
British Standard Specification for

Design, installation, testing and maintenance of services supplying water for domestic use within buildings and their curtilages

Conception, installation, contrôle et entretien des circuits d'alimentation en eau à usage domestique
des immeubles et de leurs courtes — Spécifications

Bemessung, Einbau, Prüfung und Instandhaltung von Gebäudewasserversorgungssystemen

Foreword

This standard has been prepared under the direction of the Building Services Standards Committee and is intended for the use of engineers, architects, surveyors, contractors, plumbers and inspection authorities and should also be of general interest. It supersedes CP 99, CP 310, CP 324.202 and CP 342 : Part 1 which are withdrawn. Centralized hot water supply for buildings other than individual dwellings is still covered by CP 342 : Part 2 which should be used in conjunction with this standard.

NOTE. This standard has been written in the form of a practice specification in accordance with the guidance given in PD 6501 : Part 1. To comply with this specification, the user has to comply with all its requirements. The user may depart from recommendations but this would be on his own responsibility and he would be expected to have good reason for doing so.

In view of the varying scope and nature of work on water services, it may in some cases be appropriate to cite only certain portions of this standard in the contract.

The previous edition of this standard, CP 310 : 1965, covered water treatment, water mains and the plumbing aspects of water services for buildings. However, since 1965 the water supply industry has been reorganized and it is no longer sensible to cover water treatment by the water supplier and water mains in the same standard as water services for buildings; these subjects are not, therefore, included in this edition. Neither is the design of large scale underground reticulations included. Whilst certain aspects of underground systems and the larger storage facilities are dealt with in the standard, it will also be necessary for reference to be made to the procedures of the water supply industry when designing large installations of this nature.

At present the installation of hot and cold water services in buildings is covered by a complex of interrelated British Standard codes of practice. In producing this standard, it was the intention to consolidate into a single standard virtually all aspects of hot and cold water supply within buildings and their immediate surroundings but to exclude water treatment plants, fire-fighting systems and water supply for industrial processes. This standard interfaces with numerous codes as indicated by references in the text; in particular it interfaces with and to a small extent overlaps the codes dealing with space heating by hot water. In this respect it has been assumed that this standard should deal with the transmission of both hot and cold water for whatever purpose, while the transmission of heat by whatever medium (including water) should clearly be the province of other standards. However, where hot water is the heat transfer medium, the pipework carrying the hot water to the heating apparatus will be of common interest. Mains-fed unvented hot water storage systems are basically new to the UK and are dealt with in this standard for the first time. In the past, this type of installation was prohibited by the byelaws made by water suppliers under the terms of the Water Act 1945. A new model Water Byelaws has been issued that omits this prohibition and it is anticipated that water undertakers in England and Wales will in due course make new byelaws that conform to the new model. In the meantime the systems in question can be legally installed only if a relaxation of the relevant

byelaw is obtained. In order to control the safety of unvented domestic hot water storage systems, this aspect has been included in the Building Regulations 1985 Schedule 1 (Part G3) which came into effect on 11 November 1985. The Approved Document issued in connection with Building Regulation G3 states that any unvented hot water storage system should be either in the form of a 'unit' which incorporates all the necessary safety devices and the operating devices to prevent backflow, control working pressure, relieve excess pressure and accommodate expansion fitted on the unit by the manufacturer, or in the form of a 'package' in which the safety devices are fitted by the manufacturer, as for a unit, but the other devices are supplied by the manufacturer as a kit for fitting on site by the installer. In addition, the unit or package should be the subject of a current British Board of Agrément Certificate; the conditions of use should be in accordance with the terms of that Certificate and the whole of the installation should be carried out by an installer approved by the British Board of Agrément.

The similarities between vented and unvented systems far exceed the differences and so they have not been dealt with separately, which would have involved considerable repetition. However, significant differences do exist (especially in respect of bursting) and it is important that the relevant text be readily locatable. The major areas of difference occur in clauses 5, 6, 7, 13 and 15. There are numerous references to detail on unvented systems elsewhere in the text and these can be identified by reference to the index under 'unvented systems'.

Where products are covered by a suitable British Standard* this should be specified and complied with. This standard specifically recommends the use of third party certification.

Enquiries as to the availability of third party certification should be addressed to the appropriate authority.

Where a suitable British Standard does not exist the use of United Kingdom Water Fittings Byelaws Scheme listed materials and fittings should be considered. Whilst a United Kingdom Water Fittings Byelaws Scheme listing does not certify that the material or fitting is fit for the purpose, provided that they are installed in accordance with any conditions laid down by the United Kingdom Water Fittings Byelaws Scheme and in accordance with the water supplier's byelaws, use of such listed materials and fittings will ensure that (a) they will not lead to contamination due to the materials in the fittings and (b) the use of the materials or fittings will not contravene water suppliers' byelaws (see appendix A).

Consideration should also be given to products covered by a British Board of Agrément Certificate.

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

* See appendix H.

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Section one. General

1 Scope

This British Standard specifies requirements for and gives recommendations on the design, installation, alteration, testing and maintenance of services supplying water for domestic use within buildings and their curtilages. It covers the system of pipes, fittings and connected appliances installed to supply any building, whether domestic or not, with water for ablutionary, cleaning, sanitary, culinary, drinking and domestic laundry purposes.

This standard deals only with low temperature systems; it does not cover systems that are designed to operate with steam or high temperature hot water (see 3.1).

This standard does not cover domestic central heating appliances*.

Although many of its recommendations will be applicable, this standard does not set out to cover fire fighting services nor water supply for industrial or other specialist purposes other than to indicate precautions that should be taken when these are used in association with other water services. The point at which a domestic activity becomes an industrial process, e.g. in food preparation, has not been defined and the applicability of this standard will need to be considered in each case.

Appendix A lists the statutory requirements relating to matters dealt with in this standard.

NOTE. The titles of the publications referred to in this standard, together with related standards, are given in appendix H.

2 Definitions

For the purposes of this British Standard the definitions given in BS 4118 apply, together with the following.

2.1 building. Any structure (including a floating structure) whether of a permanent character or not, and whether movable or immovable, connected to the water supplier's mains.

2.2 cavity wall. Any wall whether structural or partition that is formed by two upright parts of similar or dissimilar building materials suitably tied together with a gap formed between them which may be (but need not be) filled with insulating material.

2.3 chase. A recess that is cut or pre-formed so as not to affect in any way the strength of the structure in which it is formed and so as to have a minimum effect on any thermal or acoustic insulation, and designed to accommodate water pipes and fittings which can be accessible by removal of a cover or covers.

2.4 cover. A panel or sheet of rigid material fixed over a chase, duct or access point, of sufficient strength to withstand surface loadings appropriate to its position.

NOTE. Except where providing access to joints or changes of direction (i.e. at an inspection access point) a cover may be plastered or screeded over.

2.5 duct. An enclosure designed to accommodate water pipes and fittings and other services if required and constructed so that access to the interior can be obtained either throughout its length or at specified points by removal of a cover or covers.

2.6 dwelling. Premises, buildings or part of a building providing accommodation, including a terraced house, a semi-detached house, a detached house, a flat in a block of flats, a unit in a block of maisonettes, a bungalow, a flat within any non-domestic premises, a maisonette in a block of flats, or any other habitable building and any caravan, vessel, boat or houseboat connected to the water supplier's mains.

2.7 inspection access point. A position of access to a duct or chase whereby the pipe or pipes therein can be inspected by removing a cover which is fixed by removable fastenings but does not necessitate the removal of surface plaster, screed or continuous surface decoration.

2.8 removable fastenings. Fastenings that can be removed readily and replaced without causing damage and include turn buckles, clips, magnetic or touch latches, coin operated screws and conventional screws, but do not include nails, pins or adhesives.

2.9 sleeve. An enclosure of tubular or other section of suitable material so designed as to provide a space through an obstruction to accommodate a single water pipe and to which access to the interior can be obtained only from either end of such sleeve.

2.10 tap size designations. Numbers directly related to the nominal size of the thread on the inlet of the tap, which in turn is unchanged from the nominal size in inches before metrication, e.g. ½ nominal size tap means a tap with an inlet having a ½ BSP thread.

2.11 walkway or crawlway. An enclosure similar to a duct, but of such size as to provide access to the interior by persons through doors or manholes and which will accommodate water pipes and fittings and other services if required.

2.12 water supplier. Any water supply organization, including water authorities, regional and islands councils, and water companies.

3 Materials

3.1 Choice of material

The following factors shall be taken into account in selecting materials used in a water service:

- (a) cost;
- (b) effect on water quality;
- (c) internal and external corrosion;
- (d) compatibility of different materials;
- (e) ageing, fatigue and temperature effects;
- (f) mechanical properties;
- (g) durability.

* See the foreword.

Pipes and fittings shall be used within the limits stated in the relevant British Standards and manufacturer's recommendations.

Every part of a water installation shall be capable of operating effectively under the conditions which it will experience in service.

Every pipe, pipe joint and connected fitting shall be capable of withstanding, without damage or deterioration, sustained temperatures up to 40 °C for cold water installations and up to 70 °C, with occasional short-term excursions up to 100 °C to allow for malfunctions, for heated water installations. In addition, every draw-off tap shall be capable of operating effectively at any water temperature not exceeding 65 °C and at any internal water pressure to which it is likely to be subject. Discharge pipes connected to temperature or expansion relief valves in unvented hot water systems shall be capable of withstanding any continuous hot water or steam discharge at temperatures up to 125 °C.

If pipes, pipe joints or connected fittings are of dissimilar metals, necessary measures shall be taken to prevent corrosion. Dissimilar metals shall be avoided in below ground installations wherever practicable.

COMMENTARY AND RECOMMENDATIONS ON 3.1.

Cost will usually be a major factor in materials selection. As well as first cost, service life and expected maintenance expenditure should be considered so that an estimate of total cost in use can be made.

Where the use is for a temporary purpose during a period not exceeding 3 months, materials with a lesser durability than those recommended in this standard may be adequate for the purpose.

In consultation with the water supplier, consideration should be given to the character of the water supply taking account of any anticipated future changes, and its effect on the choice of materials.

The influence on water quality of the materials used in the construction of the water service installation, and of those in contact with the installation, is dealt with in clause 9.

Internal corrosion leading to premature failure of metal pipes may occur with certain waters. External corrosion of pipes and fittings laid below ground may be a serious local problem depending on the particular ground conditions. Protection by means of a lining internally or coating externally or by using a corrosion resistant material should be considered (the water supplier may be able to advise on the choice of an effective lining or coating material).

Careful consideration should be given to how particular materials or products are likely to react in the long term in hot water installations. Ageing, creep and fatigue are important factors when using plastics materials. Advice may be available from the relevant British Standard, British Board of Agrément, manufacturer, or water supplier.

3.2 Lead

No pipe or other water fitting or storage cistern made from lead or internally lined with lead shall be used in new installations.

Repairs to existing lead services shall be by replacement with other materials. The repair or partial replacement of lead piping with copper piping shall be avoided.

COMMENTARY AND RECOMMENDATIONS ON 3.2.

In areas where the water is plumbosolvent, such a layout can result in increased lead contamination.

3.3 Copper

3.3.1 Copper is, in general, resistant to corrosion and is suitable for hot and cold water applications. Where supply waters are capable of dissolving an undue amount of copper such that either

- (a) unacceptable green staining is produced, or
- (b) deposition of copper onto aluminium or zinc surfaces promotes galvanic attack,

consideration shall be given to the use of alternative materials or water treatment.

COMMENTARY AND RECOMMENDATIONS ON 3.3.1.

Galvanized pipework should not be used connected to and especially downstream from copper pipework otherwise it will be subject to accelerated corrosion.

3.3.2 Where supply water is capable of supporting localized pitting corrosion attack copper tube shall be free from carbon residues in the bore.

COMMENTARY AND RECOMMENDATIONS ON 3.3.2.

Copper tube should comply with BS 2871 : Part 1. It is strongly recommended that independent certification of such tube should be obtained, as it has been found by experience that this is the only way to obtain any reasonable assurance that the copper tube in question will not suffer from pin-hole corrosion when used in water services. Details of available certification facilities are given in the foreword.

3.3.3 In districts where pitting corrosion of copper cylinders occurs (e.g. where there is hard or moderately hard, deep well water) they shall be fitted with aluminium protector rods.

COMMENTARY AND RECOMMENDATIONS ON 3.3.3.

Protector rods should be fitted during manufacture and should be installed in accordance with the relevant British Standard specifications for cylinders, i.e. BS 699, BS 1566 : Parts 1 and 2 and BS 3198.

3.3.4 No copper pipe shall be connected to or incorporated with any lead pipe unless galvanic action is prevented.

3.4 Copper alloys

Fittings for use with underground copper tube shall be resistant or immune to dezincification and where compression fittings are used these shall be manipulative type B fittings complying with BS 864 : Part 2. Where it

is known that the local supply water is capable of causing dezincification, or where grid distribution systems might introduce such water, or any doubt exists, fittings manufactured from alloys subject to dezincification shall not be used, except for draw-off fittings.

COMMENTARY AND RECOMMENDATIONS ON 3.4.

Copper cannot corrode in this way and other recommended materials are the gunmetals or the special brasses inhibited and treated to be highly resistant to this form of corrosion. For alloys in the latter category a specific test of dezincification resistance is included as an appendix to BS 2872 and BS 2874. For ease of identification, fittings manufactured from dezincification resistant brasses capable of passing the test procedures in BS 2872 and BS 2874 are marked with the recognized dezincification symbol Ω . Gunmetal fittings are immune to dezincification although not so marked.

Copper and copper alloy tube fittings should comply with BS 864.

3.5 Stainless steel

3.5.1 COMMENTARY AND RECOMMENDATIONS ON THE USE OF STAINLESS STEEL. *Although mixed copper and stainless steel systems can be used, e.g. stainless steel can be used where pipework shows and copper where the pipework is hidden, small copper to large stainless steel areas should be avoided, e.g. copper pipes into a large stainless steel tank.*

Stainless steel tubing should comply with BS 4127. Jointing should be made using stainless steel or copper capillary or compression fittings (see 9.2.2).

3.5.2 *Soldering stainless steel.* Fluxes that will cause pitting corrosion of stainless steel, e.g. those that contain chlorides or borides, shall not be used.

COMMENTARY AND RECOMMENDATIONS ON 3.5.2.

Phosphoric acid based fluxes that comply with BS 5245 are non-corrosive to stainless steel and should be used when making soft-soldered capillary joints in stainless steel pipework. In the case of stainless steel capillary fittings a solder-paste consisting of a mixture of soft solder powder and a phosphoric acid-based flux is recommended for jointing.

3.6 Carbon steel

3.6.1 Restrictions imposed by the water supplier on the use of carbon steel components shall be complied with.

COMMENTARY AND RECOMMENDATIONS ON 3.6.1.

Where steel tube is not prohibited by the water supplier, medium tube to BS 1387 should be used above ground for distributing pipes from a storage cistern and for fire fighting purposes; except that light tube to BS 1387 can be used for fire sprinkler systems from which no other water is drawn off. All tubes laid in the ground should be heavy grade. All tubes, other than for supplies exclusively used for fire fighting, should be protected against corrosion. The design and installation of underground steel pipelines should be in accordance with CP 2010 : Parts 1 and 2.

3.6.2 Galvanized steel tube shall be jointed only by screwed connections; under no circumstances shall welded or brazed joints be used because this would damage the galvanizing. Site bending of galvanized tube will also damage the galvanizing so where it is necessary to change direction pre-formed bends shall be used.

COMMENTARY AND RECOMMENDATIONS ON 3.6.2.

Galvanized tubes offer only marginal protection against corrosion.

3.7 COMMENTARY AND RECOMMENDATIONS ON IRON.

The requirement of the water supplier for a protective coating or lining to CP 2010 : Part 3 should be ascertained.

3.8 Plastics

3.8.1 *General.* Plastics pipes shall not be installed close to sources of heat so that their performance is impaired.

Coefficients of expansion are greater than those for metal pipes, but this is not generally a problem where pipes are buried. Where pipes are situated above ground, consideration shall be given to accommodating thermal movement.

COMMENTARY AND RECOMMENDATIONS ON 3.8.1.

The use and installation of pipelines for the supply of potable water using pipes of plastics materials should be in accordance with CP 312.

3.8.2 COMMENTARY AND RECOMMENDATIONS ON UNPLASTICIZED POLYVINYLCHLORIDE. *The use and installation of unplasticized PVC pipes should be in accordance with CP 312 : Part 2 and specific attention is drawn to the amendment relating to surge pressures. BS 3505 specifies the requirements for pipe and BS 4346 specifies the joints and solvent cements to be used with the pipe.*

Below ground and in confined locations above ground, mechanical joints should be used in preference to solvent cement joints due to the difficulty in making satisfactory solvent cement joints in such adverse conditions. Where mechanical joints are made with copper alloy fittings these should be dezincification resistant or immune. In accessible positions above ground solvent cement joints can be used. As unplasticized PVC pipes become increasingly brittle with reducing temperatures, particular care should be taken in handling them in temperatures below 5 °C.

3.8.3 COMMENTARY AND RECOMMENDATIONS ON POLYETHYLENE (PE). *The use and installation of polyethylene pipelines for the supply of potable water should be in accordance with CP 312 : Part 3. Requirements for pipes are specified in BS 1972 (above ground use), BS 6437 (general purposes) and BS 6572 (below ground use, up to size 63). A standard covering pipes for below ground use, above size 63, is in preparation. Copper alloy compression fittings for use with polyethylene pipe should be to BS 864 : Part 3 and joints should comply with BS 5114.*

PE cold water storage cisterns to BS 4213 are suitable for storage and expansion purposes.

3.8.4 COMMENTARY AND RECOMMENDATIONS ON PROPYLENE COPOLYMER (PP). *This material cannot be solvent welded. Pipe for potable water use should comply with series 1 of BS 4991.*

Cold water storage cisterns complying with BS 4213 are suitable for storage and expansion purposes.

Floors for float-operated valves should comply with BS 2456.

3.8.5 COMMENTARY AND RECOMMENDATIONS ON ACETAL. *Fittings, mostly terminal water fittings, made from acetal are suitable for cold (including potable) and most hot water applications. Jointing carried out by mechanical or push-fit methods is suitable.*

Taps complying with BS 5413 and float-operated valves complying with BS 1212 : Part 3 are suitable.

3.8.6 COMMENTARY AND RECOMMENDATIONS ON CROSS-LINKED POLYETHYLENE (XLPE). *Pipes made from cross-linked polyethylene are suitable for cold (including potable) and hot water applications.*

Cross-linked polyethylene cannot be solvent welded or thermal fusion welded. Jointing carried out by mechanical or push-fit methods is suitable using fittings supplied for this purpose.

3.8.7 COMMENTARY AND RECOMMENDATIONS ON POLYBUTYLENE (PB). *Pipes and fittings made from polybutylene are suitable for cold (including potable) and hot water applications. The material is suitable where the requirements are for abrasion resistance and resistance to freezing temperatures.*

Polybutylene cannot be solvent welded. Jointing by push-fit mechanical joints, or by thermal fusion is suitable.

3.8.8 COMMENTARY AND RECOMMENDATIONS ON CHLORINATED POLYVINYL CHLORIDE. *Pipes and fittings made from chlorinated PVC are suitable for cold (including potable) and hot water applications.*

Jointing by solvent welding, screwed joints or unions is suitable.

3.9 COMMENTARY AND RECOMMENDATIONS ON CONCRETE. *The design and construction of prestressed concrete pressure pipelines should be in accordance with CP 2010 : Part 5.*

The design and construction of reinforced and prestressed concrete structures for the storage of water should be in accordance with BS 5337 (see also 13.4.4 of this standard).

3.10 COMMENTARY AND RECOMMENDATIONS ON ASBESTOS CEMENT*. *The design and construction of asbestos cement pipelines should be in accordance with CP 2010 : Part 4.*

Because of the nature of the material, it should be protected from impact when used in exposed positions. Asbestos cement pressure pipes are suitable where freedom from tuberculation and relatively high corrosion resistance (except in sulphate bearing soils) are the requirements. An external bitumen coating should be used where high acidity or sulphate bearing soils are present.

Asbestos cement cold water storage cisterns are brittle and care should be used in making connections and supporting the cistern.

3.11 Coating and lining materials

No pipe, pipe fitting or storage cistern intended for conveying or storing water shall be lined or coated internally with coal tar or any substance that includes coal tar.

COMMENTARY AND RECOMMENDATIONS ON 3.11.
BS 5493 gives recommendations for the protective coating against corrosion of iron and steel structures, including pipes, fittings and cisterns. This should be consulted where detailed guidance is required. Part 8 of table 3 of BS 5493 : 1977 deals with non-saline water (potable and non-potable) and is applicable to domestic water installations. Typical times to first maintenance, general descriptions of recommended coatings and their thicknesses are given. Other tables give more detailed information about the coating systems. Of particular relevance is note (n) to table 3, which concerns fittings used with potable water. Internal protection of steel pipes should be in accordance with clause 33 of BS 534 : 1981.

3.12 COMMENTARY AND RECOMMENDATIONS ON JOINTING MATERIALS. *Materials and processes for jointing are dealt with in 9.2.2 and clause 13.*

3.13 COMMENTARY AND RECOMMENDATIONS ON SEALING RINGS. *For any jointing system using elastomeric sealing rings in contact with potable water, the material of these rings should comply with the requirements for type 1 of BS 2494. Reference should also be made to 9.2.2.*

* See also the safety requirements in 13.1.

Section two. Design considerations

4 Initial procedures

4.1 Preliminary investigations

The following factors shall be taken into consideration in the design:

- (a) the water supplier's requirements;
- (b) the estimated daily consumption and the maximum and average flows required, together with the estimated time of peak flow;
- (c) the location of the available supply;
- (d) the quality, quantity and pressure required;
- (e) the cold water storage capacity required;
- (f) the likelihood of ground subsidence due to mining activities or any other reason;
- (g) the likelihood of contamination of the site.

4.2 Supplies from a statutory water undertaker

4.2.1 COMMENTARY AND RECOMMENDATIONS ON SUPPLIES FROM A STATUTORY WATER UNDERTAKER.

Where the water is to be supplied by a public water supplier all the byelaws and any other lawful requirements of that undertaker have to be complied with. Byelaws apply whenever the work involves either a new service or the modification or disconnection of existing services. Subject to any express byelaw provisions to the contrary, existing services that comply with the byelaws applicable at the time of their installation need not be updated to comply with current byelaws. For advice on the relevant legal requirements, see appendix A.

The supplier may require or give the consumer the option of supply through a meter, in which case an agreement will have to be entered into by the consumer. The supplier may require to know the size of the pipe on which the meter is to be connected, the estimated maximum demand in litres per second and the estimated quarterly or annual consumption in litres or cubic metres.

4.2.2 Design. The installation shall be designed to avoid waste, undue consumption, misuse and contamination and to ensure continued compliance with the byelaws throughout its useful life without an uneconomic maintenance requirement. The installation shall be designed to avoid the trapping of air during filling and the formation of air locks during operation. Where necessary venting valves shall be fitted.

COMMENTARY AND RECOMMENDATIONS ON 4.2.2.

The design of the system should include provision not only for the appliances connected to it but also where reasonable, practicable and economic to do so, for additional appliances that are likely to be installed in the future, such as water softeners (in hard water areas), water meters, etc. The recommendations in appendix B should be taken into consideration in order to produce an installation free from excessive noise.

4.2.3 Extensions. Where a water service is to be extended it shall be ascertained whether the existing system is suitable for extension, and whether any changes in byelaws and other legal requirements have been made since the date of the original installation.

COMMENTARY AND RECOMMENDATIONS ON 4.2.3.

If the existing supply is part of a common supply pipe, i.e. the supply pipe serves several properties, the water supplier may require a separate service pipe to be provided. Where properties are being supplied with a new service from a water supplier's main, it is strongly advised that a separate service pipe should be provided wherever feasible and the supplier will normally require this.

4.2.4 Water mains. Where there is no water main available to serve the premises or the existing main is inadequate to provide a satisfactory supply, the water supplier shall be requisitioned to lay new mains or extend an existing main, or an alternative water supply shall be arranged.

COMMENTARY AND RECOMMENDATIONS ON 4.2.4.

Full information about proposals should be furnished as early as possible to the water supplier. Site plans should be supplied showing the layout of roads, footpaths, buildings and boundaries. The work programme should take into account the fact that normally the supplier will not lay a main until at least the line and level of the kerb are permanently established on site.

4.2.5 Private water supplies. Where a private supply of water is to be used in addition to water supplied by a statutory water undertaker, the undertaker's approval to the proposals shall be obtained before work commences.

4.3 Ground movement

In designing pipe layout, precautions shall be taken to minimize the effects of ground movement on the pipes and fittings.

COMMENTARY AND RECOMMENDATIONS ON 4.3.

Ground movement may occur due to underground mining operations, natural movements of the earth's strata or movement of superficial deposits. These movements may occur in both the horizontal and vertical planes and will vary in magnitude over the affected area.

The effects of undermining can be predicted with reasonable accuracy and the area surveyor and minerals manager of British Coal, or the responsible company in the case of other mineral mining, should be consulted for advice on precautionary measures to be adopted.

Movement of superficial deposits may be due to seasonal swelling and shrinkage, settlement (especially where fibrous organic soils are encountered) or to slope stability failures. An appreciation of ground conditions existing along the line of a proposed construction should be gained by site investigation so as to enable an assessment of likely movement to be made. The extent of movements of superficial deposits can only be assessed by consideration of the findings of a site investigation.

Where ground is liable to movement a suitable type of pipework should be used to minimize the risk of damage. Where the pipes or the joints are not sufficiently flexible to accommodate movement in pipelines laid in recently disturbed ground, continuous longitudinal support should be provided.

In selecting the type of pipe or storage cistern, components of brittle materials should be more carefully protected from movement than those of materials containing some inherent flexibility. Provision for change in length of pipelines can be made by the use of telescopic joints whilst angular deflections should be compensated by the use of flexible type joints. The continuity of gradient towards washouts and air valves could be affected by subsidence and therefore when such a situation could occur provision should be made to support pipelines and to ensure reasonable gradients between high and low points on the pipeline. Pipes passing through walls should be free to deflect and in the case of outer walls telescopic joints are recommended. Where a capacity to compensate for compression in such a joint is necessary, the spigot should not be fully pushed home.

4.4 Contamination of the site

If there is any indication that contamination of the ground has occurred, an investigation shall be made to ascertain any residual contamination which may adversely affect buried pipes or fittings.

COMMENTARY AND RECOMMENDATIONS ON 4.4.

Such indications should be sought from the local authority, the site owner or the water supplier (see clause 9).

4.5 External pipework

External pipework shall be installed such that it is unlikely to be damaged by frost or traffic loads and vibration.

COMMENTARY AND RECOMMENDATIONS ON 4.5.

The normal minimum depth for protection against frost damage for underground pipework is 0.75 m. This may have to be increased to avoid frost damage, obstructions and/or damage from traffic, to a maximum of 1.35 m. (See clause 10 for details on frost protection.)

Outside pipework should be located above ground only in exceptional circumstances. It should be lagged with waterproof insulation material in accordance with 10.4 and provision should be made for draining off all water from such lengths of pipe in frosty weather through a draw-off point, which should not be buried in the ground or so placed that its outlet is in danger of being flooded.

The following recommendations should be carried out where practicable.

- (a) No pipework should be laid under surfaced footpaths or drives.*
- (b) The underground service pipe should be laid at right angles to the main.*
- (c) The underground service pipe should be laid in approximately straight lines to facilitate location for repairs but with slight deviations to allow for minor*

ground movements. Where access for repair or replacement may be difficult, consideration should be given to the provision of some form of duct or sleeve.

4.6 Liaison and consultation

From an early stage in the design process of the water installation, the necessary liaisons and consultations shall take place with the designer of the building, the building owner or his agent, the water supplier and all other public and private utilities, highway and local authorities, landowners and others involved.

Proper completion and timely submission of notices and applications shall be made to avoid delays.

Whenever other services* are in close proximity to the water service pipes, any byelaws, regulations and requirements of all undertakers concerned shall be ascertained.

Where it is necessary to open the highway or ground for pipe laying or other works, the necessary notices, drawings, documents and applications for consent shall be lodged with the highway authority, public utility undertakers, landowners and any other interested parties as early as possible.

COMMENTARY AND RECOMMENDATIONS ON 4.6.

The installer should be provided with working drawings of the water services showing clearly the precise location of all pipe runs, indicating the method of ducting to be employed where appropriate, the location and full description of all appliances, valves and all other fittings, methods of fixing, protection and all other information which may be required to enable him to construct the work satisfactorily.

The drawings or an accompanying specification should set out clearly any precautions to be taken against frost, corrosion, bursting, expansion and contraction, contamination, noise, damage due to earth movement or any other damage, any consultation required with other public utilities or subcontractors and any notice to be served before or during the execution of the work.

In respect of all legal requirements, in particular highways, the terms of the Public Utilities Street Works Act 1950 have to be observed.

Where possible, the point of entry of the water service should be arranged to facilitate the equipotential bonding of incoming metallic services to the main electrical earth terminal as near as is practical to their point of entry into the premises.

The routing and laying of all services should be co-ordinated to ensure that they are laid in an orderly sequence, to the required line and level and at the appropriate time. A programme should be agreed that takes into consideration the method of construction to be employed, the sequence of hand-over of the buildings, the undertaker's method of working, the size of the services and the position of the incoming services to the site relative to the area to be developed.

* In addition to gas, electricity and telephone, these could include amongst others oil pipelines, television relay cables, district heating systems and drainage connections, see National Joint Utilities Group Publication No. 6 obtainable from NJUG, 30 Millbank, London SW1P 4RD.

5 Cold water services

5.1 General

5.1.1 In every dwelling cold water directly from the supply pipe from the main shall be provided at the kitchen sink. Because any cold tap is likely to be used for drinking water all such taps not connected directly to the supplier's mains shall be supplied from a storage cistern which is protected in accordance with 5.3.1.

Where draw-off fittings are above the height to which the water supplier is able or obliged to supply, e.g. in multi-storey blocks of flats, the drinking water tap shall be supplied from a storage cistern that is protected in accordance with 5.3.1 or from a header on a boosted rising pipe.

Pipe runs to cold water taps within buildings shall not follow the routes of space heating or hot water pipes or pass through heated areas such as airing cupboards or, where local proximity is unavoidable, the hot and cold pipes shall be insulated from each other.

5.1.2 Sufficient drinking water provision shall be made in office buildings, etc.

No drinking water point shall be installed at the end of a long pipe where only small volumes of water are drawn off. COMMENTARY AND RECOMMENDATIONS ON 5.1.2.

Drinking water points should be located in areas intended for the preparation of food and for its consumption in addition to rooms provided for tea and beverage making. Where tea/beverage making facilities are not provided, drinking water points should be sited in the vicinity of, but not inside, toilets. Nevertheless, a drinking water fountain may be installed within a toilet area but it should be sited as far away as possible from WCs and urinals and should be of the shrouded nozzle type discharging above the top edge of the bowl (see BS 6465 : Part 1).

To reduce the risk of stagnation the layout of pipework should be arranged, where possible, so that fittings downstream of a drinking water point have a high demand.

5.1.3 Every tap shall comply with the backflow protection requirements of clause 9.

COMMENTARY AND RECOMMENDATIONS ON 5.1.3.

In order to enable buckets and similar utensils to be filled the outlet of the kitchen tap should be not less than 275 mm above the bottom of the sink. The outlet of such a tap should be designed to make the connection of a hose or sink swiller difficult.

5.1.4 In an installation in a new single dwelling, new commercial or industrial premises, and wherever else reasonably practicable, a pipe leading to a mains drinking water tap (see 5.1.1) shall be connected directly to the supply pipe prior to any water softener inlet.

COMMENTARY AND RECOMMENDATIONS ON 5.1.4.

In the case of existing dwellings, i.e. where building had begun before the date of this standard, wherever reasonably practicable the connection to a drinking water tap should be made upstream of the water softener. If this is not practicable and lead pipe exists downstream of the water softener the advice of the water supplier should be sought.

5.2 Type of system

5.2.1 Systems in dwellings. Water shall be supplied to cold taps either directly from the mains via the service pipe or indirectly from a cold water storage cistern. The method of supply may be affected by the requirements of the water supplier and these shall be ascertained before proceeding with the installation of a water service.

COMMENTARY AND RECOMMENDATIONS ON 5.2.1.

The main factors that should be considered when choosing a cold water supply system are as follows.

(a) *Characteristics of supply via a storage cistern:*

(1) *availability of a reserve of water for use in case of interruption of the mains supply;*

(2) *additional protection of the mains from contamination;*

(3) *reduced risk of water-hammer and reduced noise from outlets, but additional noise generated by the float-operated valve controlling the water supply to the cistern;*

(4) *a constant low pressure which reduces risk of leakage and rate of leakage and which is suitable for mixer fittings in conjunction with low pressure (vented) hot water supply, but the pressure available is usually insufficient for some types of taps and may not be sufficient for showering;*

(5) *increased risk of frost damage;*

(6) *space occupied and cost of storage cistern, structural support and additional pipework;*

(7) *need to ensure that the cistern is continuously protected against the ingress of any contaminant and need to replace the cistern, usually at infrequent intervals.*

(b) *Characteristics of supply direct from mains:*

(a) *smaller pipes may be used in most cases;*

(b) *high pressure supply more suitable for instantaneous type shower heaters, hose taps and for mixer fittings used in conjunction with a high pressure (unvented) hot water supply;*

(c) *more expensive dual-flow mixer fittings required if used in conjunction with a low pressure (vented) hot water supply.*

In some cases a combination of the two methods of supply may be the best arrangement. In a dwelling house, for example, the ground floor cold outlets and any outside tap could be supplied under mains pressure while all other cold water outlets could be fed from a storage cistern.

5.2.2 Systems in buildings other than dwellings. For buildings other than dwellings, the method of supply shall be related to the size and usage of the building and the number of appliances to be served.

COMMENTARY AND RECOMMENDATIONS ON 5.2.2.

In the case of small buildings where the water consumption is likely to be comparable to that of a dwelling house, the options stated in 5.2.1 should be considered. For larger buildings, such as office blocks, hostels and factories, it will usually be preferable for all water, except drinking water, to be supplied indirectly via a storage cistern or cisterns.

Drinking water should be taken directly from the water supplier's main wherever practicable or, when circumstances dictate otherwise, from a cistern protected in accordance with 5.3.1.

5.2.3 Pumped systems. Where the available pressure is insufficient to supply the whole of a building and the water supplier is unable to increase the supply pressure in the supplier's mains, consideration shall be given to installing a pumped system.

COMMENTARY AND RECOMMENDATIONS ON 5.2.3.

When deciding on the method of pumping and on the siting of break tanks and pumps, consideration should be given to the use of such pressure as may be available in the mains supply. In all systems, precautions have to be taken to ensure that back-siphonage does not occur from the distribution pipework and pumping plant (see 9.1.3 and 9.3).

The design and installation of a pumped system should be entrusted to a competent specialist in such work. Examples of the basic design considerations of a number of typical systems are given in appendix C.

5.3 Storage cisterns

5.3.1 General

5.3.1.1 Storage cisterns and lids for domestic purposes shall not impart taste, colour, odour or toxicity to the water, nor promote or foster microbial growth under the conditions where the cistern is installed (see clause 9).

Any cistern from which water for domestic purposes may be drawn shall be:

- (a) a watertight vessel having a tightly fitting, but not airtight, opaque and rigid access cover of materials not likely to fragment nor to contaminate any condensate which may form on its underside, that will exclude insects, securely fixed in position;
- (b) where necessary, lined or coated with a material suitable for use in contact with potable water;
- (c) where necessary, insulated against heat and frost;
- (d) supplied from a service pipe from the water supplier's mains or from a pump drawing water from a cistern which is also a watertight closed vessel similarly equipped and supplied as above;
- (e) when of capacity greater than 1000 L, so constructed that the interior can be readily inspected and cleaned, and the inlet control valve adjusted and maintained without having to remove the cover or the whole of any cover which is in two or more parts;
- (f) fitted with a cover arranged to accommodate any vent or expansion pipes in closely-fitting, purpose-made holes or sleeves.

5.3.1.2 The material of a cistern shall be corrosion resisting or shall be coated internally with corrosion resisting material. The cistern shall be designed to have sufficient strength to perform its function without undue deformation. The lid or cover shall be made of materials compatible with those of the cistern.

5.3.1.3 The cistern shall be supported on a firm level base capable of withstanding the weight of the cistern when filled with water to the rim. Every plastics cistern shall be supported on a flat rigid platform fully supporting the bottom of the cistern over the whole of its area.

NOTE. See 13.4 for detailed requirements and guidance on connections to cisterns.

5.3.1.4 Access shall be provided to cisterns as described in 11.6.

5.3.1.5 No cistern shall be buried or sunk in the ground unless special measures are taken to detect leakage and protect the cistern from ingress of contaminants. Unless used only for non-potable water, every cistern shall be located so that ingress of surface water or ground water cannot occur. Space shall be provided under and around the cistern for maintenance and the outlet of any overflow pipe shall be above outside ground or flood level.

Where the ground water table dictates, buried cisterns shall be anchored to prevent them lifting when empty or partially filled.

5.3.1.6 Except for interconnected cisterns arranged to store water at the same level, every pipe supplying water to a cistern shall be fitted with a float-operated valve or some other equally effective device to control the inflow of water and maintain it at the required level. The inlet control device shall be suitable for the particular application, bearing in mind the supply pressure and the temperature of the water in the cistern. When a float-operated valve is used it shall either:

- (a) comply with BS 1212 : Part 2 or 3 and be used with a float complying with BS 1968 or BS 2456 of the correct size corresponding to the length of the lever arm and the water supply pressure; or
- (b) where any other float-operated valve or other level control device is used, it shall comply with the performance requirements of BS 1212 where applicable to the circumstances of its use and shall be clearly marked with the water pressure, temperature and other characteristics for which it is intended to be used (see also 9.3).

Every float-operated valve shall be securely fixed to the cistern it supplies and where necessary braced to prevent the thrust of the float causing the valve to move and so affect the water level at which it shuts off. This water level shall be at least 25 mm below the lowest point of the warning pipe connection or, if no warning pipe is fitted, at least 50 mm below the lowest point of the lowest overflow pipe connection.

5.3.1.7 All distributing pipes from cisterns shall be connected so that the lowest point of the outlet is not less than 30 mm above the bottom of the cistern.

COMMENTARY AND RECOMMENDATIONS ON 5.3.1.7.

This is to impede the passage of sediment into the pipework.

5.3.1.8 Connections to distributing pipes feeding hot water apparatus shall be set at a level at least 25 mm above connections to pipes feeding cold water outlets.

COMMENTARY AND RECOMMENDATIONS ON 5.3.1.8.
This will minimize the risk of scalding should the water supply fail.

5.3.2 Large cisterns. When the volume of water to be stored is large, the cistern shall comply with 5.3.1 and the following requirements.

Sometimes, particularly in the case of a complex of buildings, because of the larger volume of storage required or to provide the necessary head, it may be necessary to support the cistern in an independent structure outside the building(s). Although such a storage facility is often referred to as a tank or water tower, it is, by definition, a cistern and shall be treated as such.

If a washout pipe is provided, it shall not be connected to a drain but may be arranged to discharge into open air at least 150 mm above a drain if required.

COMMENTARY AND RECOMMENDATIONS ON 5.3.2.

Large cisterns generally provide over 5000 L storage and should be made up of pre-formed panels or constructed of concrete; they should be divided into two or more compartments to avoid interruption of the water supply when carrying out repairs or maintenance to the cistern.

The heights of connections to distributing pipes above the bottom of the cistern should be related to the size of such pipes and generally they should be not less than 80 mm to 100 mm above the bottom of the cistern. Such outlets should be provided with a suitable strainer of corrosion resistant material.

A washout pipe should be provided flush with the bottom of the cistern at its lowest point. The floor of the cistern should be laid to a slight fall to the washout pipe for cleaning purposes. The washout pipe outlet should be controlled by a suitable fullway valve and blanked off with a plug or flange when not in use.

Cisterns mounted outside buildings, whether fixed to the building itself or supported on an independent structure, should be enclosed in a well ventilated, but draughtproof, housing constructed to prevent ingress of birds, animals, and insects, but providing access to the interior of the cistern by authorized persons only for maintenance. Ventilation openings should be screened by a corrosion-resistant mesh of a maximum aperture size 0.65 mm.

5.3.3 Cistern capacity. In designing the storage cistern capacity account shall be taken of the pattern of water use in the premises concerned and, where possible to assess, the likely frequency and duration of breakdown in supply from the water supplier's mains.

COMMENTARY AND RECOMMENDATIONS ON 5.3.3.

For example, a water supplier may be providing water within its statutory requirements but, nevertheless, the pressure may be so low over such periods of the day as to warrant increased storage capacity to ensure that there is an adequate reserve for all purposes in the building.

Table 1 gives recommendations for storage capacities related to various types of use but these are to be regarded as a guide only. The water supplier should be consulted regarding any particular requirements it may have in this matter.

In small houses it is usual for storage cisterns supplying only 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 larger houses a total storage capacity of 100 L per bedroom is recommended.

In a hospital it is important to ensure that storage is adequate to meet the particular demands of the facilities provided. For example, a convalescent home may not require the same amount of water as a fully equipped teaching hospital. It is usual to calculate storage capacity on the basis of so much per bed space. The same philosophy should be applied to setting storage requirements in various types of hotels.

Table 1. Recommended minimum storage of cold water for domestic purposes (hot and cold outlets)

Type of building or occupation	Minimum storage
	L
Hostel	90 per bed space
Hotel	200 per bed space
Office premises:	
with canteen facilities	45 per employee
without canteen facilities	40 per employee
Restaurant	7 per meal
Day school: nursery	15 per pupil
primary	
secondary	
technical	20 per pupil
Boarding school	90 per pupil
Children's home or residential nursery	135 per bed space
Nurse's home	120 per bed space
Nursing or convalescent home	135 per bed space

5.4 Pipework

5.4.1 Supply and distributing pipes. Where cold water pipes pass through areas of relatively high dew point, e.g. habitable rooms, they shall be insulated to prevent condensation forming on them.

No pipe other than a flush pipe fed by flushing cistern or trough or a warning pipe which discharges into the air at least 150 mm above the top edge of a water closet pan, shall be installed so that it can deliver water to any WC pan or urinal.

COMMENTARY AND RECOMMENDATIONS ON 5.4.1.

Pipe runs within buildings should not be laid exactly horizontal but to a slight fall to reduce the risk of air locks forming. For a similar reason, pipes should be laid clear of obstructions such as joists and doorways to avoid local undulations.

5.4.2 Warning and overflow pipes. Every cistern of capacity (if filled to the level at which water just starts to flow through any overflow pipe) up to 1000 L shall be fitted with a warning pipe, and no other overflow pipe. Cisterns of capacity exceeding 1000 L shall be fitted with one or more overflow pipes. For capacities up to 5000 L the lowest overflow pipe shall be a warning pipe. For capacities over 5000 L but not greater than 10 000 L, either the lowest overflow pipe shall be a warning pipe, or a device shall be fitted that indicates when the water in the cistern reaches a level that is at least 50 mm below the lowest point of the lowest overflow pipe connection. For capacities greater than 10 000 L, either the lowest overflow pipe shall be a warning pipe or a device shall be fitted that gives an audible or visual alarm when the water reaches the level overflowing and which acts independently of the normal service inlet control valve.

Overflow and warning pipes shall be made of rigid, corrosion resistant material; no flexible hose shall be connected to or form part of any overflow or warning pipe. When a single overflow pipe is fitted its bore shall be greater than that of the inlet pipe to the cistern and in no case shall any warning pipe be less than 19 mm internal diameter.

No warning or overflow pipe shall rise in level outside the cistern.

Every warning pipe shall discharge water immediately the water in the cistern reaches the overflowing level and shall discharge in a conspicuous position, preferably outside the building where this is appropriate.

It is permissible for the warning pipes from a number of flushing cisterns installed with the same overflowing level to be combined into one outlet suitably labelled and at a level that can be seen readily. The label at the outlet point shall enable the defective apparatus to be located quickly. Each warning pipe shall discharge into a funnel or tundish which renders the discharge visible above the rim of the tundish. Warning pipes shall not discharge into WC pans via the flush pipe.

COMMENTARY AND RECOMMENDATIONS ON 5.4.2.

Ideally the overflow pipe or pipes should be able to carry away all water which is discharged into the cistern in the event of the inlet control device becoming defective, without the water level reaching the spill-over level of the cistern or submerging the discharge orifice of the inlet pipe or valve.

Where overflow and warning pipes discharge through the external wall of a building they should be arranged so as to prevent the inward flow of cold air by turning down the warning pipe into the cistern and below the water line except where this could interfere with the operation of the flushing mechanism or float-operated valve in a WC flushing cistern (see 10.3.4).

5.5 Stopvalves

5.5.1 Stopvalves fitted to service pipes below ground shall comply with BS 2580 or BS 5433 when the pipe is less than 50 mm nominal size, with BS 2580, BS 5163 or BS 5433 when the pipe is 50 mm nominal size, and with BS 5163 when the pipe is greater than 50 mm nominal size. Stopvalves fitted to service pipes above ground shall either comply with the appropriate requirements for stopvalves fitted to service pipes below ground or, when the pipe is not larger than 50 mm nominal size, with BS 1010 : Part 2 (see table 2).

Table 2. British Standards for stopvalves		
Nominal size of pipe	British Standard	
	Above ground	Below ground
50 mm or smaller	BS 1010 : Part 2 BS 2580 BS 5433	BS 2580 BS 5433
50 mm or larger	BS 5163	BS 5163

The stopvalve components of fittings incorporating stopvalves shall comply with the requirements for stopvalves.

When a stopvalve is installed on an underground pipe it shall be enclosed in a pipe guard under a surface box.

5.5.2 In every building or part of a building to which a separately chargeable supply of water is provided and in all premises occupied as a dwelling, whether or not separately charged for a supply of water, a stopvalve shall be provided that controls the whole of the supply to the premises concerned without shutting off the supply to any other premises. This stopvalve shall, so far as is practicable, be installed within the building or premises concerned in an accessible position above floor level and close to the point of entry of the pipe supplying water to that premises, whether this be a supply pipe or a distributing pipe.

In addition, where a common supply or distributing pipe provides water to two or more premises, it shall be fitted with a stopvalve that controls the water supply to all of the premises supplied by that pipe. This stopvalve shall be installed either inside or outside the building in a position to which every occupier of premises supplied has access.

A stopvalve shall be installed in every pipe supplying water to any structure erected within the curtilage of a building but having no access from the main building. This stopvalve shall be located in the main building as near as practicable to the exit point of the supply pipe to the other structure or if this is not practicable in the other structure itself as near as possible to the entry point of the supply.

COMMENTARY AND RECOMMENDATIONS ON 5.5.2.

In addition to the above requirements, it is often advantageous where a building is divided into separately occupied parts, for the supply to each part to be capable of being shut off by a second stopvalve installed outside that part without shutting off the supply to other parts of the building. The principle on which these requirements and recommendations are based is to provide a ready means of isolating any private or common supply causing damage or nuisance or for the purpose of effecting repairs, replacements or alterations. Any occupier should be able to drain down his supply to avoid frost damage and to shut off his own supply or a supply in unoccupied premises which is causing damage or nuisance by means of a stop-valve under his control or to which he has ready access.

5.6 Servicing valves

5.6.1 Servicing valves shall be provided and located in accessible positions so as to enable the flow of water to individual or groups of appliances to be controlled and to limit the inconvenience caused by interruption of supply during repairs.

COMMENTARY AND RECOMMENDATIONS ON 5.6.1.

This is of particular importance in large buildings.

5.6.2 A servicing valve shall either comply with the requirements for stopvalves specified in 5.5.1 or shall be capable of withstanding a static pressure 1.5 times the maximum pressure it will be subjected to in use, be leak-tight when closed against the latter pressure and, when installed on any pipe pressurized from the mains or on any pipe under a static pressure exceeding 1 bar, shall be operable only by means of a key, screwdriver or coin inserted into a slot on the valve. Screwdown servicing valves shall not be of loose jumper design.

5.6.3 Pipes connecting feed cisterns to primary circuits shall not be fitted with servicing valves where the capacity of the cistern does not exceed 18 L.

A servicing valve shall be fitted upstream of, and as close as practicable to, every float-operated valve connected to a supply pipe.

Every pipe taking water from a cistern of capacity exceeding 18 L shall be fitted with a servicing valve near the cistern, and every pipe taking water from a hot water storage cylinder, tank or cistern shall be fitted with a servicing valve close to the storage cistern, tank or cylinder.

COMMENTARY AND RECOMMENDATIONS ON 5.6.3.

Having regard to the hydraulic resistance of screwdown type valves, it is permissible for copper alloy gatevalves complying with BS 5154 to be used for this purpose. Specially designed spherical plug valves are available in the smaller sizes and are well suited for fitting near to single outlet fittings and appliances as servicing valves.

5.7 Draining taps (see 10.6)

Draining taps shall be of screwdown type with a removable key and shall be fixed over a drain or have provision for

discharging the water to the nearest convenient point for disposal. Draining taps shall comply with BS 2879.

COMMENTARY AND RECOMMENDATIONS ON 5.7.

Combined stopvalves and draining taps are a convenient way of providing facilities for draining down.

5.8 Revenue meter installations

5.8.1 General. Where the consumer is required, or permitted, to carry out the installation of the meter, the water supplier shall be consulted with regard to any requirements concerning the installation additional to those specified in 5.8.2 to 5.8.5 before work is begun.

COMMENTARY AND RECOMMENDATIONS ON 5.8.1.

It is usual for the installation of the meter on the incoming supply to a premises for revenue charging purposes to be supplied by the water supplier and sited by agreement between the consumer and the water supplier.

The meter installation requirements given in 5.8.2 to 5.8.5 are in accordance with BS 5728 : Part 2.

Wherever possible meters should be installed at or near the street boundary of the premises supplied, which is the limit of the responsibility of the water supplier for maintenance of the communication pipe. Where a meter is to be installed near the boundary of a premises, the distance to the public highway should not exceed 10 m. However, in the case of flats and industrial premises or shops in multiple occupation, as well as existing premises opting for a meter for the first time, an internal installation may be necessary and is acceptable provided it registers the whole supply.

The meter should be protected from the risk of damage by shock or vibration induced by the surroundings at the place of installation.

5.8.2 Meters. The meter shall comply with BS 5728 : Part 1, with suitable connectors to facilitate future meter changes without the use of heat or major disturbance of the pipework. The connections for nominal size G $\frac{3}{4}$ B meters shall terminate in either:

- (a) plain 15 mm (outside diameter) pipework; or
- (b) G $\frac{3}{4}$ B male thread; or
- (c) a United Kingdom Water Fittings Byelaws Scheme listed mechanical joint, e.g. 15 mm compression fitting.

Connectors shall be straight or elbow. To aid meter removal straight connections shall have flat seats and be complete with 1.5 mm (approximately) thick washers to allow for the tolerance in meter lengths. These connections shall be installed without modification.

For dwellings the revenue meter shall comply with the requirements for precision class C of BS 5728 : Part 1 and for the majority of cases have a nominal flow rate* of 1.5 m³/h (nominal size G $\frac{3}{4}$ B).

NOTE. In a few premises a nominal size G1 B meter (nominal flow rate 2.5 m³/h) may be required by the water supplier.

For G $\frac{3}{4}$ B meters the body length shall be 134 mm; for G1 B meters any of the alternative lengths specified in BS 5728 : Part 1 shall be used.

* The nominal flow rate is one-half the maximum permissible flow rate.

5.8.3 Bonding. No water pipe shall be used as an electrode for earthing purposes, but all metal water pipes shall be bonded to the electrical installation main earth terminal as near as possible to the point of entry into the building.

A suitable conductor shall be installed for bonding between inlet and outlet pipework connections to water meters, water authority stopvalves or other water conveying components in a metal water supply pipe to ensure equipotential bonding applies to any pipework temporarily disconnected for the purpose of removing such components for replacement or maintenance.

For dwellings a bond of at least 6 mm² cross section shall be connected prior to attaching the pipework and remain in place following installation.

COMMENTARY AND RECOMMENDATIONS ON 5.8.3.

These arrangements are necessary on both internal and external installations for protection of the installer against electrical fault and for maintenance of the earth connection.

5.8.4 External installations

5.8.4.1 In external meter installations the meter shall be installed below ground in a horizontal position with the dial uppermost accessible for meter reading and changing. The chamber shall be well constructed of brick, concrete, glass reinforced plastics or PVC with a cover marked 'water meter', of sufficient strength to carry the loads to which it may be subjected and fitted with slots or lifting eyes. Steel framed, concrete filled covers are not recommended on account of their weight and their liability to flex causing the concrete to crack and the cover to jam. Pipes, cables or drains other than the meter pipework shall not pass through the meter chamber.

5.8.4.2 Meters shall be raised within the chamber so that the connections are a nominal 300 mm below the surface of the cover, as shown in figure 1, or, if the water supplier agrees, proprietary meter yokes (see figure 2) incorporating integral valves and which raise the meter to the recommended level shall be used.

5.8.4.3 The meter chamber shall be sized so that there is an unrestricted space of 150 mm to one side of the meter and a minimum of 30 mm without obstruction between any part of the meter/valve assembly and the sides of the chamber.

Space shall be left for the extraction of bolts from the flanges for ready dismantling of joints and no part of the meter assembly shall be built into the walls of the chamber or concreted into the chamber.

COMMENTARY AND RECOMMENDATIONS ON 5.8.4.3.

Recommended internal dimensions for meter chambers are given in table 3. Generally, the chamber should be sited symmetrically about the proposed meter installation.

Table 3. Recommended internal dimensions for meter chambers				
Size of meter	Size of chamber			Remarks
	Length	Breadth	Depth	
mm	mm	mm	mm	mm
15 to 20	430	280	To suit pattern of meter but not less than 750	Or 380 circular
25	600	600		—
40 to 50	900	600		
80 *	1900	750		
100 *	2000	750		
150 *	2150	750		
* Dimensions for these sizes take account of compound assemblies but do not provide for isolating valves.				

The clear opening of the surface box should be the same as the internal dimension of the chamber, except that the dimensions may be varied to provide, in the opinion of the water supplier, no less suitable access if this should be warranted by the circumstances in which the pit is located.

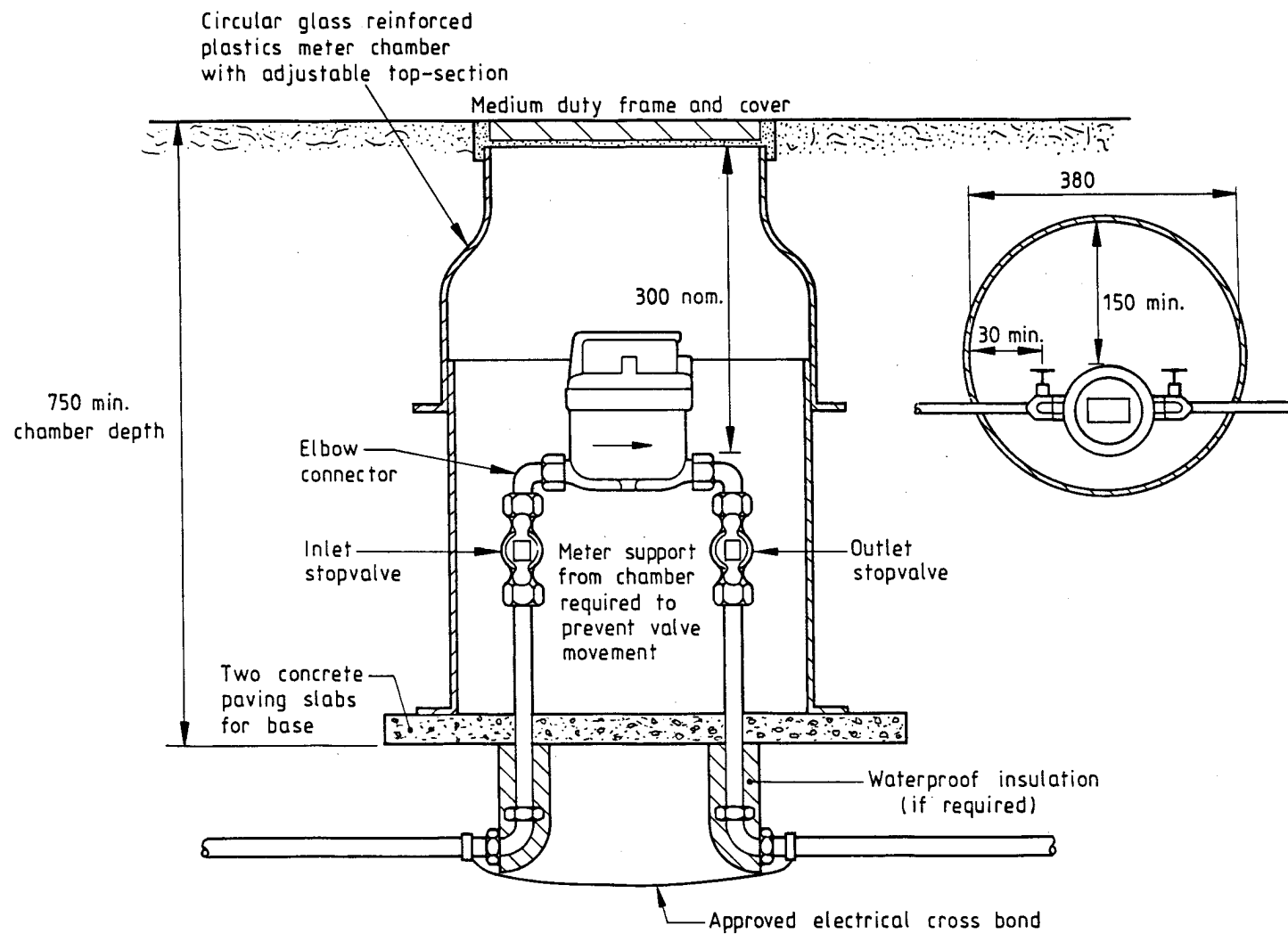
For meters over 80 mm the chamber size provides for a combination meter if required for the flow range. In a combination meter the meters for low and high flows are arranged in parallel with an automatic changeover valve that directs flow to the appropriate meter at the correct point in the range.

5.8.4.4 The pipe on both sides of the meter assembly shall have a clearance space around it through the wall of the chamber to facilitate exchange of the meter. Where the chamber needs to be watertight the clearance shall be fitted with a sealing material approved by the water supplier and sufficient length of pipe left inside the pit to facilitate meter exchange.

COMMENTARY AND RECOMMENDATIONS ON 5.8.4.4.

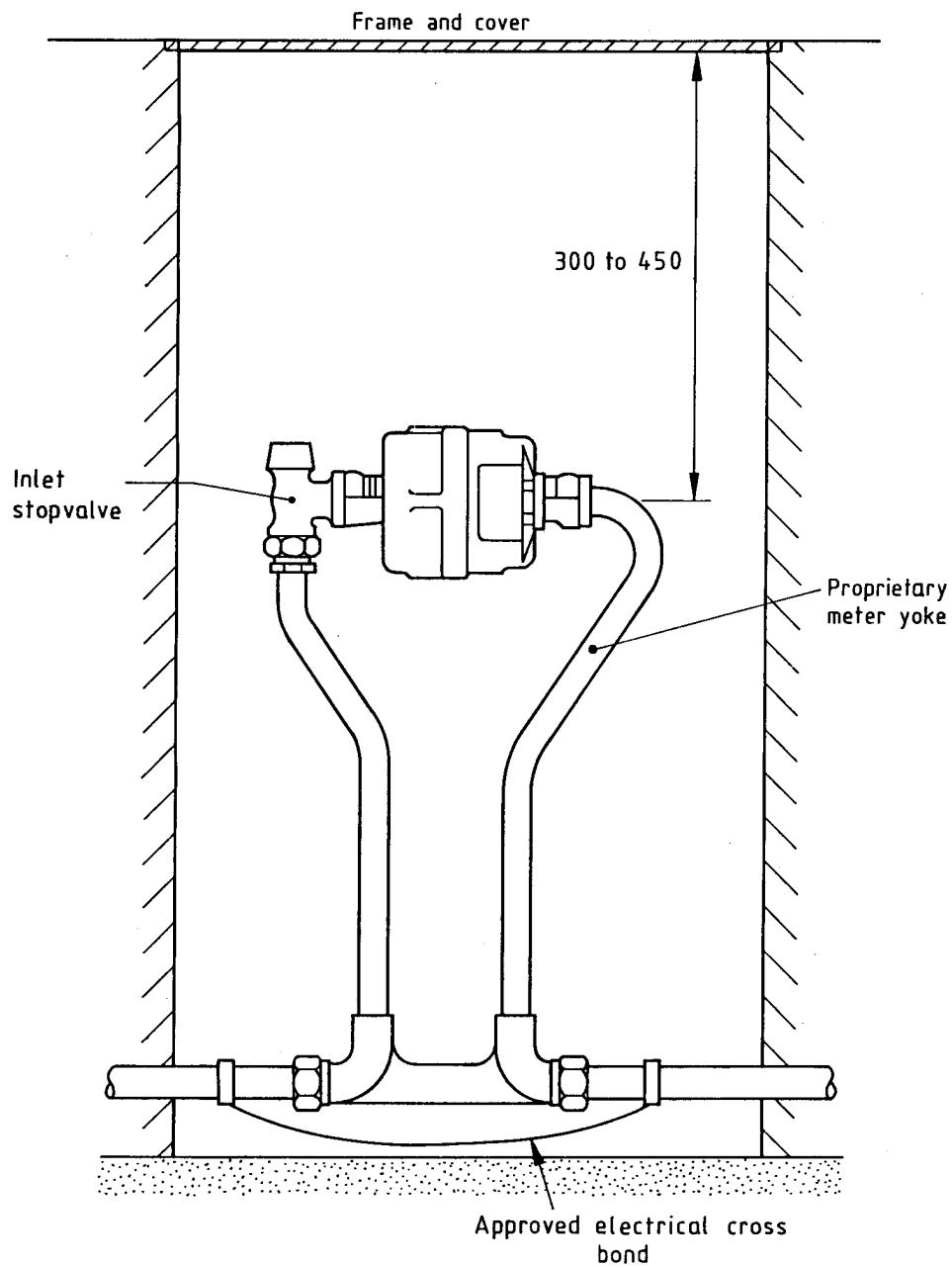
Where a meter chamber cannot be made watertight and drainage can be provided by a drainage sump, this should be provided.

5.8.4.5 Pipework on both sides of the meter assembly, particularly where bends are nearby, shall be firmly fixed to prevent movement of any flexible joints within the meter assembly. Nevertheless, such anchorage shall leave sufficient room for connecting and disconnecting the meter making use of the adaptors provided. The meter shall also be supported on the underside so as not to create differential loads between the meter and its connecting pipework.



All dimensions are in millimetres.

Figure 1. Connections for meters outdoors



NOTE. Outlet stop valve may be required

All dimensions are in millimetres.

Figure 2. Proprietary meter yokes for meters outdoors

5.8.4.6 An isolating valve shall be installed adjacent to the meter on both sides, although where the meter is within a reasonable distance of a statutory stopvalve, this can be used as one of the isolating valves.

5.8.4.7 Any stopvalve in a meter chamber shall comply with BS 1010, BS 2580 or BS 5433, or BS 5163 if 50 mm nominal size or above.

5.8.5 Internal meters

5.8.5.1 Internal meters shall be fixed horizontally or vertically and with the dial not more than 1.5 m above floor level and readily visible for reading. The type of meter that will function accurately in the position selected, i.e. horizontal or vertical, shall be installed.

Where the existing pipework is or can be re-positioned so as to be parallel to the wall and is not less than 50 mm away from it, installations shall be as indicated in figure 3 or 4 provided that all fittings used are United Kingdom Water Fittings Byelaws Scheme listed.

If, however, the meter will be located inside a small cupboard, such as a kitchen unit, the meter shall be brought forward to within 300 mm of the front of the cupboard as shown in figure 4 or 5 provided that all fittings used are United Kingdom Water Fittings Byelaws Scheme listed.

COMMENTARY AND RECOMMENDATIONS ON 5.8.5.1.

Where a consumer wishes to limit access to the meter for reading purposes, a remote readout device can be installed if the water supplier agrees.

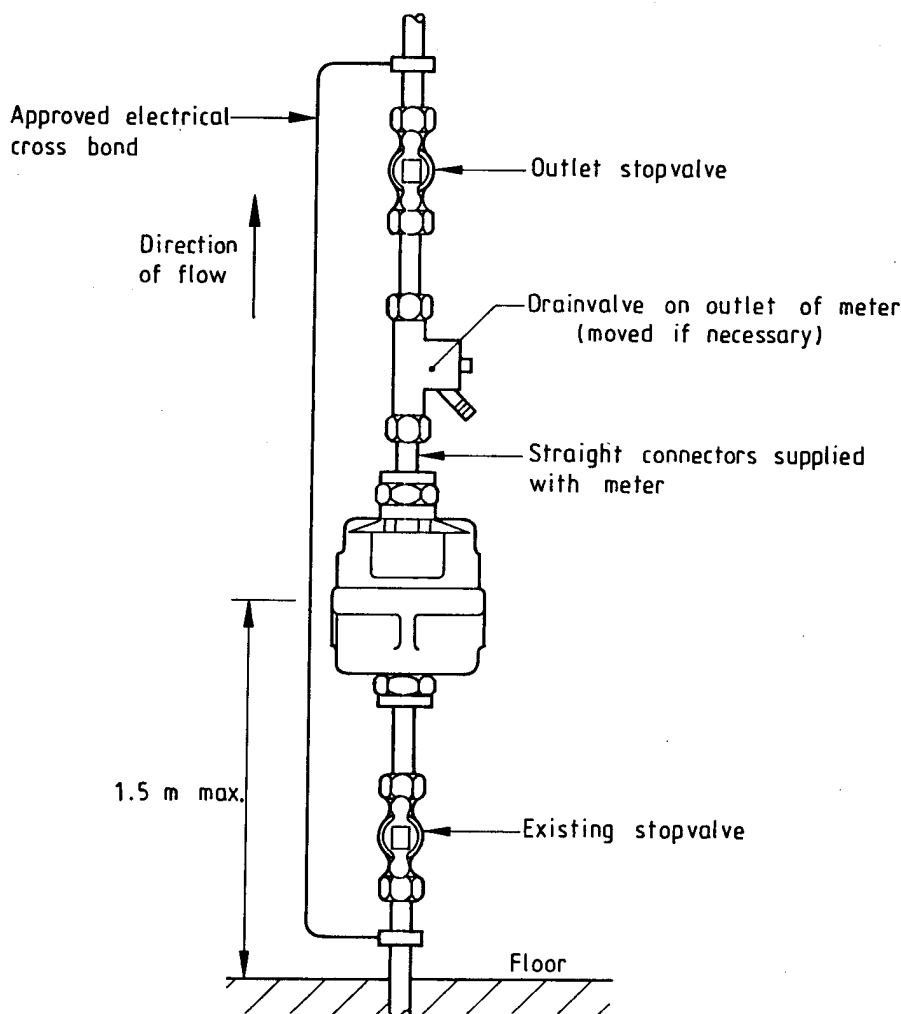


Figure 3. Meter installation indoors

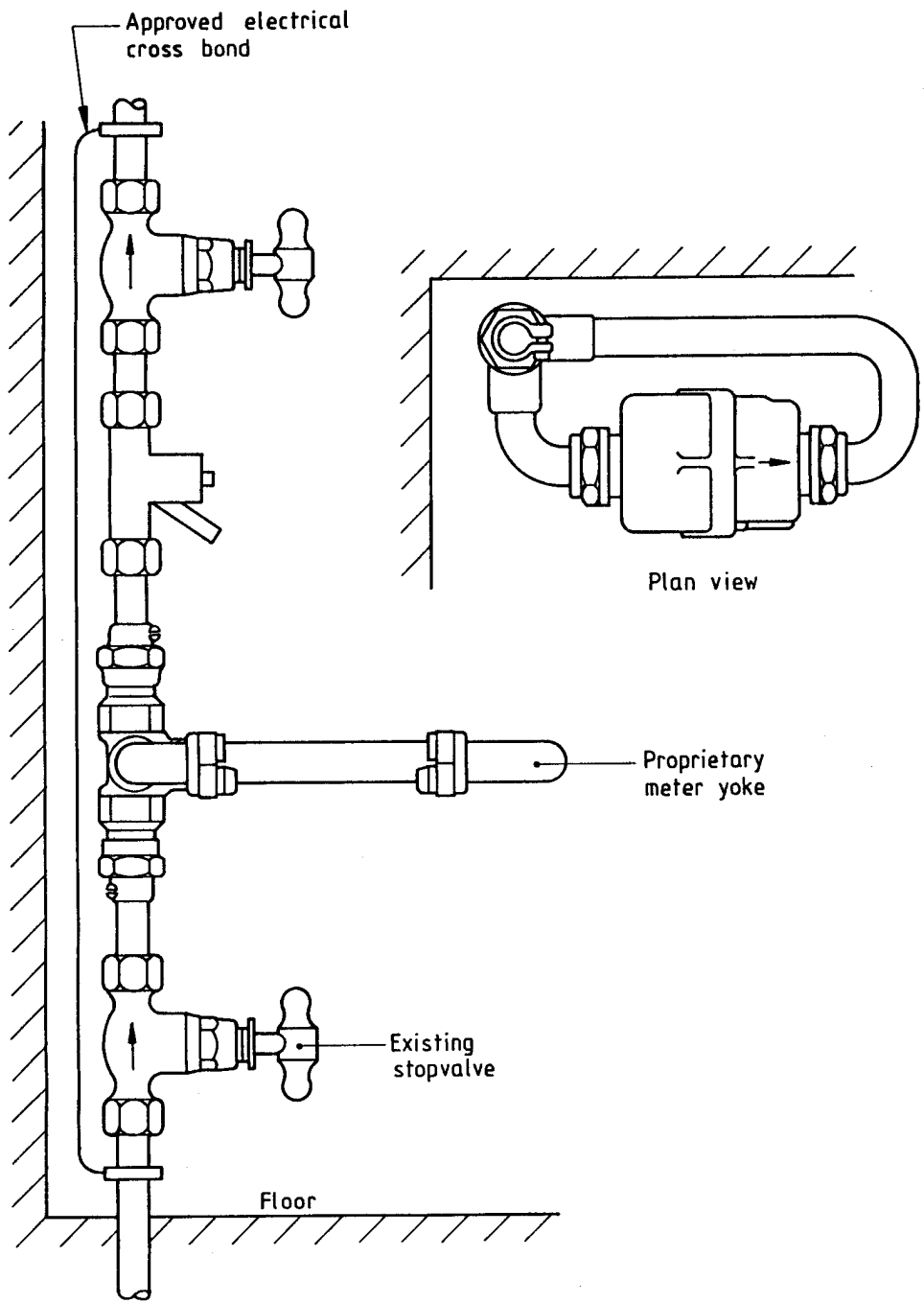
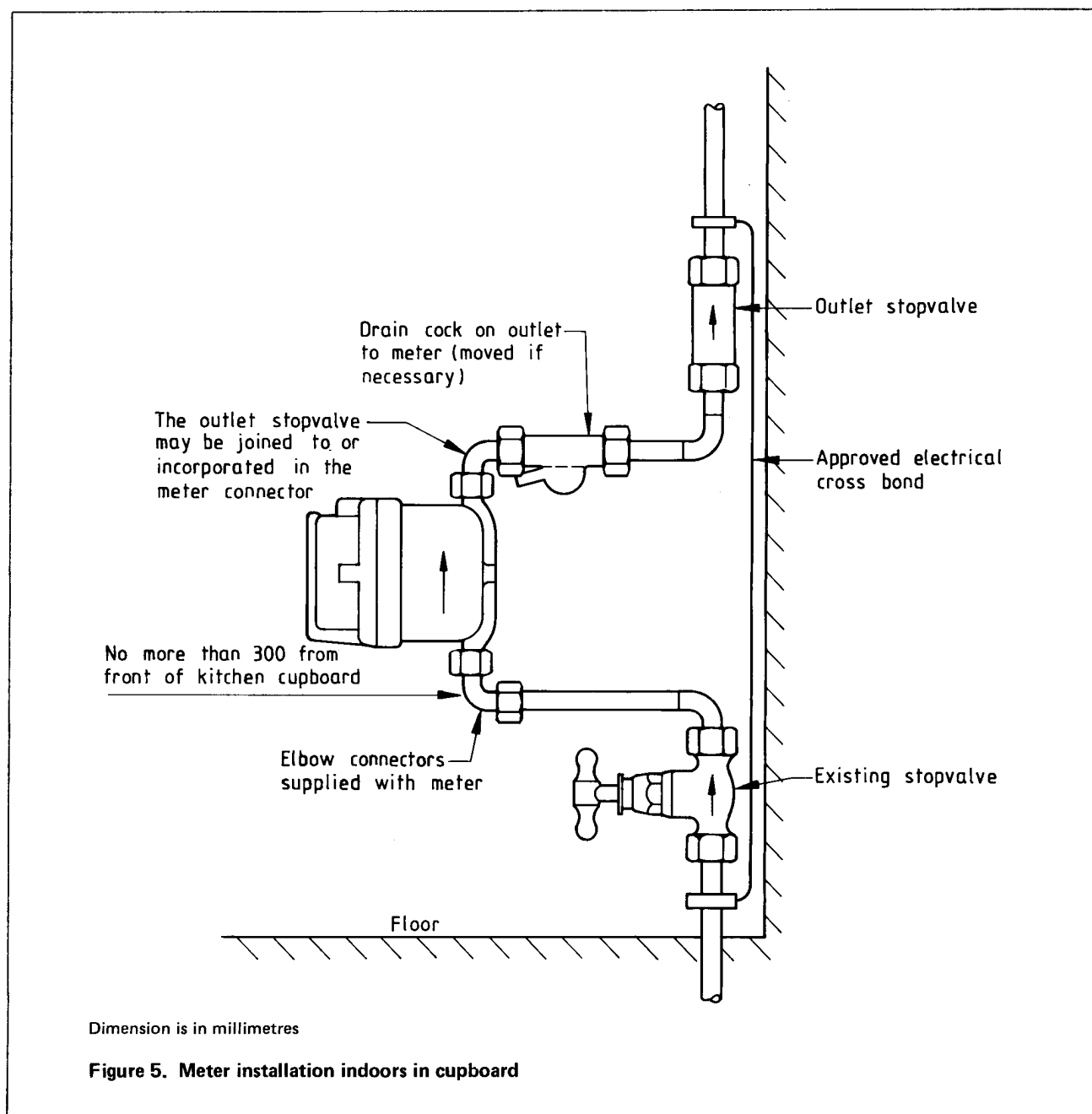


Figure 4. Meter installation indoors using a proprietary meter yoke



5.8.5.2 Pipework shall be adequately supported but leaving sufficient room for changing the meter with the connections provided.

5.8.5.3 The meter shall be installed downstream of the existing internal stopvalve and as close to it as possible. Where a drain valve is required in accordance with the byelaws, it shall be installed immediately downstream of the meter.

COMMENTARY AND RECOMMENDATIONS ON 5.8.5.3.

This may require an existing drain valve to be moved and/or existing combined stop and drain valve to be replaced. The length of pipe between the stopvalve and the meter cannot

easily be drained and will thus require effective protection against damage from frost in accordance with clause 10.

5.8.5.4 A second stopvalve or servicing valve shall be installed downstream of the meter.

COMMENTARY AND RECOMMENDATIONS ON 5.8.5.4.

Whilst in general this valve will be fitted downstream of the drain valve, this does not preclude the use of a meter connector which incorporates a servicing valve.

The risk of freezing causing the pipework to fracture is reduced, if, after draining the pipework, the downstream servicing valve is not closed. It may therefore be advantageous to specify downstream servicing valves which require a removable tool for their operation.

5.8.5.5 Where the installation of meters in exposed points, e.g. garages subject to frost, is unavoidable and agreed by the water supplier, adequate insulation to 10.4 shall be provided but not so as seriously to impede reading and changing the meter.

5.9 COMMENTARY AND RECOMMENDATIONS ON NON-REVENUE METER INSTALLATIONS. *The installation of non-revenue meters should comply with 5.8 with the exception that the water supplier need not normally be consulted.*

5.10 COMMENTARY AND RECOMMENDATIONS ON WATER SOFTENERS. *Correct location of the water softener is important and this should have regard to water draw-off points that do not need to or should not be softened. The drain discharge points should be as close to the equipment as practicable in order to reduce back pressure. Particular care should be taken to protect against freezing of any part of the installation.*

Provision should be made in the pipework to allow easy bypass of the water softener in the event of malfunction or maintenance (see figure 6 for a typical installation).

6 Hot water services

6.1 General principles

The hot water service shall be designed to provide, so far as is practicable, hot water at the locations, in the quantities and at the temperatures required by the user at the least overall cost, taking account of installation, maintenance and fuel costs and the requirements, commentary and recommendations given in 6.2 to 6.10, and 9.5.

COMMENTARY AND RECOMMENDATIONS ON 6.1.

Because hot water supply systems are often combined with hot water central heating systems, some aspects of central heating installations are referred to, but neither central heating nor boiler installations above 45 kW output are covered. Information on central heating installations is given in BS 5449 : Part 1. The clauses on water heaters and systems should be read in conjunction with the clauses on components.

6.2 Choice of system (see figure 7)

Initially a choice shall be made between water heating by one or more instantaneous heaters, a hot water storage system, and a water-jacketed tube type heater. This choice shall be made bearing in mind the objectives expressed in 6.1 and the characteristics of the different systems. Furthermore, the system shall be sized to meet the requirements of the user as closely as possible.

Where the user requirements are specified, the system shall be designed to satisfy these unless to do so would be

impracticable or uneconomic, in which case their specifier shall be informed and the specification modified by mutual agreement.

Where the user requirements are not specified, and in particular where the user is not known, as in speculative housing developments for example, an assessment of user needs shall be made on the basis of the size and type of building. Data on which this assessment is made shall include the following:

Hot water (60 °C) use 35 L to 45 L per person per day in dwellings:

Average bath: 60 L at 60 °C plus
40 L at 10 °C
or 100 L at 40 °C

Shower: 0.05 to 0.10 L/s at 40 °C

Wash basin hot tap: 0.15 L/s at 40 °C to 60 °C

Kitchen sink: 0.20 L/s at 60 °C

Where a dwelling has only one bathroom it shall be assumed that immediately after filling a bath, some hot water will be required for kitchen use, but a second bath will not be required within 20 min to 30 min. Where a dwelling has two or more bathrooms it shall be assumed that all the installed baths will be filled in succession and that hot water will immediately be required for kitchen use.

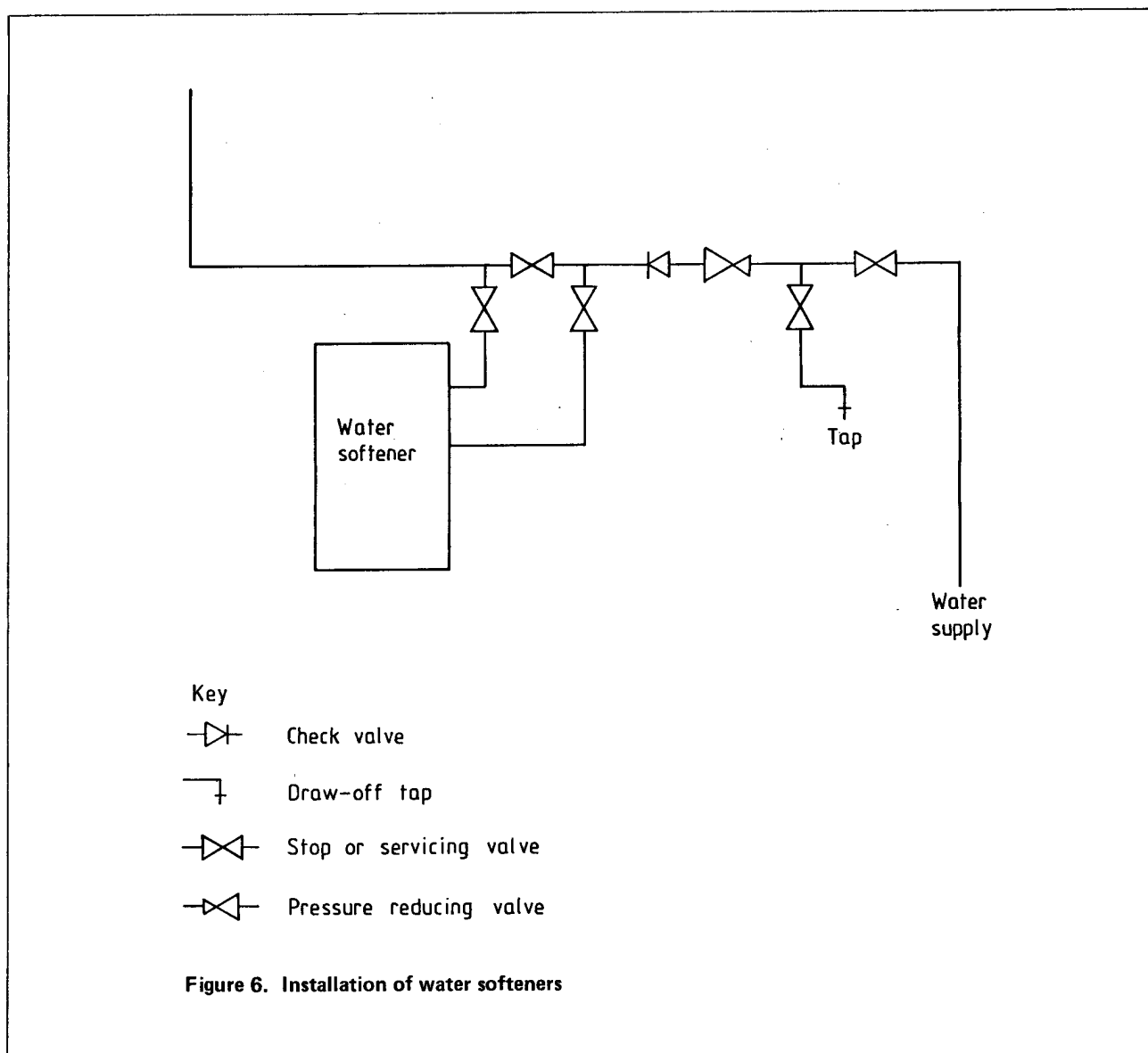
COMMENTARY AND RECOMMENDATIONS ON 6.2.

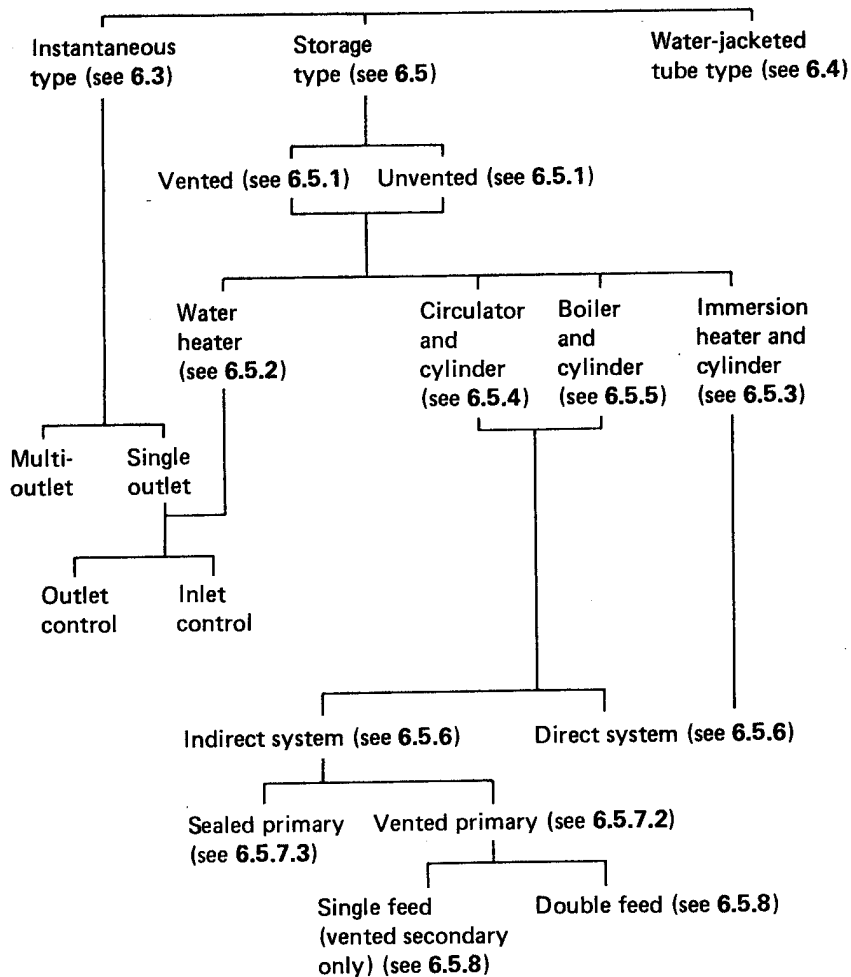
In choosing the hot water system, the main factors to be taken into account are as follows.

The rate of flow of hot water from an instantaneous heater is limited and depends upon the power rating as described in the commentary and recommendations on 6.3. With this type of heater many of the design flow rates given in this clause and in table 4 are not achievable. On the other hand, where these restricted rates of delivery are acceptable, instantaneous heaters can deliver hot water continuously without requiring time to reheat. Some instantaneous heaters have recommended maximum periods of continuous use in hard water areas; this is to prevent rapid scale formation.

Dependent on type and heat output of the associated heat source, water-jacketed tube heaters deliver hot water at rates comparable with the design flow rates referred to above but at a slowly reducing temperature. If they incorporate a primary heat store the rate of temperature recovery depends upon the internal arrangements of the heater as well as on its power rating. Manufacturers' technical data should be consulted on this subject.

Storage-type water heaters can deliver hot water at rates that comply with all the design flow rates given in this clause and in table 4, until the stored hot water has all been used. Information on suitable storage capacities for various rates of heat input is given in appendix D.





NOTE. Not all combinations are relevant.

Figure 7. Choice of hot water system

6.3 Gas and electric instantaneous water heaters

Gas-fired instantaneous water heaters installed in bathrooms shall be of the room-sealed type.

COMMENTARY AND RECOMMENDATIONS ON 6.3.

When a gas-fired instantaneous water heater is used in rooms other than bathrooms, the room-sealed type should be selected whenever possible. Instantaneous water heaters have relatively high power ratings and the need to provide an adequate electricity or gas supply should be taken into account. The rate of flow of hot water, the temperature rise from feed to delivery, the power consumption and the efficiency of the appliance are related by the formula:

$$FT = 14.3EP$$

where

F is the flow rate (in L/min);

T is the temperature rise (in °C);

E is the efficiency (= ratio of heat output to heat input);

P is the input power rating (in kW).

If the appliance efficiency is not known, a value of 0.75 may be assumed for gas-fired instantaneous water heaters and 0.90 for electric instantaneous water heaters, this will give a conservative estimate of the flow available for a given temperature rise. Single outlet instantaneous water heaters may be inlet controlled or outlet controlled. Multi-outlet heaters are outlet controlled only and are most satisfactory when only one outlet is used at any one time. For economy in use of fuel and water the heater should be located as close as possible to the hot water outlet in most frequent use, usually the kitchen tap. When close control of temperature is required, for example a shower, thermostatic control and/or the use of a heater fitted with a water governor is recommended. Alternatively, the heater should be fed from a storage cistern through its own separate feed pipe; most instantaneous shower units require a minimum supply pressure of about 1 bar or 10 m head. Multi-outlet heaters are not generally recommended for supplying showers. For information on shower installations, reference should be made to BS 6340.*

6.4 Water-jacketed tube heaters

Water-jacketed tube heater installations supplied directly from a supply pipe shall accommodate expansion of water so that there is no discharge from the system except in emergency situations.

COMMENTARY AND RECOMMENDATIONS ON 6.4.

The cold water feed may be from mains or from a storage cistern. The water drawn off for use passes through a heat exchanger in a reservoir of primary water heated by an integral or separate boiler. The size of this reservoir, which in some designs can include the space-heating circuit, the rate of heat input to it and the heat exchanger characteristics determine the amount and rate of flow of hot water that can be provided without unacceptable temperature drop. The primary circuit may be vented or sealed.

The performance characteristics of individual appliances should be ascertained from the manufacturers.

* 1 bar = 10^5 N/m² = 10^5 Pa.

6.5 Storage-type hot water systems

6.5.1 Choice of vented or unvented system. The choice between the vented and the unvented type of installation shall be made in conjunction with the choice of method of cold water supply (see 5.2), taking account of the desirability of supplying mixing fittings with balanced hot and cold water pressures. Consideration shall also be given to the system features listed in the commentary and recommendations in this clause. Whichever system is installed, it shall comply with the relevant requirements of clause 7.

COMMENTARY AND RECOMMENDATIONS ON 6.5.1.

A summary of the main differences between vented and unvented systems is as follows.

(a) *Vented systems. Vented domestic hot water service systems are fed with cold water from a storage cistern which is situated above the highest outlet to provide the necessary pressure in the system and which accommodates expansion of the water when it is heated. An open vent pipe runs from the top of the hot water storage vessel to a point above the cold water storage cistern, into which it is arranged to discharge. The main characteristics of vented systems are as follows.*

(1) *Explosion protection is provided by the open vent pipe and the cistern, involving no mechanical devices.*

(2) *The storage cistern provides a constant low pressure and a reserve of water in case of supply failure, but needs to be protected against the ingress of contaminants.*

(b) *Unvented systems. Unvented systems can be fed from a storage cistern, either directly or through a booster pump, but usually are fed from the supply pipe, either directly or, more commonly, via a pressure reducing valve. The main characteristics of unvented systems are as follows.*

(1) *Explosion protection is provided by safety devices that need periodic inspection and maintenance.*

(2) *Mains fed systems have no reserve of water but higher pressures are available if required.*

(3) *The elimination of the storage cistern reduces the risk of frost damage and removes the source of refill or float-operated valve noise.*

(4) *The safety aspects of unvented, storage-type, hot water systems are subject to the requirements of building regulations.*

6.5.2 Storage water heaters

6.5.2.1 Non-pressure or inlet controlled type. No hose or other connection shall be made to the outlet of a non-pressure or inlet-controlled storage-type water heater and under no circumstances shall the outlet be controlled by a valve or tap.

COMMENTARY AND RECOMMENDATIONS ON 6.5.2.1.

Special taps and mixer taps in which the tap mechanism controls the cold water inlet to the heater while the hot water from the heater is discharged through the tap outlet can be used when specified by the heater manufacturer as long as the tap outlet remains unobstructed.

6.5.2.2 Pressure or outlet controlled type. If mains connection is desired and is permitted by the water supplier, it shall be verified that the heater is suitable for the supply pressure, and suitable arrangements to accommodate expansion of the heated water shall be made.

COMMENTARY AND RECOMMENDATIONS ON 6.5.2.2.

Although called pressure-type water heaters, many are designed for storage cistern feed only and will not withstand mains water pressures.

For installations in small dwellings a capacity of 100 L to 150 L, either electric or gas heated, is sufficient to provide a comprehensive hot water service including a supply to a bath. Heaters designed to take advantage of off-peak electricity tariffs usually have a capacity of 200 L or more.

6.5.3 Electric immersion heater and storage vessel. It is permissible for a storage-type electric water heater installation to be made up by installing one or more thermostatically-controlled immersion heaters in a suitable storage vessel provided with adequate feed and expansion arrangements. The storage vessel shall comply with the relevant requirements of clause 9 and shall be corrosion resistant. The immersion heater or heaters shall comply with BS 3456 : Section 2.21; all electrical controls, including thermostats, cut-outs and switches, shall comply with BS 3955.

Since this appliance is site assembled, it is particularly important to ensure that it is protected against bursting in accordance with clause 7 for a direct system and that any backflow prevention devices required by clause 9 are correctly fitted. Immersion heater and controls shall be so located that insertion, removal and adjustment can readily be carried out. The storage vessel shall be thermally insulated, either by means of a jacket in accordance with BS 5615 or by any other means that complies with the performance and fire-resistance requirements for factory-applied thermal insulation given in BS 699.

COMMENTARY AND RECOMMENDATIONS ON 6.5.3.

Immersion heaters also form a convenient means of providing supplementary water heating in systems combining hot water supply and space heating (see 6.6). The insertion of an immersion heater into the storage vessel of an indirect system converts it to a direct system so far as the immersion heater is concerned and the safety controls appropriate to a direct system should therefore be fitted.

6.5.4 Gas-fired circulator and storage vessel. In hard water areas where scale deposition may obstruct pipes, an indirect cylinder shall be used with the circulator. The storage vessel and fittings shall comply with clauses 7 and 9.

6.5.5 Boiler heated hot water systems

6.5.5.1 Boiler heated hot water systems specified in this standard comprise a hot water storage vessel and an

independent heating appliance such as an independent heater, a back-boiler associated with an open fire or room heater, a boiler incorporated in a cooker, or a gas-fired circulator. Boilers fuelled by gas, oil or solid fuel, and electrically powered boilers are covered.

This standard includes direct and indirect, vented and unvented systems. Figures 8 to 11 illustrate the basic differences between direct and indirect, and between vented and unvented systems. These figures are diagrammatic and should not be taken as complete designs; for simplicity, gravity circulation is shown and temperature controls and distribution pipework omitted. Many other possible arrangements are satisfactory.

6.5.5.2 The decision whether to use a vented or an unvented system shall be taken on the basis of the factors given in 6.5.1. The decision whether to use a direct or an indirect system shall be made taking account of the considerations given in 6.5.6 bearing in mind the interaction of this decision with that between vented and unvented systems and that between sealed and vented primaries dealt with in 6.5.7.

6.5.6 Direct and indirect systems. Direct systems shall be designed for gravity circulation with flow and return pipes between boiler and storage vessel run as directly as possible and not less than 25 mm bore (19 mm bore in the case of small back-boilers). The storage vessel shall be located at a sufficient height above the boiler to give adequate circulation. In hard water areas where scale deposition may obstruct pipes an indirect system shall be used.

An indirect system shall always be used when domestic hot water and hot water central heating are supplied by one boiler. The primary circuit of an indirect system shall either be cistern fed and vented or be sealed.

Primary circuits shall not be permanently connected to a supply pipe from the mains but a temporary connection via a double check valve assembly or a combination of a check valve and vacuum breaker permanently installed in the primary circuit is permissible for filling, refilling, replenishing or flushing out the primary circuit. Any temporary connection of this kind shall be made only for such time as is necessary to carry out the task in question, and shall be removed immediately after use.

6.5.7 Domestic hot water primary circuits

6.5.7.1 General. Primary circuits shall comprise the boiler, the primary heat exchanger within the hot water storage vessel and the interconnecting and associated pipework; they shall be either vented or sealed.

COMMENTARY AND RECOMMENDATIONS ON 6.5.7.1.

Primary circuits may be designed either for gravity circulation or pumped circulation; the latter type is to be preferred.

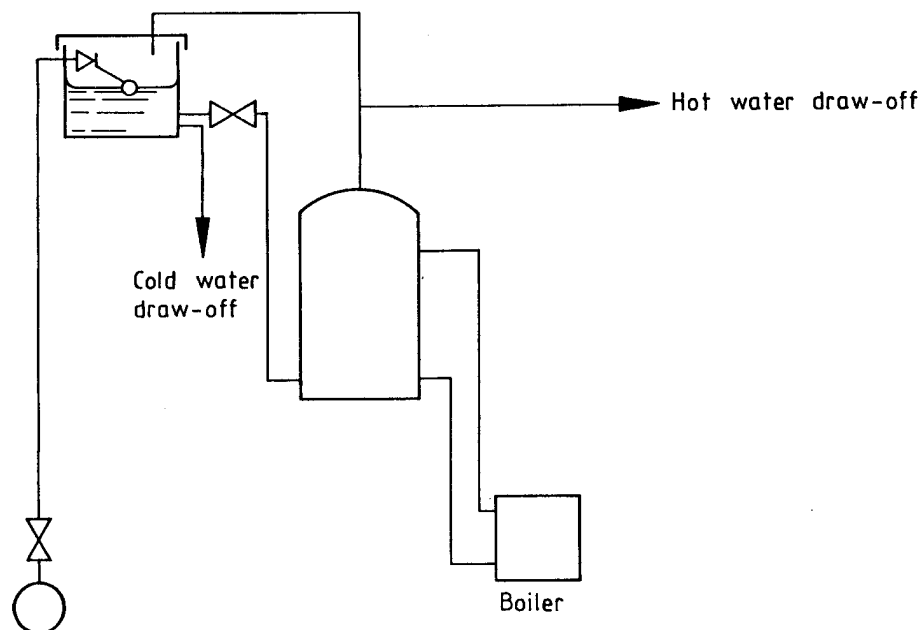


Figure 8. Direct (vented) system

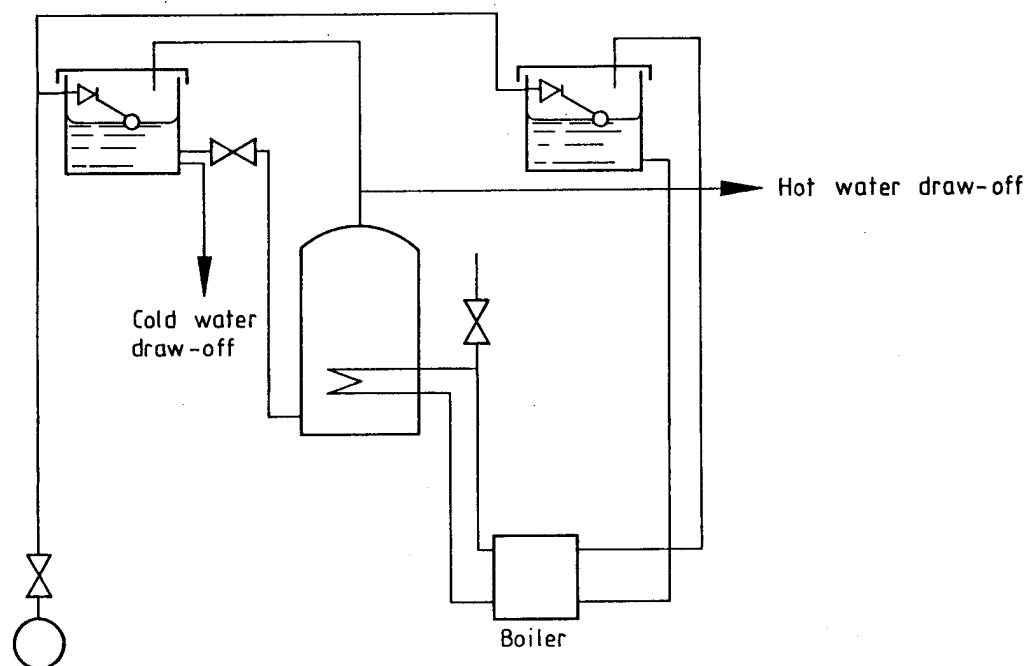


Figure 9. Indirect (vented) system

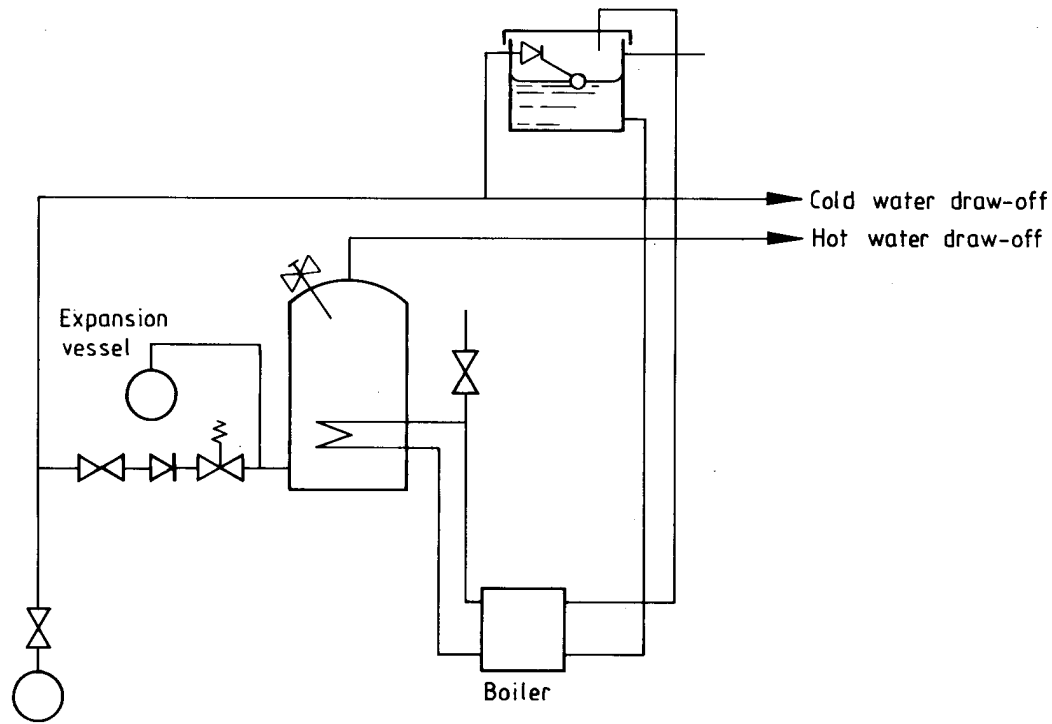


Figure 10. Indirect unvented (vented primary) system

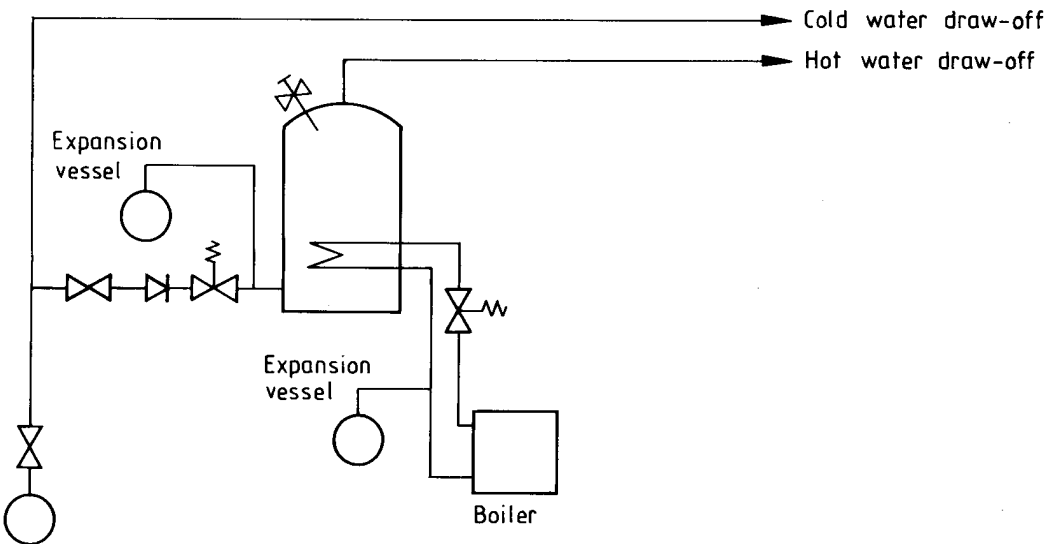


Figure 11. Indirect unvented (sealed primary) system

6.5.7.2 Vented primary circuits. Vented primary circuits shall have a vent route connecting the flow connection on the boiler to the vent pipe outlet above the expansion cistern and a feed water route from a point near the bottom of the expansion cistern to the return connection on the boiler. Except as specified in this subclause, these routes shall be independent. It is permissible for both these routes to be incorporated in parts of the primary flow and return pipework, but the vent route shall not include any valve, pump or any impediment to flow whatsoever. Where the design of the primary circuit so dictates, it is permissible to include a circulating pump and its associated isolating valves in the feed water route. Where the water content of any double feed primary circuit (see 6.5.8) is such that a 4 % expansion (see 6.11.5) can be accommodated by an expansion cistern of 18 L capacity, a cistern not exceeding this capacity shall be fitted. A servicing valve shall be fitted in the draw-off pipe from every expansion cistern of capacity exceeding 18 L in a readily accessible position as close to the cistern as possible. Except for a circulating pump and its associated isolating valves and except for a servicing valve, both fitted only in the circumstances specified in this subclause, the feed water route shall not include any valve, pump or any impediment to flow whatsoever. Where the vent route and water feed route are combined, the boiler and primary circuit shall have the protection specified in clause 7 for a sealed primary circuit and the combined route shall not include any valve, pump or any impediment to flow whatsoever.

For domestic installations the vent shall nowhere be less than 19 mm bore (see 7.2). Where the vent pipe is not connected to the highest point in the primary circuit, an air release valve shall be installed at that point. Pipes shall be laid to falls to avoid airlocks and facilitate draining. Where circulation is by gravity, the minimum size of the flow and return pipes shall be 25 mm bore (19 mm bore in the case of small back-boilers). Where circulation is pump assisted the minimum size shall be 13 mm bore.

6.5.7.3 Sealed primary circuits. Pipe sizes in sealed primary circuits shall comply with the relevant requirements for vented primary circuits specified in 6.5.7.2. In place of the expansion cistern and vent pipe, a sealed primary circuit shall be fitted with an expansion vessel of sufficient capacity to accommodate, with the pressure differentials involved, the increase in volume of the water content of the whole of the primary system, including any space heating circuits, when heated from 10 °C to 110 °C. Indirect cylinders fitted in sealed primary circuits shall have primary heaters suitable for operating at a pressure of 0.35 bar in excess of the pressure relief valve setting. The specific requirements concerning the safety of sealed primary circuits given in clauses 7 and 9 shall be complied with in every case.

6.5.8 Double feed and single feed primary circuits. The primary circuit shall either be fed independently of the secondary system or be fed from the secondary system by using a hot water cylinder incorporating a special primary heat exchanger. A single feed indirect cylinder shall only be used when both primary and secondary systems are of the vented type. Where a single feed indirect cylinder is used:

- (a) the cylinder shall comply with BS 1566 : Part 2 and shall be installed in accordance with the cylinder and appliance manufacturers' instructions;
- (b) where the primary is pumped, the static head of the system shall be in excess of the maximum pump head;
- (c) no corrosion inhibitor or additive shall be introduced into the primary circuit;
- (d) the recommendations of the manufacturers of the boiler and the radiators as to the suitability of their products for use in this system shall be complied with.

6.6 Hot water supply in association with hot water for central heating

When an installation is designed for combined central and domestic water heating and the central heating circuit includes a circulating pump while the parallel circuit to the primary heater in the hot water storage vessel operates by gravity circulation, the return pipes of the two circuits shall be connected to separate connections on the boiler or shall be combined by means of an injector type fitting installed near the boiler.

COMMENTARY AND RECOMMENDATIONS ON 6.6.

Additional controls are desirable and in some circumstances essential, typical forms of temperature control for boiler systems are given in BS 5449 : Part 1.

A combined installation should be designed so that hot water demand and central heating demand can both be satisfied. The most appropriate arrangement will depend upon the circumstances of the particular installation and the fuel used and is outside the scope of this standard.

6.7 Supplementary water heating and independent summer water heating

It is permissible for supplementary water heating and independent summer water heating to be provided in the storage vessel by an electric immersion heater, a gas-fired circulator or a heat pump and for supplementary water heating to be provided from solar energy.

Where supplementary electric heating is to be used in conjunction with a boiler, the height of the storage vessel above the boiler shall be sufficient to prevent circulation of hot water from the storage vessel to the boiler when the electric heater is in operation.

COMMENTARY AND RECOMMENDATIONS ON 6.7.

The minimum height required from the top of the boiler to the bottom of the storage vessel depends on the flow resistance of the primary circuit in gravity circulation systems, but generally should be not less than 1 m.

6.8 Water heating by solar energy

Solar water heating shall be in accordance with BS 5918.
COMMENTARY AND RECOMMENDATIONS ON 6.8.

Solar energy may be used to augment a conventional domestic water heating system of the boiler or immersion heater type, although in hot sunny weather solar energy alone may be sufficient to heat water to draw-off temperatures.

Many different designs of solar water heating systems are possible from simple direct feed gravity systems to more complex pumped circuits using two indirect storage cylinders or one cylinder with two indirect heating coils.

6.9 Water heating by heat pumps

Until such time as a British Standard is available for the installation and use of heat pumps, the guidance of manufacturers and water suppliers shall be sought.

COMMENTARY AND RECOMMENDATIONS ON 6.9.

The use of heat pumps to supply total domestic hot water requirements or to augment existing systems is growing as an energy conservation system.

6.10 Secondary distribution systems

Secondary water systems shall be gravity fed from a cold water storage cistern and fitted with an open vent pipe, or of unvented type supplied with cold water by gravity from a cold water storage cistern or from the mains supply to the building, either directly or through a pressure reducing valve. In systems incorporating a hot water storage vessel, the hot water draw-off shall be arranged to be from the top of the vessel or as near thereto as practicable and always above any primary flow connection.

COMMENTARY AND RECOMMENDATIONS ON 6.10.

To promote maximum economy of fuel and water the hot water distribution system should be designed so that hot water appears quickly at the taps when opened. To this end dead legs should be as short as possible. The hot water pipe feeding a spray tap for hand washing should not exceed 1 m in length. When draw-off points are situated at a distance from the water heater or hot water storage vessel, consideration should be given to the use of a separate water heater installed close to those draw-off points. When this is impracticable a secondary circuit with flow and return pipes to the storage vessel should be considered. Secondary circuits inevitably dissipate heat and should be avoided where possible. The flow pipe should be taken from the top of the hot water storage vessel and, as it is also the draw-off pipe, it should be sized in accordance with clause 8. The return pipe should be connected to the hot water storage vessel at a point not lower than the level of the boiler flow pipe connection if any (see clause 7). Attention is drawn to 12.3.1 concerning the thermal insulation of long dead legs and the pipework of secondary circuits.

6.11 Components

6.11.1 General. The components used in domestic hot water installations shall comply with 6.11.2 to 6.11.10 and shall be chosen after taking account of the information given in those subclauses.

6.11.2 Cold feed pipe. The cold feed pipe to the hot water storage vessel or water heater shall be sized in accordance with clause 8. It shall discharge near the bottom of the heater or storage vessel or vessels and if the system is cistern fed this pipe shall not be used for any other purpose.

A separate cold feed pipe from a separate expansion cistern shall be provided to the lowest point of a vented primary circuit in an indirect system unless a single feed hot water cylinder is used.

A gate valve or stopvalve with fixed jumper shall be provided in a convenient and accessible position in every cold feed pipe other than those to a vented primary circuit which shall be valved only when the capacity of the expansion cistern exceeds 18 L (see 6.5.7.2).

NOTE 1. In cistern fed installations this valve should preferably be fitted close to the feed cistern.

In direct type boiler systems the cold feed pipe and the return pipe to the boiler shall be separately connected to the hot water storage vessel.

NOTE 2. Any interconnection of these pipes could result in a flow of cold water to a hot boiler which could damage the boiler due to thermal shock.

6.11.3 Open vent pipe. The vent pipe to a storage type hot water 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. An offset shall be included in the vent pipe close to its point of connection to the hot water storage vessel.

When a vented primary circuit is used in an indirect system, unless a single feed hot water storage cylinder is used, the vent pipe shall run from the highest point of the primary circuit to a point above the primary feed and expansion cistern at a height that will prevent a discharge of water from the vent pipe and/or air entrainment into the system under normal working conditions, making due allowance for the head induced by any circulating pump used (see BS 5449 : Part 1).

NOTE. For gravity circulation systems this height should be not less than 150 mm plus 12 mm for every 300 mm in the height of the overflow level above the lowest point of the cold feed pipe.

No valves shall be fitted to any vent pipe and the pipe shall rise continuously from its point of connection to the hot water system to its point of discharge.

Vent pipes shall be of not less than 19 mm bore.

One pipe shall not serve as both open vent pipe and cold feed pipe, unless the associated system or circuit has the protection specified in clause 7 for an unvented system or sealed primary circuit as appropriate.

6.11.4 Hot water storage vessels

6.11.4.1 General. Storage vessels shall comply with the relevant British Standards. Special copper cylinders, for installing in a shallow recess consisting of twin inter-connected small diameter cylinders, elliptical and oval cylinders, shall be used only when a standard vessel cannot be accommodated, and in every case the primary heater, where fitted, shall comply with the relevant requirements of BS 1566 : Part 1 (double feed) or Part 2 (single feed).

A cistern (or combination) type storage water heater incorporating a cold water feed cistern shall be located so that the water heater base is higher than the level of the highest outlet to be served and it gives adequate flow at the outlets.

Where an immersion primary heater, usually fitted through the immersion heater boss, is used to convert an existing direct hot water cylinder for indirect use, such heaters shall only be used where the primary circulation is pumped and shall not be used for new installations. Such heaters shall have any joints made by socketting and bracing with an overlap of not less than one-third the nominal tube size, and they shall be capable of withstanding without damage a test pressure of 7 bar.

COMMENTARY AND RECOMMENDATIONS ON 6.11.4.1.

Immersion primary heaters are usually of limited heating surface compared to an indirect cylinder complying with BS 1566.

Coil type primary heaters for conversion of a direct cylinder to indirect are fitted through holes drilled in the side of the cylinder.

Conversions form a lower cost alternative where a direct cylinder is already fitted in a dwelling, provided that the user is aware of any reduction in heating capacity and the probable remaining life of the existing direct cylinder.

6.11.4.2 Stratification. Hot water storage vessels intended for heating by off-peak electricity shall be arranged so that advantage can be taken of stratification as indicated in appendix D.

COMMENTARY AND RECOMMENDATIONS ON 6.11.4.2.

Other types of hot water storage vessels may perform better when arranged so that stratification or 'layering' of hot and cold water is promoted. This subject is treated more fully in appendix D.

6.11.4.3 Hot water storage capacities. The amount of hot water to be stored shall be related to the likely consumption and recovery rate.

A minimum hot water storage capacity of 100 L shall be used in solid fuel fired boiler hot water systems.

COMMENTARY AND RECOMMENDATIONS ON 6.11.4.3.

In dwellings the storage capacity should normally be based on 45 L per occupant unless pumped primary circuits or special appliances justify the use of smaller storage capacities. Where electrical off-peak heating is used the minimum capacity should be 200 L. Storage capacity should be increased when the heating appliance is of limited output. This is treated in detail in appendix D.

6.11.4.4 Insulation. The storage vessel shall be thermally insulated at least to the standards given by fitting an insulating jacket complying with BS 5615 or in accordance with the requirements for factory insulated cylinders specified in BS 699, BS 1566 or BS 3198 as appropriate.

6.11.4.5 COMMENTARY AND RECOMMENDATIONS ON HOT WATER STORAGE TEMPERATURES. *In normal circumstances the temperature of the stored water should never exceed 65 °C. A stored water temperature of 60 °C is considered sufficient to meet all normal requirements and will minimize deposition of scale in hard water areas.*

6.11.5 Cisterns and expansion vessels. Feed cisterns, expansion cisterns, combined feed and expansion cisterns and expansion vessels shall comply with BS 417, BS 2777, BS 4213 or BS 4814, as appropriate.

A cistern used only to feed the hot water supply system shall comply with all the requirements for a cold water storage cistern (see 5.3). It shall have a capacity at least equal to that of the hot water cylinder. The feed cistern shall be situated at a height which will ensure a satisfactory flow of water at the highest point of discharge.

If there is a cold water storage cistern that supplies cold water to draw-off points, and this is also used as the feed cistern for a direct system or for the secondary part only of an indirect system, it shall have a capacity of at least 230 L.

The expansion cistern for the primary circuit of an indirect system shall be used only for that circuit and shall be able to accommodate the expansion of the water in the circuit if raised to boiling point. The increase in volume shall be taken as 4 % of the volume of the water in the circuit. The float-operated valve in an expansion cistern for a primary circuit shall incorporate adequate backflow protection (see 9.3.4.2(b)) or shall comply with BS 1212 : Part 2 or 3 and be installed at a level no lower than that of the warning pipe. The valve shall be adjusted to shut off when the water is cold at a level low enough to ensure that expansion on heating does not cause the water to rise higher than 25 mm below the over-flowing level of the warning pipe. The float shall be of a material suitable for use in hot water at a temperature of 100 °C and shall be fitted to a drop lever where necessary.

No warning or overflow pipe from any cistern connected to a primary circuit shall be installed to convey water to any cistern from which water may be drawn for any domestic purpose.

6.11.6 Boilers. All boilers and firing equipment shall comply with the following British Standards as applicable:

BS 799	BS 4834
BS 1894	BS 4876
BS 3377	BS 5258 : Parts 1 and 8
BS 3378	BS 5376
BS 4433	BS 5871

Where a combined boiler and cylinder unit is required, each of the items comprising the unit shall comply with the appropriate British Standard.

With boilers fired by solid fuel the manufacturer's recommendations shall be followed to ensure that all heat generated when the boiler is slumbering is dissipated, e.g. by the installation of the necessary heating surface in a gravity circuit. Neither this heat emitter nor its circuit shall be fitted with valves.

Boilers fired by gas shall be suitable for the gas with which they are to be supplied.

Boilers for use with sealed primaries require specific controls and shall therefore be selected only from those designed specifically for this purpose.

Boilers shall always be sited in an adequately ventilated location and, except in the case of a room-sealed appliance, provision for an adequate supply of combustion air shall be made.

Provision shall be made for sufficient working space to enable maintenance to be carried out.

NOTE. This is of particular importance with direct systems. The dimensions of the necessary clearance should be obtained from the manufacturer of the boiler and of any other items such as oil or gas burners.

There shall be sufficient space and access to ensure that the boiler can be removed and replaced.

The clearance in front of a solid fuel boiler for stoking and cleaning purposes shall be not less than $1.25 \times$ the back to front overall dimension of the boiler, with a minimum of 1 m.

Constructional material of a combustible character shall not be located adjacent to a boiler (see relevant building regulations).

COMMENTARY AND RECOMMENDATIONS ON 6.11.6.

Boilers fired by solid fuel should be selected from the list of 'Approved domestic solid fuel appliances' published on behalf of the Domestic Solid Fuel Appliances Approval Scheme or should have been approved since publication of the latest list.

Boilers fired by oil should be selected from the BSI list of tested and approved domestic oil burning appliances, or should have been approved since publication of the latest list.

6.11.7 Circulating pump. Pumped circulation shall be provided in all cases where the natural circulating pressure available is insufficient to circulate the water round the system.

Immersed rotor (glandless) type circulating pumps shall be used on primary circuits only. Pumps for boosting or secondary circulation shall be adequately resistant to corrosion.

Inlet and outlets connections to a circulating pump shall be fitted with fullway valves.

Circulating pumps shall be quiet in operation (see appendix B) and shall be suitably suppressed to prevent radio or television interference.

The circulating pump shall be installed in accordance with the manufacturer's recommendations and space shall be allowed for maintenance and removal.

Circulating pumps shall comply with BS 1394 : Parts 1 and 2.

6.11.8 Valves and taps. Valves used for isolating a section of the water service shall provide a positive seal when closed.

Sufficient draining taps complying with BS 1010 or BS 2879 shall be fitted in accessible positions for draining down the entire system including the boiler.

Mixing valves (whether thermostatically controlled or not) and single outlet combination taps for mixing hot water and cold water and discharging the mixture shall be supplied with cold water from the same source, e.g. storage cistern or mains, that feeds the hot water system; this is especially important with showers and spray fittings.

Except for bath/shower cistern units manually operated non-thermostatically controlled mixing valves shall not be used to control the water to more than one outlet.

Thermostatic mixing valves shall be used where automatic temperature control of the water is required.

6.11.9 Safety devices. Pressure operated, temperature operated and combined relief valves, check valves, pressure reducing valves, anti-vacuum valves and pipe interrupters shall be fitted in accordance with clauses 7 and 9 and shall comply with the relevant Part or Parts of BS 6280, BS 6281, BS 6282 and BS 6283.

6.11.10 Flues. An adequate flue shall be provided wherever necessary. The following British Standards shall be consulted where relevant in addition to the Gas Safety (Installation and Use) Regulations (in the case of gas appliances), the Building Regulations and the appliance manufacturer's instructions: BS 41, BS 567, BS 715, BS 835, BS 1181, BS 1289, BS 4543, BS 5410 : Parts 1 and 2, BS 5440 : Part 1 and BS 6461 : Parts 1 and 2. All materials and components shall comply with the requirements of the appropriate standard.

Warning note. The use of an inadequate or badly maintained flue can have fatal consequences.

6.12 Energy supply and fuel storage

Electric wiring shall be in accordance with current edition of the 'Regulations for electrical installations' published by the Institution of Electrical Engineers, and installed by a competent person such as a certificate holder of NICEIC.

All gas installation work shall comply with the Gas Safety (Installation and Use) Regulations and be carried out in accordance with relevant codes of practice, by a competent person such as an installer registered with CORGI for the category of work concerned.

Solid fuel installations shall be installed in accordance with the relevant codes of practice by a competent person such as a Solid Fuel Advisory Service registered heating contractor.

COMMENTARY AND RECOMMENDATIONS ON 6.12.

For information on delivery, storage and metering of fuel reference should be made to BS 5449 for solid fuel, BS 6400 for gas, BS 5482 for liquefied petroleum gas and BS 5410 for oil fuel. For electricity reference should be made to the local Electricity Board.