heating appliance.

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To obtain the maximum quantity of stored hot water from a direct storage vessel, the flow pipe should be connected to the side of the vessel as close as practicable to the top. The return pipe should be connected to the bottom part of the vessel, preferably between 100 mm and 200 mm from the base. Indirect storage vessels should already have suitable connections provided. The appliance should be positioned as close to the hot water storage vessel as practicable in order to keep the length of the circulation pipes to a minimum, but in gravity circuits the position should enable adequate circulating head to be provided. Where a direct cylinder is to be converted to an indirect cylinder by use of a coil, the manufacturer's instructions should be followed.

The ratio of the total lengths of the horizontal and vertical circulating pipes should not exceed 4 to 1.

The minimum vertical height of the flow pipe between the flow connection on the appliance and the flow connection on the cylinder should be one quarter of the horizontal length of the flow pipe plus the minimum circulation head of the appliance.

For example, for a circulator with a minimum circulation head of 300 mm and fitted 4 m horizontally from the cylinder, the minimum vertical height, h, in metres, of the flow pipe is given by:

$$h = (4 \times 0.25) + 0.3 = 1.3$$

The combined length of flow and return pipes should not exceed that specified by the manufacturer. The size of a circulating pipe should normally be the same as that of the connection at the appliance.

6.15.4 Feed pipes

6.15.4.1 The internal diameter of the cold feed pipe connecting the cistern to a hot water storage vessel shall be not less than 19 mm.

*COMMENTARY AND RECOMMENDATIONS ON **6.15.4.1***
The cold feed pipe should be sized to meet the maximum demand with all taps in use. A servicing valve should be provided in the cold feed pipe in an accessible position, and as near as practicable to the cistern.

In order to maximize the quantity of stored hot water available, and to minimize mixing of incoming cold water, the feed pipe from the feed cistern should be connected near the bottom of the hot water storage vessel.

6.15.4.2 The internal diameter of the cold feed pipe connecting the feed cistern to the primary circuit of an indirect system incorporating a double-feed storage cylinder shall be not less than 13 mm.

*COMMENTARY AND RECOMMENDATIONS ON **6.15.4.2***
The cold feed pipe should not include a servicing valve.

6.15.4.3 Where the return pipe from a single-feed indirect storage vessel to the water-heating appliance forms the cold feed pipe to the primary circuit, this pipe shall not be restricted or valved in any way that could cause the flow of water to the water-heating appliance to be less than that required by the manufacturer for the efficient operation of the appliance.

*COMMENTARY AND RECOMMENDATIONS ON **6.15.4.3***
A circulator of up to and including 6 kW output may be fitted with a restriction in the return pipe, provided that this does not totally close off the pipe and that the circulator manufacturer's instructions specifically allow it.

6.15.5 Open vent pipes

6.15.5.1 The hot water storage vessel shall be provided with an open vent pipe of not less than 19 mm internal diameter. This vent pipe shall be connected to the highest point of the vessel.

6.15.5.2 The vent pipe to a hot water storage system shall run from the top of the storage vessel or the highest point of the distribution pipework to a point above the cold feed cistern. The vent shall terminate so that it can discharge into the cistern through a sealed sleeve in the top cover of the cistern.

*COMMENTARY AND RECOMMENDATIONS ON **6.15.5.2***
An offset (see Figure 6) should be included in the vent pipe close to its point of connection to the hot water storage vessel in order to minimize circulation within the pipe.

6.15.5.3 The open vent pipe from a hot water storage vessel shall rise to a level at least 150 mm above the connection of the warning pipe from the feed cistern.

6.15.5.4 In an indirect system incorporating a double-feed storage vessel, a separate open vent pipe of not less than 19 mm internal diameter shall be connected to the primary circuit.

6.15.5.5 The open vent pipe from a gravity primary circuit shall be connected to the highest point of the flow pipe from the water-heating appliance and shall rise continuously to the point of discharge unless the appliance manufacturer's instructions state otherwise.

6.15.5.6 The flow pipe from a water-heating appliance to an indirect single-feed storage vessel forms the open vent from the primary circuit and this pipe shall be treated as an open vent.

6.15.5.7 Where primary circulation is pumped, the pump, open vent and siting of the cold feed shall conform to BS EN 12828.

*COMMENTARY AND RECOMMENDATIONS ON **6.15.5.7***
The National Annex to BS EN 12828 provides guidance on the use of BS EN 12828 in the UK.

6.15.5.8 No valve or restricting fitting shall be present in any open vent pipe.

6.15.6 Draining

6.15.6.1 Draining taps shall be located so that they permit the draining of the whole system, including the water-heating appliance and hot water storage vessel.

*COMMENTARY AND RECOMMENDATIONS ON **6.15.6.1***
Draining taps should be accessible and should not be installed in a position where they are, or are likely to become, submerged, buried or covered with soil.

6.15.6.2 Draining taps shall conform to BS 2879.

6.15.7 Thermal insulation

6.15.7.1 Water storage vessels shall be insulated in accordance with:

a) BS 1566, for open-vented storage vessels; or

b) BS EN 12897, for unvented storage vessels.

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*COMMENTARY AND RECOMMENDATIONS ON **6.15.7.1***
Primary circulation pipes for hot water service circuits should be insulated throughout their length, subject only to practical constraints imposed by the need to penetrate joists and other structural elements. All pipes connected to hot water storage vessels, including the vent pipe, should be insulated for at least 1 m from their points of connection to the storage vessel or at least up to any point where they become concealed. If secondary circulation is used, all pipes kept hot by that circulation should be insulated. Attention is drawn to government guidelines for demonstrating compliance with the Building Regulations, which cover insulation efficiency.

Any pipe adjacent to any flue or appliance should be insulated with material suitable for the temperature at the surface of that flue and appliance.

For further information, see the Government's Planning Portal website www.planningportal.gov.uk.

6.15.7.2 The surface of the cylinder insulation adjacent to any part of an open-flued circulator shall be made of, or protected by, non-combustible material as defined in BS 476-4.

*COMMENTARY AND RECOMMENDATIONS ON **6.15.7.2***
A suitable method is the use of a jacket of a sectional type incorporating non-combustible panels, coloured in contrast to the remaining panels and located adjacent to the circulator.

6.16 Showers

6.16.1 General

6.16.1.1 The following types of water-heating appliance shall not be used to supply a shower:

a) flueless water-heating appliances;

b) inlet-controlled water-heating appliances of the broken feed type.

6.16.1.2 Pipework shall be routed to avoid the collection of air.

6.16.1.3 Means shall be provided to allow the user to adjust the temperature of the shower water, at the point of showering.

6.16.1.4 Water supplies shall be taken from a common source (both from a storage system by gravity or both from the supply pipe).

*COMMENTARY AND RECOMMENDATIONS ON **6.16.1***
Shower units should be installed in accordance with BS 6340-2.

A temperature range suitable for showering is 38 °C to 43 °C, and it is normally necessary to incorporate means for mixing cold water with the hot water in order to achieve these temperatures.

The hot and cold water supplies should be at reasonably balanced pressures.

6.16.2 Cistern-fed showers

6.16.2.1 General

*COMMENTARY AND RECOMMENDATIONS ON **6.16.2.1***
*The cold water connection for a shower may be taken from the cold feed pipe which runs from a cistern to the hot water storage vessel, provided that the cold feed pipe has an internal diameter of at least 19 mm (see **6.15.4.1**).*

6.16.2.1.1 Means shall be provided to prevent hot water from being supplied to the shower head if the cold supply fails.

*COMMENTARY AND RECOMMENDATIONS ON **6.16.2.1.1***
A thermostatically controlled shower mixer will satisfy this requirement. Alternatively, the shower may be installed in such a way that, should the cold water supply fail, hot water flow to the shower ceases before the cold water flow to the shower ceases.

6.16.2.1.2 Where a flexible hose is used to supply the shower head, and the shower head is capable of being lowered to a level that is less than 25 mm above the spillover level of the bath or shower tray, means shall be provided to prevent back-siphonage and backflow of water.

*COMMENTARY AND RECOMMENDATIONS ON **6.16.2.1.2***
This can be done by:

a) using a hose-retaining clip so that the head of the shower cannot fall to a level lower than 25 mm above the spillover level of the bath or shower tray; or

b) fixing a double-check valve after the mixer control or on the supply connection; or

c) fitting a combined check valve and vacuum breaker, provided that there is no control valve downstream.

6.16.2.2 Gravity cistern-fed showers

6.16.2.2.1 The minimum flow rate from the shower head shall be 4 L/min when the shower head is located between 1.5 m and 1.7 m above the floor level.

*COMMENTARY AND RECOMMENDATIONS ON **6.16.2.2.1***
*The manufacturer's recommendation on minimum static head and maximum pipe length should be considered in relation to the desired flow rate (see also **6.7.4**).*

It is recommended that the flow rate be not less than 5.5 L/min to provide a more acceptable shower.

6.16.2.2.2 A shower used in conjunction with a storage combination unit shall be thermostatically controlled.

*COMMENTARY AND RECOMMENDATIONS ON **6.16.2.2.2***
When a storage combination unit is used, it is necessary to use an additional cold feed cistern to supply the cold feed to the shower. This additional cold feed cistern should have a static head approximately equal to that of the storage combination unit. The hot draw-off should be taken from as close as possible to the storage unit outlet connection.

6.16.2.3 Pumped cistern-fed showers

*COMMENTARY AND RECOMMENDATIONS ON **6.16.2.3***
Under the Water Fittings Regulations [6], if a pump is capable of drawing more than 12 L/min, the water supplier's consent is required for its installation, notice of the proposed installation is to be given to the local water supplier and its consent granted before installation work commences.

6.16.2.3.1 If the flow of water into the feed cistern is 6.5 L/min or less, the storage capacity of the feed cistern shall be not less than 115 L. If the flow of water into the feed cistern exceeds 6.5 L/min, the storage capacity of the feed cistern shall be not less than 90 L.

6.16.2.3.2 The temperature of the stored water shall be limited to less than 65 °C unless the manufacturer of the shower system specifically states otherwise.

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6.16.2.3.3 Pumped showers shall not be installed with single-feed indirect cylinders unless the manufacturer of the shower system specifically states otherwise.

6.16.2.3.4 Pumped showers shall not be installed with combination storage units unless the manufacturer of the shower system specifically states otherwise, in which case a thermostatic mixer or other equally effective means shall be used to prevent hot water only being supplied to the shower head.

6.16.2.3.5 Electrical wiring shall conform to **6.6**.

6.16.3 Showers with instantaneous water-heating appliances and combination boilers

6.16.3.1 Where a flexible hose is used to supply the shower head, means shall be provided to prevent back-siphonage or backflow of water.

*COMMENTARY AND RECOMMENDATIONS ON **6.16.3.1***
*See commentary and recommendations on **6.16.2.1.2**.*

6.16.3.2 The water-heating appliance and the cold supply to the shower shall be fed from the same source.

*COMMENTARY AND RECOMMENDATIONS ON **6.16.3.2***
The water-heating appliance and shower should both be fed from either the cold water supply pipe or the same cistern.

6.16.3.3 Where a manual mixing valve is used, and the water-heating appliance and shower are fed from the cold water supply pipe, a water governor shall be installed to control the water pressure to both the water-heating appliance and shower.

*COMMENTARY AND RECOMMENDATIONS ON **6.16.3.3***
It is preferable that either a thermostatic shower or a shower specifically intended for this situation be used.

6.16.3.4 The hot water flow rate shall be adequate to maintain the water-heating appliance gas valve in the open position.

*COMMENTARY AND RECOMMENDATIONS ON **6.16.3.4***
The resistance to water flow, offered from the shower head, mixing control and pipework, should be taken into account in determining the necessary flow rate.

For information on the minimum flow rate necessary to maintain the water-heating appliance gas valve in the open position, reference should be made to the manufacturer's instructions.

6.16.3.5 The pressure head available shall be adequate to provide the required rate of flow when the shower head is positioned between 1.5 m and 1.7 m above the floor level.

6.17 Prevention of scalding

The temperature of the hot water supplied to a bath shall be controlled.

*COMMENTARY AND RECOMMENDATIONS ON **6.17***
Attention is drawn to the Building Regulations [2]–[5], as relevant for the country/territory where the system is installed, some of which include a requirement that the hot water supply to a bath is limited to a temperature lower than 60 °C.

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7 Installation and location of water-heating appliances (condensing)

7.1 General

Water-heating appliances designed to be used in the condensing mode shall be installed in accordance with the manufacturer's installation instructions, or, if there are no specific instructions, the requirements in **7.2**, **7.3**, **7.4** and **7.5** shall be followed.

NOTE Attention is drawn to the Building Regulations for England and Wales, Part L1 [19] if the domestic hot water is to be provided from a combination boiler. These regulations require that gas-fired boilers installed after 1 April 2005 are condensing boilers, whether they are replacements or new installations, with a few exceptions.

For selection of a suitable combination boiler in England and Wales, attention is drawn to the DCLG publication, Guide to the Condensing Boiler Installation Assessment Procedure for Dwellings *[20]*.

For selection of a suitable combination boiler in Scotland, attention is drawn to the Building (Scotland) Regulations 2004, Section 6 (Energy) of the Technical Handbooks [21].

For selection of a suitable combination boiler in Northern Ireland, attention is drawn to the Building Regulations for Northern Ireland and specifically Technical Booklet F1 [22].

Similar requirements might apply in other areas of the UK.

*COMMENTARY AND RECOMMENDATIONS ON **7.1***
The manufacturer's installation instructions should describe any particular requirements for the condensing appliance, e.g. a means for disposal of condensate and the water temperature operating range.

7.2 Siting of the chimney outlet

NOTE 1 The chimney outlet was originally referred to as the flue terminal in UK standards.

*NOTE 2 For information on siting the chimney system, see **6.2**.*

Where it is considered that the plume from a chimney outlet might cause a nuisance to the user or their neighbours, reference shall be made to the water-heating appliance manufacturer's instructions for specialist advice on how to redirect the chimney outlet, for example by the:

a) partial rotation of the chimney terminal;

b) fitting of a deflector elbow;

c) use of a kit that provides high level termination.

In particular, the potential for the plume to cross the following situations shall be avoided:

1) a public footpath;

2) a frequently used access route;

3) a frequently used area (such as a patio);

4) a neighbouring dwelling.

The terminal shall not be directed towards a window or door, or be sited close to a facing wall, boundary fence or neighbouring property.

*COMMENTARY AND RECOMMENDATIONS ON **7.2***
Condensing appliances produce a visible plume of water vapour for a significant proportion of their operating time. At low level, this plume might cause nuisance.

Other aspects to consider when planning the chimney outlet position include the following.

a) A free passage of air is needed to aid plume dispersal.

b) The section on flue terminal siting in the DCLG publication, Guide to the Condensing Boiler Installation Assessment Procedure for Dwellings *[20] advises against the positioning of the flue termination of a condensing boiler under a carport.*

c) In cold weather, the plume could cause a safety hazard if it freezes on pathways or if it results in frost damage to surfaces.

d) The plume could trigger infra-red security lighting if sited in the wrong place.

e) The plume could affect the performance of external temperature sensors associated with energy management control systems.

f) The chimney outlet or plume should not obscure security camera field of vision.

g) The chimney outlet guards should be able to resist any corrosive properties of the condensate.

h) A plume management kit might be necessary when provided or specified by the appliance manufacturer. However, it is not intended that a plume management kit be used to correct a chimney outlet that has not been positioned in accordance with BS 5440-1.

*i) Some appliances can be designed to disperse condensate in a spray form within the combustion products discharge. With these types of appliance, particular care is necessary when siting the terminal to ensure safe disposal of the condensate in accordance with the manufacturer's instructions (see **7.4.1,** Note 3).*

Further information on chimney outlet siting and plume management is provided in BS 5440-1. For guidance on how to reduce the possibility of nuisance to neighbouring buildings, refer to the section on flue terminal siting in the DCLG publication, Guide to the Condensing Boiler Installation Assessment Procedure for Dwellings *[20].*

7.3 Selection of condensate drainage pipe

7.3.1 Material

The condensate drainage pipe shall be run in a standard drainpipe material, e.g. poly(vinyl chloride) (PVC), unplasticized poly(vinyl chloride) (PVC-U), acrylonitrilebutadiene-styrene (ABS), polypropylene (PP) or chlorinated poly(vinyl chloride) (PVC-C).

7.3.2 Condensate removal by gravity

The condensate drainage pipe connected to the condensate drain outlet on the appliance shall have a nominal outside diameter of 22 mm, or as recommended by the appliance manufacturer, to promote the clearance of condensate.

Any trap in the condensate drainage pipe shall be fitted within the dwelling.

NOTE Condensing water-heating appliances might have a siphon fitted as part of the condensate trap arrangement. This significantly reduces the risk of condensate freezing where part of the condensate drainage pipe is run externally.

For externally run condensate drainage pipe, extra care is necessary in order to reduce the risk of the condensate drainage pipe becoming blocked owing to the condensate freezing, so the length of condensate drainage pipe external to the dwelling shall be kept as short as possible and not more than 3 m, unless it is insulated.

If a water-heating appliance does not include a siphon, any external condensate drainage pipe shall be increased to a minimum of 32 mm nominal outside diameter to reduce the risk of freezing.

In external locations where the condensate drainage pipe is less than 32 mm nominal outside diameter, the pipe shall be protected with waterproof pipe insulation.

*COMMENTARY AND RECOMMENDATIONS ON **7.3.2***
When a water-heating appliance is to be installed in an unheated location, e.g. garage, all condensate drainage pipes downstream from the trap or siphon should be considered as external.

7.3.3 Condensate removal by pump

A condensate removal pump shall be used when the condensate cannot be removed by gravity to achieve the condensate drainage arrangements in **7.4**. Where a condensate removal pump is required, the water-heating appliance manufacturer shall be consulted for suitable options.

*COMMENTARY AND RECOMMENDATIONS on **7.3.3***
Examples of where a condensate removal pump can provide a solution are where an appliance is to be installed in a basement or below ground level, or conversely on an internal wall or in an airing cupboard. Manufacturers of condensate removal pumps will also be able to provide detailed suggestions for the optimum disposal routes.

7.4 Positioning and termination of the condensate drainage pipe

7.4.1 General

The condensate drainage pipe shall be positioned and terminated such that it discharges the condensate safely away from the building.

All condensate drainage pipes and connecting pipework operating under gravity shall have a fall of at least 2.5° to the horizontal or approximately 45 mm per metre of condensate drainage pipe run. The number of bends and fittings shall be kept to a minimum in order to reduce the risk of condensate being trapped.

*NOTE 1 Where condensate cannot be removed under gravity, see **7.3.3** for guidance on condensate removal pumps.*

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Suitable condensate discharge arrangements shall be by connection to:

a) a soil and vent stack (internal or external) (see **7.4.2**);

b) an internal waste pipe (see **7.4.3**);

c) an external drain, rainwater downpipe or gully, which discharges into a foul water system and does not discharge into a surface water or storm drain (see **7.4.4**);

d) a rainwater hopper that is part of a combined system, i.e. a sewer that carries both foul water and rainwater (see **7.4.4**);

NOTE 2 For further information on the identification of a combined system, refer to the local water undertaker.

e) a purpose-made soakaway (see **7.4.5**).

NOTE 3 Where the condensate is, by design, discharged with the combustion products from the flue terminal, the manufacturer's instructions will contain advice regarding the siting of the chimney outlet to enable the safe disposal of the condensate.

*COMMENTARY AND RECOMMENDATIONS ON **7.4.1***
Internal drainage points are preferred as they are less likely to become blocked (for example, by leaves or by frozen condensate).

It should be noted that the connection of a condensate drainage pipe to a drain might be subject to local building controls.

The condensate drainage pipe should be supported at a maximum spacing of 0.5 m for near horizontal sections and 1.0 m for vertical sections.

In some circumstances it is permissible to connect the condensate drain to either a package treatment plant (i.e. a digester), a septic tank or a cesspit; however, this should not be undertaken unless the person responsible for the sewerage system has agreed that it will not adversely impact on the system. To make this assessment, the person responsible will need to know the typical condensate discharge conditions, e.g. the amount of acidulated condensate produced per day, the pH of the condensate and the proportion that the condensate is of the total flow going to the package treatment plant, septic tank or cesspit.

7.4.2 Connection to a soil and vent stack system (Figure 9)

7.4.2.1 Connection to an internal soil and vent stack system

*NOTE 1 Provided that the condensate drainage pipe meets the requirements in **7.3** and **7.4**, there is no length restriction.*

The condensate drainage pipe shall incorporate a trap with a minimum condensate seal of 75 mm. Many condensing appliances incorporate a condensate trap within the appliance; if this condensate trap has a condensate seal of less than 75 mm, an additional trap of 75 mm shall be fitted with a visible air break between the appliance and the additional trap.

The condensate drainage pipe shall not discharge into the internal soil and vent stack lower than 450 mm above the invert of the tail of the bend at the foot of the stack for single dwellings of up to three storeys. If this is not visible, the height shall be measured from the lowest straight section of the stack that is visible.

For multi-storey buildings this distance shall be increased as follows:

a) for up to and including five storeys, the condensate drainage pipe shall not discharge into the internal soil and vent stack less than 750 mm above the invert of the tail of the bend at the foot of the stack;

b) for more than five storeys but not more than 20 storeys, ground-floor appliances shall discharge into their own internal soil and vent stack or discharge directly to an external drain, gully or rainwater hopper;

c) for more than 20 storeys, the ground-floor and first-floor appliances shall discharge into their own internal soil and vent stack or directly to an external drain, gully or rainwater hopper.

The connection to the internal soil and vent stack shall not be made in a way that could cause cross flow into any other branch pipe or from that branch pipe into the condensate drainage pipe.

NOTE 2 This can be achieved by maintaining an offset between branch pipes of at least 110 mm on a 100 mm diameter stack and 250 mm on a 150 mm diameter stack.

When connecting into a cast iron internal soil and vent stack, connection shall not be above the highest point of any existing wastewater or into any branch not used for wastewater disposal.

Any parts of the cast iron stack likely to be exposed to the condensate shall be either in a vertical plain or of reasonably short length with significant fall to limit the likelihood of concentrations of condensate at any point.

*COMMENTARY AND RECOMMENDATIONS ON **7.4.2.1***
A redundant branch where original sanitary appliances have been disconnected is an example of a branch not used for wastewater disposal.

Care should be exercised if any connection to the cast iron waste system involves drilling or cutting the cast iron as older existing cast iron installations can be brittle and prone to shattering.

In the event that the connection to the internal soil stack is in, or runs through, a roof space or unheated area, it should be considered an external connection and insulated.

7.4.2.2 Connection to an external soil and vent stack system

If the termination is to be to an external soil and vent stack, the connection shall conform to **7.4.2.1**; however, extra care is necessary in order to reduce the risk of the condensate drainage pipe becoming blocked owing to the condensate freezing.

*NOTE For general requirements on external condensate drainage pipes, see **7.3.2**.*

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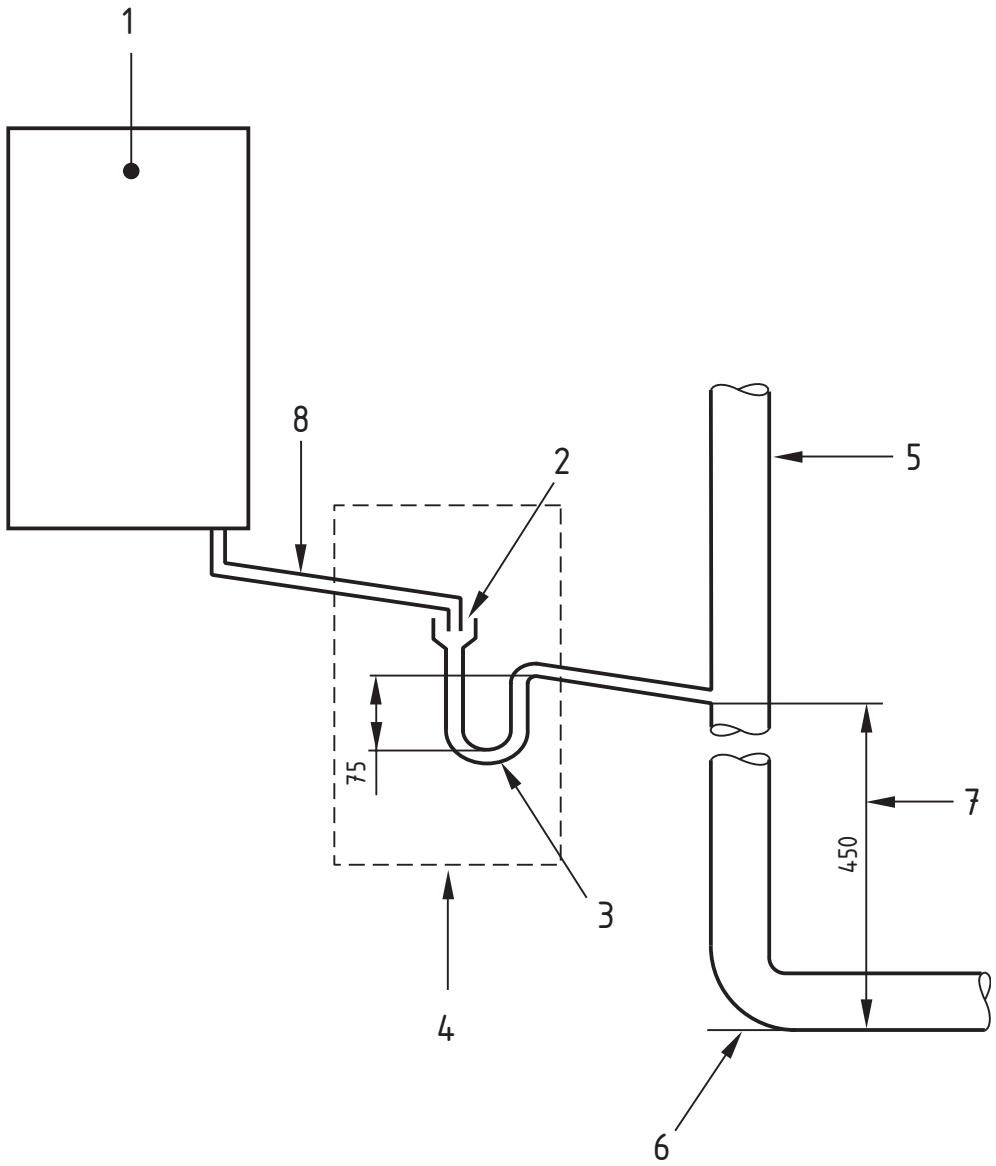
Figure 9 **Connection of condensate drainage pipe to soil and vent stack**



Key

1 Appliance
2 Visible air break
3 75 mm trap
4 Visible air break and trap not required if there is a trap with a minimum condensate seal of 75 mm incorporated into the appliance
5 Soil and vent stack
6 Invert
7 450 mm minimum up to three storeys
8 Nominal outside diameter 22 mm

7.4.3 Connection to an internal waste pipe (Figure 10)

*NOTE 1 Provided that the condensate drainage pipe meets the requirements of **7.3** and **7.4**, there is no length restriction.*

The connection shall be made to the internal waste pipe from a sink, washing machine, dishwasher, basin, bath or shower, either downstream [Figure 10a)] or upstream [Figure 10b)] of the waste trap.

NOTE 2 If practical, the connection should be made to the upper part of the pipe wall.

If the connection is downstream of the waste trap and the appliance does not have an integral condensate trap with a depth of seal of at least 75 mm, an additional trap of at least 75 mm shall be fitted. A visible air break shall be included between the trap in the appliance and the additional trap, as shown in Figure 10a).

If the connection is upstream of the waste trap, then a visible air break is necessary between the waste trap and the condensate trap but, in the case of a sink, basin or bath, this is provided by the sink, basin or bath waste pipe itself as long as the sink, basin or bath has an integral overflow, as shown in Figure 10b).

In order to prevent waste from the sink, washing machine, dishwasher, basin, bath or shower entering the condensate trap, there shall be a minimum of 100 mm between the visible air break at the lowest condensate trap and the top of the sink, basin, bath or shower tray or visible air break serving the washing machine or dishwasher.

*COMMENTARY AND RECOMMENDATIONS ON **7.4.3***
It is preferable to connect to a washing machine drain rather than a kitchen sink; this reduces the likelihood of solid waste and fats blocking or restricting the drainage of condensate.

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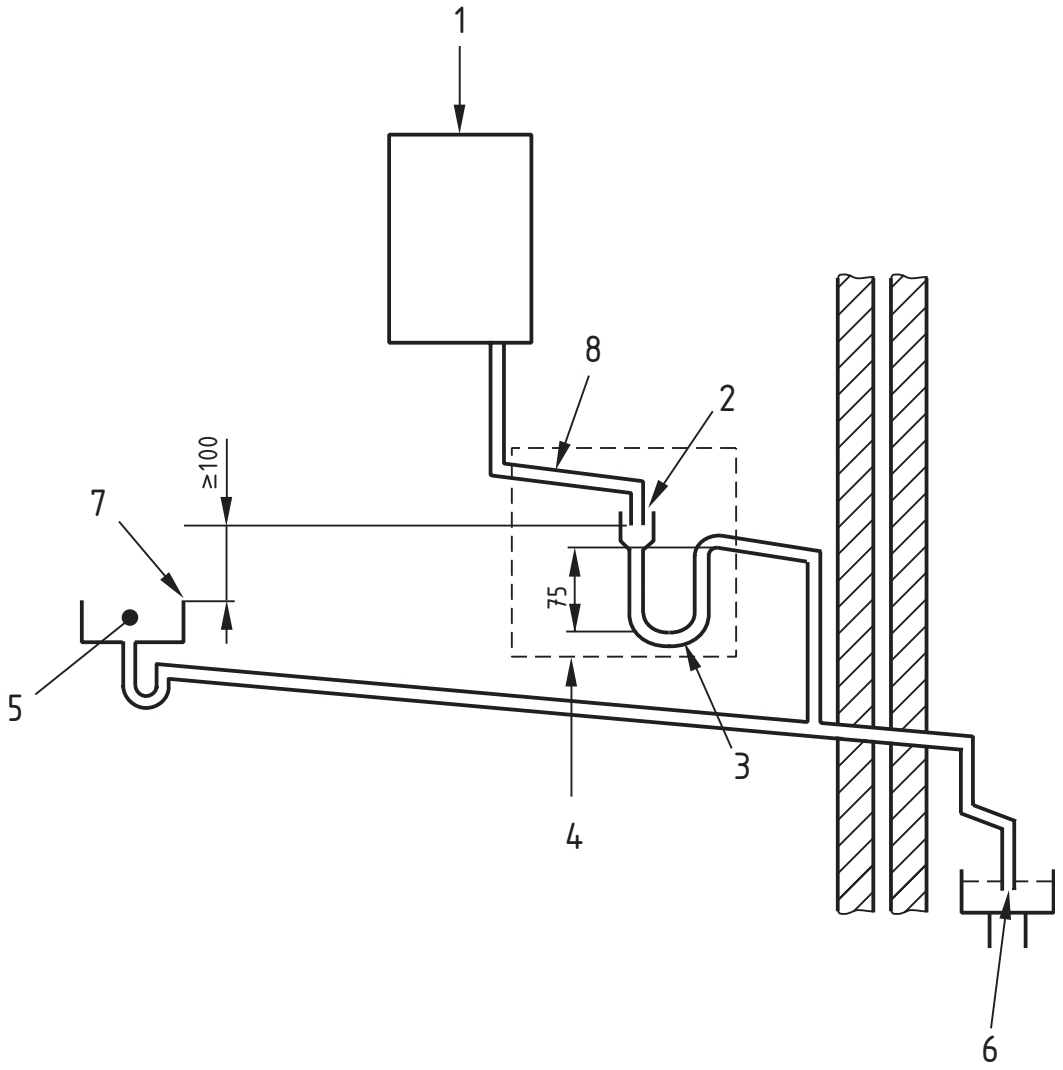
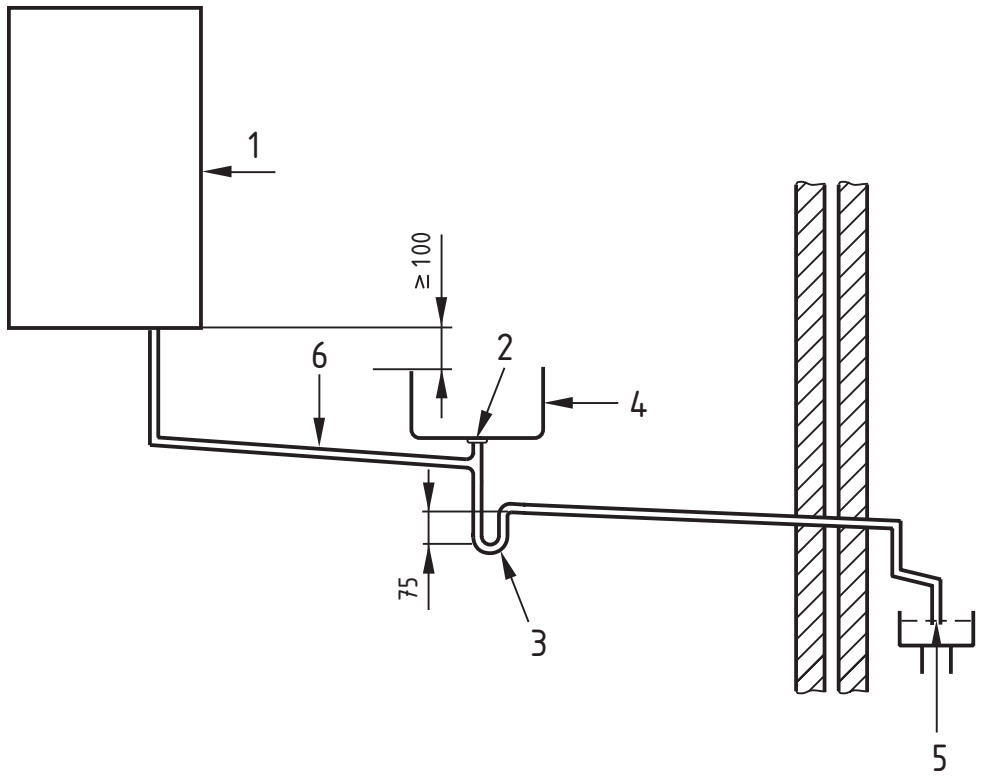
Figure 10a) **Connection of a condensate drainage pipe downstream of a sink, basin, bath or shower waste trap**



Key

1 Appliance
2 Visible air break
3 75 mm trap
4 Visible air break and trap not required if there is a trap with a minimum condensate seal of 75 mm incorporated into the appliance. In this case the 100 mm is measured to the trap in the appliance.
5 Sink, basin, bath or shower
6 Open end of condensate drainage pipe direct into gully below grating but above water level
7 Sink lip
8 Nominal outside diameter 22 mm

Figure 10b) **Connection of a condensate drainage pipe upstream of a sink, basin, bath or shower waste trap**



Key

1 Appliance
2 Visible air break at plug-hole
3 75 mm sink, basin, bath or shower waste trap
4 Sink, basin, bath or shower with integral overflow
5 Open end of condensate drainage pipe direct into gully below grating but above water level
6 Nominal outside diameter 22 mm

7.4.4 Connection to an external drain, gully or rainwater hopper (Figure 11)

The open end of the condensate drainage pipe shall be directed into a rainwater hopper or gully below the grating and above the water level. Unless the appliance includes a trap of at least 38 mm depth, a trap of at least 38 mm shall be installed between the appliance and the discharge point, with a visible air break between the appliance and the trap.

*NOTE 1 For general guidance on external condensate drainage pipes, see **7.3.2**.*

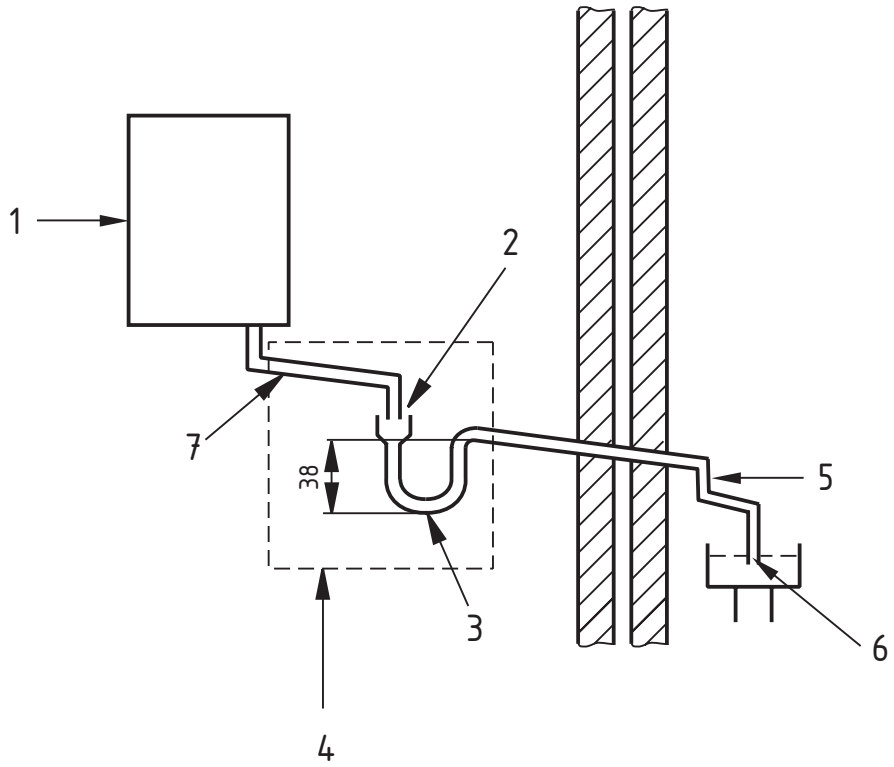
NOTE 2 When connecting the condensate pipe into a rainwater downpipe, an appropriate fitting should be used, i.e. the pipe should not be pushed directly into the downpipe as this could cause blockage.

The rainwater hopper shall be part of a combined system [see **7.4.1**d)].

Condensate shall not be disposed of into a greywater recovery system that is intended for reuse.

NOTE 3 Further guidance on greywater recovery systems can be found in the WRAS publication, Reclaimed Water Systems. Information about Installing, Modifying or Maintaining Reclaimed Water Systems (No 9-02-04) *[23] and BS 8525-1.*

Figure 11 **External termination of condensate drainage pipe**



Key

1 Appliance
2 Visible air break
3 38 mm minimum trap
4 Visible air break and trap not required if there is a trap with a minimum condensate seal of 38 mm incorporated into the appliance
5 External length of pipe 3 m maximum
6 Open end of condensate drainage pipe direct into gully below grating but above water level
7 Nominal outside diameter 22 mm

7.4.5 Connection to a purpose-made soakaway (Figure 12)

If none of the condensate discharge arrangements in **7.4.2**, **7.4.3** and **7.4.4** are practicable, a purpose-made soakaway shall be used. It shall be sited in a convenient position as close as possible to the water-heating appliance, but clear of the building's foundations, ensuring that no other services are in the vicinity to avoid interfering with their functions.

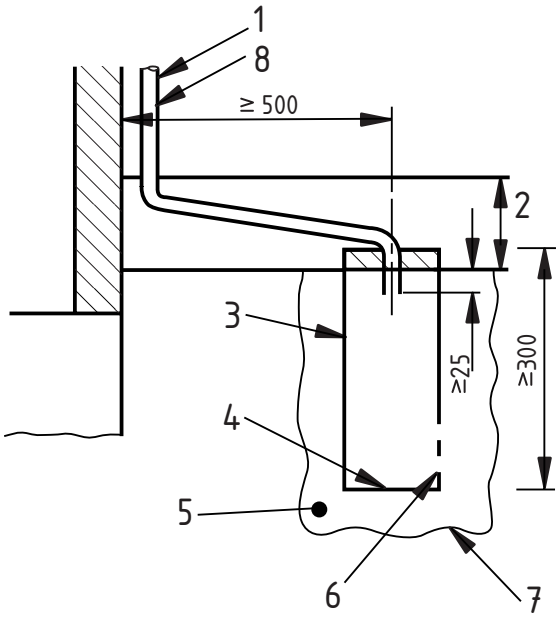
NOTE 1 An example of a suitable design is shown in Figure 12.

Unless the appliance includes a trap of at least 38 mm depth, a trap of at least 38 mm shall be installed between the appliance and the discharge point, with a visible air break between the appliance and the trap.

*NOTE 2 For general guidance on external condensate drainage pipes, see **7.3.2**.*

If the existing installation includes a purpose-made soakaway, when a new appliance is installed and the soakaway is to be reused, the limestone chippings in and/or around the soakaway shall be replaced.

Figure 12 **Example of a purpose-made soakaway**



Key

1 External length of uninsulated pipe 3 m maximum
2 Ground (this section of the condensate drainage pipe may be run either above or below ground level)
3 Diameter 100 mm minimum plastic tube
4 Bottom of tube sealed
5 Limestone chippings
6 Two rows of three 12 mm holes at 25 mm centres, 50 mm from bottom of tube and facing away from house
7 Hole depth 400 mm minimum by 300 mm diameter
8 Nominal outside diameter 22 mm

7.5 In-line condensate neutralizer devices

Where an in-line neutralizer device is fitted in the condensate line:

a) the water-heating appliance manufacturer's installation instructions shall allow that such a device can be fitted;

b) the flow rate through the device shall be compatible with the condensate flow rate stated by the water-heating appliance manufacturer's instructions;

c) the installation instructions supplied with the neutralizer device shall include advice on where the device is to be fitted, the effective life of the neutralizing agent, temperature limitations and method of replacement;

d) details of this effective life shall be prominently and durably fixed to the outside of the water-heating appliance casing by the operative and shall clearly state that it is the responsibility of the owner to ensure that a suitable service regime is in place;

e) the restrictions on condensate drainage pipe material in **7.3.1** and the discharge arrangements specified in **7.4.1** shall continue to apply, unless the system is designed to automatically turn off the water-heating appliance in the event of the neutralizing agent no longer neutralizing the condensate, and requires a qualified operative to restart the water-heating appliance.

*COMMENTARY AND RECOMMENDATION ON **7.5***
*Unless the neutralizing device automatically shuts off the water-heating appliance as described in item e) (because there is no guarantee that the owner will have a suitable service regime in place), if the drainage pipe fitted to the outlet of the device is other than as specified in **7.3**, it is likely that the drainage pipe will corrode and perforate and the acidic condensate will be inappropriately discharged.*

8 Post-installation

8.1 Inspection

Before it is commissioned, the water-heating installation shall be inspected to confirm that the work has been carried out as specified in this standard, the appliance manufacturer's instructions, the relevant sections of the current Gas Safety (Installation and Use) Regulations 1998 [1] and BS 7671.

*COMMENTARY AND RECOMMENDATIONS ON **8.1***
Attention is drawn to the Gas Safety (Installation and Use) Regulations 1998 [1] and particularly to the requirements that:

a) the provision of ventilation air and combustion air is adequate;

b) the chimney is correctly constructed;

c) the general condition of the appliance and the installation is adequate;

d) the gas fittings and other works for the supply of gas are adequate.

8.2 Commissioning

NOTE Schedule 1 of the Building Regulations for England and Wales [2] requires a notice signed by a suitably qualified person that includes a declaration that the manufacturer's commissioning procedures have been completed satisfactorily. Similar requirements might apply in other areas of the UK.

For example, the Benchmark Commissioning Checklist provided by most water-heating appliance manufacturers at the rear of the appliance instruction manual or a commissioning checklist from a Competent Persons Scheme provider can be used to show that commissioning has been carried out satisfactorily.

8.2.1 If a boiler has been installed to provide the hot-water supply, the treatment of the system at the final filling stage shall be carried out in accordance with BS 6798:2009, **6.2.1**.

8.2.2 The water-heating appliance shall be put into operation and commissioned as described in the manufacturer's instructions.

8.2.3 The operative shall confirm that the heat input is correctly adjusted in accordance with the manufacturer's instructions.

*COMMENTARY AND RECOMMENDATIONS ON **8.2.3***
Where appropriate, the pressure at the burner pressure test point should be checked to ensure that it is in accordance with the recommended value. The gas rate can be measured by the gas meter test dial or index, once it has been confirmed that no other appliance supplied through the meter is in operation and that the boiler is operating at its nominal rate throughout the measurement, i.e. without cycling or modulating.

These checking and adjustment procedures should be carried out with the burner in the hot condition. It is recommended that a heat-up time of at least 10 min is allowed, except where the manufacturer's instructions advise otherwise. The heat input might be quoted on the basis of either net or gross calorific value. The operative should establish from the manufacturer's instructions which of these is being quoted. If there is any doubt, the appliance manufacturer should be contacted. When a heat input is to be calculated from a measured gas rate, the appropriate gross or net calorific value (CV) should be used.

Where:

a) there is no meter to measure directly the heat input into the gas appliance; and

b) it is not possible to measure the operating pressure of the gas appliance because it incorporates a pre-mix burner and a zero set pressure regulator;

it is permissible to use the measured combustion performance to demonstrate that the appliance is operating safely; see the HSE Certificate of Exemption No.1 2008, for which further guidance is given in the Gas Safe Register Technical Bulletin 021 [24].

Where the measured combustion performance is used to demonstrate that the appliance is operating safely, the operative will need to:

1) have access to the boiler manufacturer's instructions and a calibrated electronic portable combustion gas analyser conforming to BS 7927 or BS EN 50379-3; and

2) be competent in its use and the interpretation of any reading obtained.

This competence can be demonstrated by satisfactory completion of the CPA1 ACS assessment, which covers the use of electronic portable combustion gas analysers in accordance with BS 7967, Parts 1 to 4.

8.2.4 The air supply and the operation of the chimney system shall be checked to ensure that the products of combustion are being safely removed.

*COMMENTARY AND RECOMMENDATIONS ON **8.2.4***
The safe removal of combustion products should be checked by the method described in the appliance manufacturer's installation instructions. If these are not specific, the method given in BS 5440-1 should be used.

8.2.5 The appliance's controls, safety devices and system controls shall be checked to ensure that they function in accordance with the manufacturer's instructions.

*COMMENTARY AND RECOMMENDATIONS ON **8.2.5***
Where the manufacturer's instructions require the combustion performance to be checked, the operative needs to have access to a calibrated electronic portable combustion gas analyser conforming to BS 7927 or BS EN 50379-3 and be competent in its use and the interpretation of any reading obtained. This competence can be

demonstrated by satisfactory completion of the CPA1 ACS assessment, which covers the use of electronic portable combustion gas analysers in accordance with BS 7967, Parts 1 to 4.

8.3 Advice to user

NOTE This is advice to be given to the user by the operative at the time of handover.

8.3.1 User instructions

8.3.1.1 The operative shall ensure that the user has been provided with the manufacturer's instructions for operating the water-heating appliance.

8.3.1.2 The correct operating procedure for the water-heating appliance, any safety shut-off controls and ancillary controls shall be demonstrated to the user.

*COMMENTARY AND RECOMMENDATIONS ON **8.3.1.2***
Where necessary, a system layout diagram and instructions for operating ancillary controls should be provided by the installer. Special instructions may be required for unvented hot water systems conforming to BS EN 12897.

With the introduction of the Gas Appliance (Safety) Regulations [25] in 1996, the majority of installed open-flued water-heating appliances will be fitted with a flue spillage or atmospheric sensing device designed to shut down the appliance under fault conditions. The user should be informed of the possible need to call an operative to rectify any fault and reset the control.

An independently mounted carbon monoxide detector having an audible alarm (conforming to BS EN 50291) may be fitted in a room containing a gas appliance to give reassurance to the user, but a detector should not be regarded as a substitute for correct installation and regular servicing by a competent person.

Where necessary, a system layout diagram and instructions for operating ancillary controls should be provided by the operative.

8.3.2 Precautions

The user shall be advised of any precautions necessary to prevent damage to the water-heating appliance, system or the building if the system remains inoperative during freezing conditions.

8.3.3 Maintenance

If the premises in which the water-heating appliance is installed are owned by the occupier, the occupier shall be advised in writing that, for continued efficient and safe operation of the appliance, it is important that adequate and regular maintenance of the water-heating appliance and system is carried out in accordance with the appliance manufacturer's recommendations by a competent person (i.e. an operative registered with the Gas Safe Register).

If the premises are tenanted and the landlord owns the gas appliance, the landlord shall be advised in writing of the duty imposed by the Gas Safety (Installation and Use) Regulations 1998 [1] to ensure that the appliance installation is maintained in a safe condition and checked for safety every 12 months.

*COMMENTARY AND RECOMMENDATIONS ON **8.3.3***
The Gas Safety (Installation and Use) Regulations 1998 [1] impose a general obligation on landlords providing gas appliances in tenanted premises to have these maintained in a safe condition and checked for safety every 12 months.

Where an independently mounted carbon monoxide detector (e.g. one conforming to BS EN 50291) is fitted in or recommended for a room containing a gas appliance, the operative should advise the user that a detector is not to be regarded as a substitute for proper installation and regular servicing by a competent person.

8.4 Service and maintenance

It is important that service and maintenance of the water-heating appliance and system is carried out by a competent person (i.e. an operative registered with the Gas Safe Register) in accordance with the appliance manufacturer's recommendations.

Where the manufacturer's instructions require the combustion performance to be checked, the operatives shall have access to a certified calibrated electronic portable combustion gas analyser, conforming to BS 7927 or BS EN 50379-3 and shall be competent in its use and the interpretation of any reading obtained.

NOTE This competence can be demonstrated by satisfactory completion of the CPA1 ACS assessment, which covers the use of these electronic portable combustion gas analysers in accordance with BS 7967, Parts 1 to 4.

*COMMENTARY AND RECOMMENDATIONS ON **8.4***
Where:

a) there is no meter to measure directly the heat input into the gas appliance; and

b) it is not possible to measure the operating pressure of the gas appliance because it incorporates a pre-mix burner and a zero set pressure regulator;

it is permissible to use the measured combustion performance to demonstrate that the appliance is operating safely; see the HSE Certificate of Exemption No.1 2008, for which further guidance is given in the Gas Safe Register's Technical Bulletin 021 [24].

In the case of a room-sealed fanned draught flue system concealed within a void, advice on inspection of the flue system is given in the Gas Safe Register's Technical Bulletin 008 [13].

Where any defects that cannot be rectified are identified as part of any maintenance or safety check activity, reference should be made to the requirements of the Gas Industry Unsafe Situations Procedure *[26].*

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