

Specification for

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

ICS 91.140.60

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- Association of Consulting Engineers
- Association of Manufacturers of Domestic Unvented Supply Systems Equipment (MODUSSE)
- British Bathroom Council
- British Non-Ferrous Metals Federation
- British Plastics Federation
- British Plumbing Fittings Manufacturers' Association
- Chartered Institution of Water and Environmental Management
- Department of the Environment
- Department of the Environment, Drinking Water Inspectorate
- Fibre Cement Manufacturers' Association Ltd.
- Institute of British Foundrymen
- Institute of Plumbing
- Local Authority Organizations
- Scottish Association of Directors of Water and Sewerage Services
- Water Companies Association
- Water Services Association of England and Wales

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Foreword

This standard has been prepared under the direction of Technical Committee B/504 and is intended for the use of engineers, architects, surveyors, contractors, plumbers and inspection authorities and should also be of general interest. 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. This new edition introduces technical amendments reflecting changes in health and safety requirements but does not constitute a full revision of BS 6700 : 1987 , which is superseded and withdrawn. Further amendments or a full revision of this standard will depend on the progress of prEN 806 and its anticipated publication as a dual standard.

This standard has been written in the form of a practice specification in accordance with PD 6501 : Part 1. In order to comply with this specification, the user has to comply with all of its requirements. It is permissible to depart from recommendations provided there is good reason for doing so.

The design of large scale underground reticulations are not included. Whilst certain aspects of underground systems and the larger storage facilities are dealt with in this 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.

This standard interfaces and overlaps with standards 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. 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.

The control of the safety of unvented domestic hot water storage systems is included in Building Regulations (see **A.1**).

The normative references listed are predominantly British Standards. As European Standards are published they will replace the relevant British Standards and be the subject of amendment to this publication.

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

Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, pages 1 to 90, an inside back cover and a back cover.

Section 1. General

1.1 Scope

This 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 drinking, culinary, domestic laundry, ablutionary, cleaning and sanitary 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 1.5.1).

This standard does not cover domestic central heating systems.

Although many of its recommendations will be applicable, this standard does not 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.

1.2 References

1.2.1 Normative references

This standard incorporates, by dated or undated reference, provisions from other publications. These normative references are made at the appropriate places in the text and the cited publications are listed on page 85. For dated references, only the edition cited applies; any subsequent amendments to or revisions of the cited publication apply to this standard only when incorporated in the reference by amendment or revision. For undated references, the latest edition of the cited publication applies, together with any amendments.

1.2.2 Informative references

This standard refers to other publications that provide information or guidance. Editions of these publications current at the time of issue of this standard are listed on page 88, but reference should be made to the latest editions.

1.2.3 Statutory references

Statutory references are listed in annex A.

1.3 Definitions

For the purposes of this British Standard the definitions given in BS 6100 : Sections 2.7 and 3.3 apply, together with the following.

1.3.1 backflow

A flow of water in the opposite direction to that intended. It includes back-siphonage, which is backflow caused by siphonage.

1.3.2 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.

1.3.3 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.

1.3.4 chase

A recess that is cut into an existing structure.

1.3.5 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.

1.3.6 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.

1.3.7 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.

1.3.8 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.

1.3.9 removable fastenings

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

1.3.10 sleeve

An enclosure of tubular or other section of suitable material designed 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.

1.3.11 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. $\frac{1}{2}$ nominal size tap means a tap with an inlet having a G $\frac{1}{2}$ thread.

1.3.12 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.

1.4 Materials

1.4.1 Choice of material

Pipes, fittings and jointing materials acceptable for water byelaw purposes are listed in the *Water fittings and materials directory* [1] and shall be used within the limits stated in the relevant British Standards and manufacturer's recommendations.

Every pipe, pipe joint and connected fitting shall be capable of withstanding, without damage or deterioration, at the maximum working pressure, sustained temperatures of 40 °C for cold water installations and 95 °C, with occasional short-term excursions in excess of 100 °C to allow for malfunctions, for heated water installations. 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, measures shall be taken to reduce corrosion.

COMMENTARY AND RECOMMENDATIONS ON 1.4.1

Attention is drawn to the building regulations (see A.1) and the water byelaws (see A.2).

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

- a) effect on water quality;*
- b) vibration, stress or settlement;*
- c) internal water pressure;*
- d) internal and external temperatures;*
- e) internal and external corrosion;*
- f) compatibility of different materials;*
- g) ageing, fatigue, durability and other mechanical factors;*
- h) permeation.*

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

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 2.6.

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 plastic materials.

1.4.2 Lead

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

Pipework shall not be connected to existing lead pipework without protection against galvanic corrosion.

Repairs to existing lead services shall be by replacement with other materials.

Solders for jointing shall be lead-free.

COMMENTARY AND RECOMMENDATIONS ON 1.4.2

In areas where the water is plumbosolvent, the use of lead components can result in increased lead contamination. (See 2.6.2.1.)

1.4.3 Copper

1.4.3.1 Copper tube shall conform to BS 2871 : Part 1.

Copper tube fittings shall conform to BS 864.

Copper shall not be connected to other metals without protection against galvanic corrosion.

COMMENTARY AND RECOMMENDATIONS ON 1.4.3.1

It is strongly recommended that independent quality assurance certification of such tube should be obtained.

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

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

COMMENTARY AND RECOMMENDATIONS ON 1.4.3.2

Protector rods should be fitted during manufacture.

1.4.4 Copper alloys

Copper alloy fittings shall conform to BS 864.

Fittings for use with copper tube laid in the ground shall be resistant or immune to dezincification and where compression fittings are used these shall be manipulative type B fittings conforming to BS 864 : Part 2. Where it is known that the local supply water is capable of causing dezincification, or where distribution systems might introduce such water, or any doubt exists, fittings (except draw off fittings) manufactured from alloys subject to dezincification shall not be used.

COMMENTARY AND RECOMMENDATIONS ON 1.4.4

Copper cannot corrode by dezincification 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 CR.

Gunmetal fittings are immune to dezincification.

1.4.5 Stainless steel

Stainless steel tubing shall conform to BS 4127.

Stainless steel tubes shall not be joined by soft solder.

COMMENTARY AND RECOMMENDATIONS ON 1.4.5

Although mixed copper and stainless steel systems can be used, small copper to large stainless steel areas should be avoided, e.g. copper pipes into a large stainless steel tank.

Joining should be made using stainless steel or copper capillary or compression fittings (see 2.6.2).

Joining of stainless steel tubes by adhesive bonding may only be used where the water temperature does not exceed 85 °C.

The water byelaws preclude the use of adhesive jointing of metal pipes where the pipes are laid underground, enclosed in a chase or duct or in any other position where access is difficult.

1.4.6 Steel

1.4.6.1 When carbon steel is used the installer shall ensure that the degree of any protection provided against corrosion is appropriate for the particular conditions of internal water quality and external installation.

COMMENTARY AND RECOMMENDATIONS ON 1.4.6.1

When used above ground for distributing pipes from a storage cistern, steel tube should be medium grade in accordance with BS 1387 and protected against corrosion.

1.4.6.2 Galvanized steel tube shall be joined only by screwed connections. Where it is necessary to change direction pre-formed bends shall be used.

COMMENTARY AND RECOMMENDATIONS ON 1.4.6.2

Galvanized tubes offer only marginal protection against corrosion. Welded or brazed joints should not be used because this would damage the galvanizing.

1.4.7 Plastics

Installations above ground shall accommodate thermal movement. Plastics pipes shall not be installed close to those sources of heat which would impair their performance.

Plastics pipework for hot water systems shall be capable of withstanding a temperature of 100 °C at the maximum working pressure for 1 h.

COMMENTARY AND RECOMMENDATIONS ON 1.4.7

Coefficients of expansion for plastics pipes are greater than those for metal pipes, but this is not generally a problem where pipes are buried. The use and installation of unplasticized polyvinylchloride (PVC-U) pipes should be in accordance with CP 312 : Part 2 and specific attention is drawn to the amendment relating to surge pressures.

Pipe should be in accordance with BS 3505 and the solvent cements to be used with the pipe should be in accordance with BS 4346.

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. Where there is adequate access, in positions above ground, solvent cement joints can be used.

As PVC-U pipes become increasingly brittle with reducing temperatures, particular care should be taken in handling them at temperatures below 5 °C.

The use and installation of polyethylene (PE) pipelines for the supply of drinking 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). Copper alloy compression fittings for use with PE pipe should be in accordance with BS 864 : Part 3 and joints should conform to BS 5114.

PE cold water storage cisterns in accordance with BS 4213 are suitable for storage and expansion purposes.

Propylene copolymer (PP) cannot be solvent welded. Pipe for drinking water use should conform to series 1 of BS 4991.

Cold water storage cisterns in PP conforming to BS 4213 are suitable for storage and expansion purposes.

Floats in PP for float-operated valves should conform to BS 2456.

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 conforming to BS 5413 and float-operated valves conforming to BS 1212 : Part 3 are suitable.

Pipes and fittings made from cross-linked polyethylene (PE-X) conforming to BS 7291 : Parts 1 and 3, are suitable for cold and hot water applications.

PE-X cannot be solvent welded. Jointing carried out by mechanical or push-fit methods is suitable using fittings supplied for this purpose.

Pipes and fittings made from polybutylene (PB), conforming to BS 7291 : Parts 1 and 2, are suitable for cold and hot water applications. The material is suitable where resistance to freezing temperatures and abrasion is required.

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

Pipes and fittings made from chlorinated polyvinyl chloride (PVC-C) conforming to BS 7291:

Parts 1 and 4, are suitable for cold and hot water applications. Jointing by solvent welding, screwed joints or unions is suitable.

Plastics pipework systems for pressure applications are not automatically inter-compatible, and there are no specifications in British Standards for connector dimensions or methods of achieving a joint. It is recommended that plastics pipework systems should be comprised of a proprietary system package with third party approval.

1.4.8 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 1.4.8

See 2.6.2. BS 5493 : 1977 gives recommendations for the protective coating of iron and steel structures, including pipes, fittings and cisterns. This should be consulted where detailed guidance is required.

BS 5493 : 1977 deals with non-saline water 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 drinking water.

Internal protection of steel pipes should be in accordance with clause 33 of BS 534 : 1990.

1.4.9 The materials of elastomeric sealing rings in contact with drinking water shall conform to the requirements of types W, H or S of BS 2494. Reference should be made to **2.6.2.1**.

Section 2. Design considerations

2.1 Initial procedures

2.1.1 Preliminary investigations

The following factors shall be accounted for in the design:

- a) the water supplier's requirements;
- b) the estimated daily consumption and the maximum and average flow rates required, together with the estimated time of peak flow;
- c) the location of the available supply;
- d) the quality, quantity and pressure required and the available pressures at various times during a typical day;
- 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.

COMMENTARY AND RECOMMENDATIONS ON 2.1.1

Where water is to be supplied by a public water supplier all the byelaws of that undertaker are to be conformed to. 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 conform to the byelaws applicable at the time of their installation need not be updated to conform to current byelaws.

2.1.2 Design

The installation shall be designed to avoid waste, undue consumption, misuse and contamination and to ensure continued conformance to the water byelaws see A.2 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 2.1.2

The design of the system should include provision not only for the appliances connected to it but also where reasonable, and practicable to do so, for additional appliances that are likely to be installed in the future.

Hot and cold water temperatures should be reached at all points in the system after a maximum period of 1 min running at full flow. To prevent bacteriological contamination the water service should be designed and installed so that cold water is stored and distributed at as low a temperature as possible below 20 °C. Bacteriological contamination is aggravated in buildings with multiple occupancy. The temperature of stored hot water should be in the range 60 °C to 65 °C (see 2.3.1) and the temperature of distributed hot water should be greater than 50 °C.

Guidance on legionnaires' disease is contained in 2.6.4 (also see [2] to [6]).

2.1.3 Extensions

Any extension to existing systems shall depend upon their capacity for extension and current water byelaws (see A.2).

COMMENTARY AND RECOMMENDATIONS ON 2.1.3

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.

2.1.4 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 requested to lay new mains or extend an existing main, or an alternative water supply shall be arranged.

COMMENTARY AND RECOMMENDATIONS ON 2.1.4

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 the supplier will not normally lay a main until at least the line and level of the kerb are permanently established on site.

2.1.5 Water from a private supply shall not access other supplier's mains.

2.1.6 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 2.1.6

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 by the surveyor of the responsible company who 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.

2.1.7 Assessment of the site for contamination

Where pipes are to be laid in the ground an assessment of the soil shall be made to detect any contamination (see 2.6.2.2)

COMMENTARY AND RECOMMENDATIONS ON 2.1.7

In making an assessment of a site, advice should be sought from the local authority, the site owner and the water supplier.

2.1.8 Pipework external to the building

Pipework shall be installed with protection from damage by frost or traffic loads and vibration.

COMMENTARY AND RECOMMENDATION ON 2.1.8

The normal minimum cover for protecting underground pipework against frost damage is achieved by laying pipework at a depth of at least 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 2.7 for details on frost protection.)

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.

External pipework should be located above ground only in exceptional circumstances. It should be lagged with waterproof insulation material in accordance with 2.7.3 and provision should be made for draining of all water from such lengths of pipe in frosty weather through a drain tap, which should not be buried in the ground or so placed that its outlet is in danger of being flooded.

2.1.9 Design consultation

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.

Notices and applications shall be completed and submitted by stipulated times.

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

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 2.1.9

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, attention is drawn to the terms of the New Roads and Street Works Act 1991 (see A.3).

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, other services could include oil pipelines, television relay cables, district heating systems and drainage connections (see National Joint Utilities Group Publication No.6 [7]).

2.2 Cold water services

2.2.1 General

2.2.1.1 The cold water service shall be designed to provide cold water at the point of use in the quantity required by the user, and at a temperature below 20 °C. Except under the circumstances described below, drinking water directly from the supply pipe shall be provided at the kitchen sink in every dwelling. Drinking water is also required at places of work in accordance with the Workplace (Health, Safety and Welfare) Regulations made under the Health and Safety at Work etc. Act 1974 (see A.4). Because any cold tap is likely to be used for drinking water, all such taps not connected directly to the supplier's pipe shall be supplied from a storage cistern which is protected in accordance with 2.2.3.

Where draw-off fittings are above the height to which the water supplier is able or obliged to supply, e.g. in multi-storey buildings, the drinking water tap shall be supplied from a storage cistern that is protected in accordance with 2.2.3 or from a drinking water header from a boosted supply.

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.

COMMENTARY AND RECOMMENDATIONS ON 2.2.1.1

The insulation requirements given in table 8 will normally give adequate protection against heat gain in pipes and cisterns. In situations where water is likely to remain static for long periods at high temperatures, such as little used taps in plant rooms, actual insulation requirements should be determined by calculation.

2.2.1.2 No drinking water point shall be installed at the end of a long pipe from which only small volumes of water are drawn or water is drawn infrequently.

COMMENTARY AND RECOMMENDATIONS ON 2.2.1.2

Attention is drawn to the Workplace (Health, Safety and Welfare) Regulations 1992 (see A.4) with respect to drinking water provision in office and other commercial buildings.

Drinking water points should be located in areas intended for the preparation of food and for its consumption in addition to rooms provided for beverage making. Where 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 spillover level 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.

2.2.1.3 The design and method of installation of every tap shall conform to the backflow protection requirements of 2.6.3.

COMMENTARY AND RECOMMENDATIONS ON 2.2.1.3

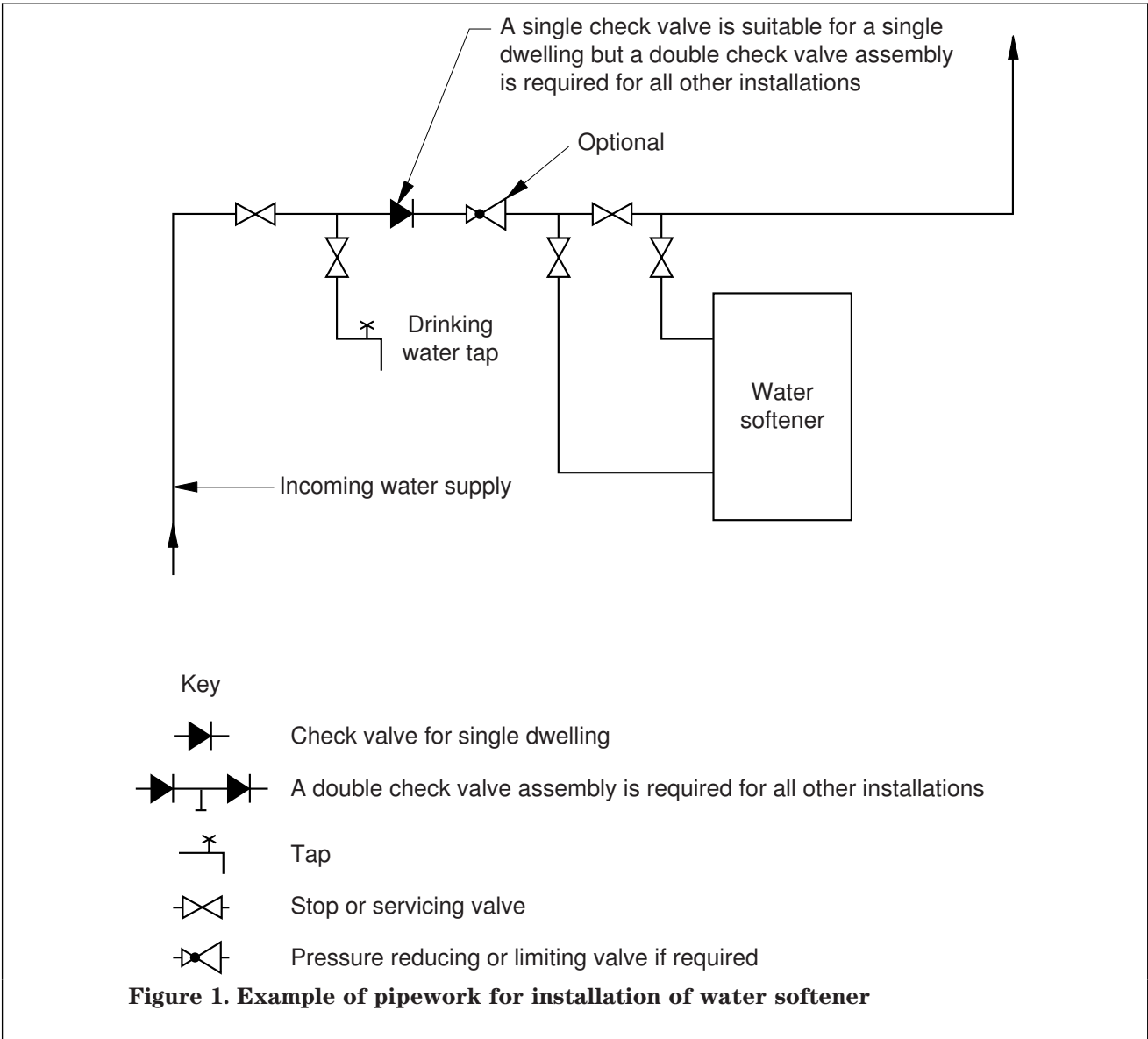
In order to enable buckets and similar utensils to be filled, the outlet of the kitchen tap should be not less than 275 mm above the bottom of the sink. To guard against backflow the outlet of such a tap should be designed to make the connection of a hose difficult.

2.2.1.4 Any ion exchange water softeners shall be installed downstream of the supply to the drinking water taps (see figure 1).

Pipework shall be provided to bypass a water softener in the event of malfunction or for the purpose of maintenance.

COMMENTARY AND RECOMMENDATIONS ON 2.2.1.4

Over softening of the water increases the potential for metal dissolution, especially plumbosolvency. If lead pipe exists downstream of the water softener specialist advice should be sought.



2.2.2 Type of system

2.2.2.1 The distribution system shall conform to the requirements of the water supplier.

COMMENTARY AND RECOMMENDATIONS ON 2.2.2.1

A choice of cold water supply system might not be available if the water supplier exercises powers to require cold water storage. In any case, considerations of pressure and reliability of supply, particularly where dwellings are located at the extremity of mains distribution system, should be studied.

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 with reduced risk 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 satisfactory showering in the absence of a booster pump;
- 5) 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.

b) Characteristics of supply directly from a water main:

- 1) smaller pipes may be used in most cases except for the service pipe which may need to be larger than the supply pipe to a storage cistern;
- 2) the higher pressure that is usually available is more suitable for instantaneous type shower heaters, hose taps and for mixer fittings used in conjunction with a high pressure (unvented) hot water supply;
- 3) where single outlet mixer fittings are used measures to prevent backflow may be necessary when used in conjunction with a low pressure (vented) hot water supply.

In some cases a combination of the two methods or supply may be the best arrangement. In a dwelling, 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.

2.2.2.2 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 2.2.2.2

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 2.2.2.1 should be considered. For larger buildings, it will be acceptable 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 2.2.3.1.

2.2.2.3 Pumped systems

The prior written consent of the water supplier shall be obtained before a pump is connected in or to a supply pipe.

COMMENTARY AND RECOMMENDATIONS ON 2.2.2.3

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 should be given to installing a pumped system.

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 backflow does not occur from the distribution pipework and pumping plant (see 2.6.1.3 and 2.6.3).

2.2.3 Storage cisterns

2.2.3.1 General

2.2.3.1.1 Drinking water storage cisterns and covers shall not impart taste, colour, odour or toxicity to the water, nor promote or foster microbial growth (see 2.6). Any cistern from which water for domestic purposes may be drawn shall be watertight and shall be:

- a) fitted with a rigid, close fitting and securely fixed cover which is not airtight but excludes light and insects from the cistern, fits closely around any vent pipe, made of materials which will not shatter or fragment when broken and will not contaminate any water which condenses on its underside;
- b) where necessary, lined or coated with a material suitable for use in contact with drinking water;
- c) where necessary, insulated against heat and frost;
- d) supplied from a supply 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; and
- f) provided with warning and overflow pipes, as appropriate (see 2.2.4), which are constructed and arranged to exclude insects.

COMMENTARY AND RECOMMENDATIONS
ON 2.2.3.1.1

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 determining the total capacity of cold water storage in the premises concerned, account should be taken of:

- a) the need to prevent stagnation by ensuring that water is held in storage for as short a time as possible; and
- b) the requirements of any associated water-using fittings and appliances, particularly where supply interruptions could cause damage to property or inconvenience to the consumer.

The probable pattern of water use (draw-off rates and their durations) should be determined and account taken of any local conditions of low or reduced mains pressures likely to affect cistern refilling at times of peak demand.

In single dwellings it is usual for storage cisterns supplying cold water fittings only to have a capacity of 100 l to 150 l, and double this capacity if supplying all water outlets, hot and cold.

Alternatively, where a constant supply at adequate pressure is a statutory requirement, a maximum capacity of 80 l per person normally resident should prove satisfactory. A larger capacity based on 130 l per person would be appropriate where cistern refilling normally takes place only during the night hours.

The water supplier should be consulted before finalising cistern capacity to hotels, hostels, office premises (with or without canteen facilities), schools (day and boarding) and other substantial establishments.

Separation of capacity among two or more cisterns should facilitate water distribution, but inlets and outlets should be located to prevent short-circuiting within the cisterns.

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 primary	} 15 per pupil
secondary technical	
Boarding school	90 per pupil
Children's home or residential nursery	135 per bed space
Nurses' home	120 per bed space
Nursing or convalescent home	135 per bed space

2.2.3.1.2 The material of a cistern shall be corrosion resistant or shall be coated internally with an approved non-toxic corrosion resistant material conforming to BS 6920 : Parts 1,2 and 3. The cistern and its cover shall be designed to have sufficient strength to operate without undue deformation.

2.2.3.1.3 The cistern shall be supported on a firm level base which is 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.

2.2.3.1.4 Access shall be provided as described in **2.8.4**. 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.

2.2.3.1.5 Every cistern providing drinking water shall be protected from ingress of contaminants. Cisterns sunk in the ground shall have special measures to detect leakage.

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

2.2.3.1.6 Except for interconnected cisterns arranged to store water at the same water 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.

When a float-operated valve is used it shall either:

- a) conform to BS 1212 : Parts 1, 2, 3 or 4 and be used with a float conforming to 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 conform to the performance requirements of BS 1212 : Parts 1, 2, 3 or 4 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 **2.6.3**).

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 closes. 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.

2.2.3.1.7 All cold water distributing pipes from cisterns shall be connected at the lowest point on the cistern.

2.2.3.1.8 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 2.2.3.1.8

This requirement will minimize the risk of scalding from mixer fittings such as showers, should the water supply fail.

2.2.3.2 Large cisterns

Cisterns over 1000 l capacity shall additionally conform to the following requirements.

To avoid interruption of the water supply when carrying out repairs or maintenance, the cistern shall be provided with compartments or a standby cistern.

A washout pipe 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 2.2.3.2

A washout pipe should be provided flush with the bottom of the cistern at its lowest point. Where practicable, 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.

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.

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 for inspection and maintenance. Ventilation openings should be screened by a corrosion-resistant mesh with a maximum aperture size of 0.65 mm.

2.2.4 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 of 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 separate warning pipes from several storage or WC flushing cisterns to be combined into one outlet, provided that the source of any overflow may be readily identified and that any overflow from one cistern cannot discharge into another. No warning pipe shall be arranged to discharge into a WC pan via the flush pipe.

COMMENTARY AND RECOMMENDATIONS ON 2.2.4

The overflow pipe or pipes should be able to carry away all the 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 opening 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.

2.2.5 Stopvalves

2.2.5.1 Stopvalves fitted to supply pipes below ground shall conform to 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 conform to the appropriate requirements for stopvalves fitted to supply pipes below ground or, when the pipe is not larger than 50 mm nominal size, to 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 2580	BS 5433
	BS 5433	
50 mm or larger	BS 5163	BS 5163

The stopvalve components of composite fittings incorporating stopvalves shall conform to 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.

2.2.5.2 In every building or part of a building to which a separately chargeable supply of water is provided and in any 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 those premises 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 the 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 2.2.5.2

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 stopvalve under his control or to which he has ready access.

2.2.6 Servicing valves

2.2.6.1 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.

2.2.6.2 A servicing valve shall be protected against unauthorized use. Screwdown servicing valves shall not be of loose washer plate design.

2.2.6.3 A servicing valve shall be fitted upstream of, and as close as practicable to, every float-operated valve or other device used to control the inflow and level of water.

Every pipe taking water from a cistern of capacity exceeding 18 l shall be fitted with a servicing valve near the cistern.

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.

COMMENTARY AND RECOMMENDATIONS ON 2.2.6.3

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

2.2.7 Draining taps

Every pipe which supplies water to a premises shall be fitted with a draining tap and arranged so that when the stopvalve installed according to 2.2.5.2 is closed, and the draining tap is open, the supply pipe downstream of the stopvalve can be drained (see 2.7.5).

Draining taps shall be fixed over a drain or have provision for discharging the water to the nearest convenient point for disposal. The draining taps on any supply or distributing pipe shall not be buried in the ground or so placed that their outlet is in danger of being flooded.

COMMENTARY AND RECOMMENDATIONS ON 2.2.7

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

The pipe runs on the downstream of every stopvalve should be arranged so as to drain continuously towards draining taps or draw-off taps at the low points. All cisterns, tanks, cylinders and boilers should be fitted with draining taps unless they can be drained through pipes leading to draining taps or draw-off taps elsewhere; provision should be made for draining both the primary and secondary parts of an indirect hot water cylinder or calorifier. Provision should be made for draining low level pipes such as those laid in ducts under a ground floor.

All draining taps should be capable of being fitted with removable hosepipes unless installed over a drain or discharging into a permanent draining pipe. Where a draining tap is necessarily at such a level or in such a position that complete drainage cannot be obtained, even by the aid of a hosepipe and syphonic action, then a sump that can be emptied by bailing or pumping should be provided to receive the water drained from the tap.

Adequate facilities should be provided to permit entry of air into the system when draining down. Where the taps and float-operated valves in the system are not suitably located for this purpose, special air inlet valves should be fitted in appropriate locations.

When a sump is used it should be arranged so that the water level in it will at all times be kept below the outlet of the drain tap to preserve an air gap and prevent backflow. Similarly, outlets of hoses connected to draining taps should be arranged to discharge freely into the air, at no time should such hose outlets be allowed to become submerged.

For effective draining, it is essential that air enters the pipework freely and draw-off taps, float-operated valves and air inlet valves should be open for this purpose when draining is being carried out. Hot water cylinders are liable to collapse if air cannot enter the system.

Draining taps should be used for draining purposes only. Where a draw-off tap is used for draining the installation, it should not be fitted with a hose unless it has backflow protection as indicated in table 5 and in accordance with the water byelaws (see A.2).

Attention is drawn to the situation where the provision of check valves and double check valve assemblies for backflow prevention at draw off taps, particularly those with flexible hoses, and other equipment may also prevent air entering the system during a draining operation.

2.2.8 Revenue meter installations

2.2.8.1 General

The consumer shall consult with the water supplier to carry out the installation of a revenue meter, with regard to any requirements concerning the installation additional to those specified in 2.2.8.2 to 2.2.8.5 before work is begun.

COMMENTARY AND RECOMMENDATIONS ON 2.2.8.1

Meters on the incoming supply to a premises, for revenue charging purposes, are usually supplied by the water supplier and sited by agreement between the consumer and the water supplier.

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.

2.2.8.2 Meters

Meters shall conform to BS 5728 : Part 1, with suitable connectors to facilitate future meter changes without the use of heat or major disturbance of the pipework.

2.2.8.3 Bonding

A suitable conductor shall be installed for bonding between inlet and outlet pipework connections to water meters, water suppliers' 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 (see 3.1.8 and 4.2.5).

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

COMMENTARY AND RECOMMENDATIONS ON 2.2.8.3

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

2.2.8.4 External installations

2.2.8.4.1 In external meter installations the meter shall be installed below ground in a position accessible for meter reading and changing, with the dial uppermost.

The chamber shall be fitted 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.

Pipes, cables or drains other than the meter pipework shall not pass through the meter chamber.

The chamber shall be sized so that there is ample space available for removing the meter using the necessary hand tools.

Space shall be left for the extraction of bolts from 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.

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.

Pipework on both sides of the meter assembly 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.

There shall be a valve which isolates the meter on both the inlet and the outlet.

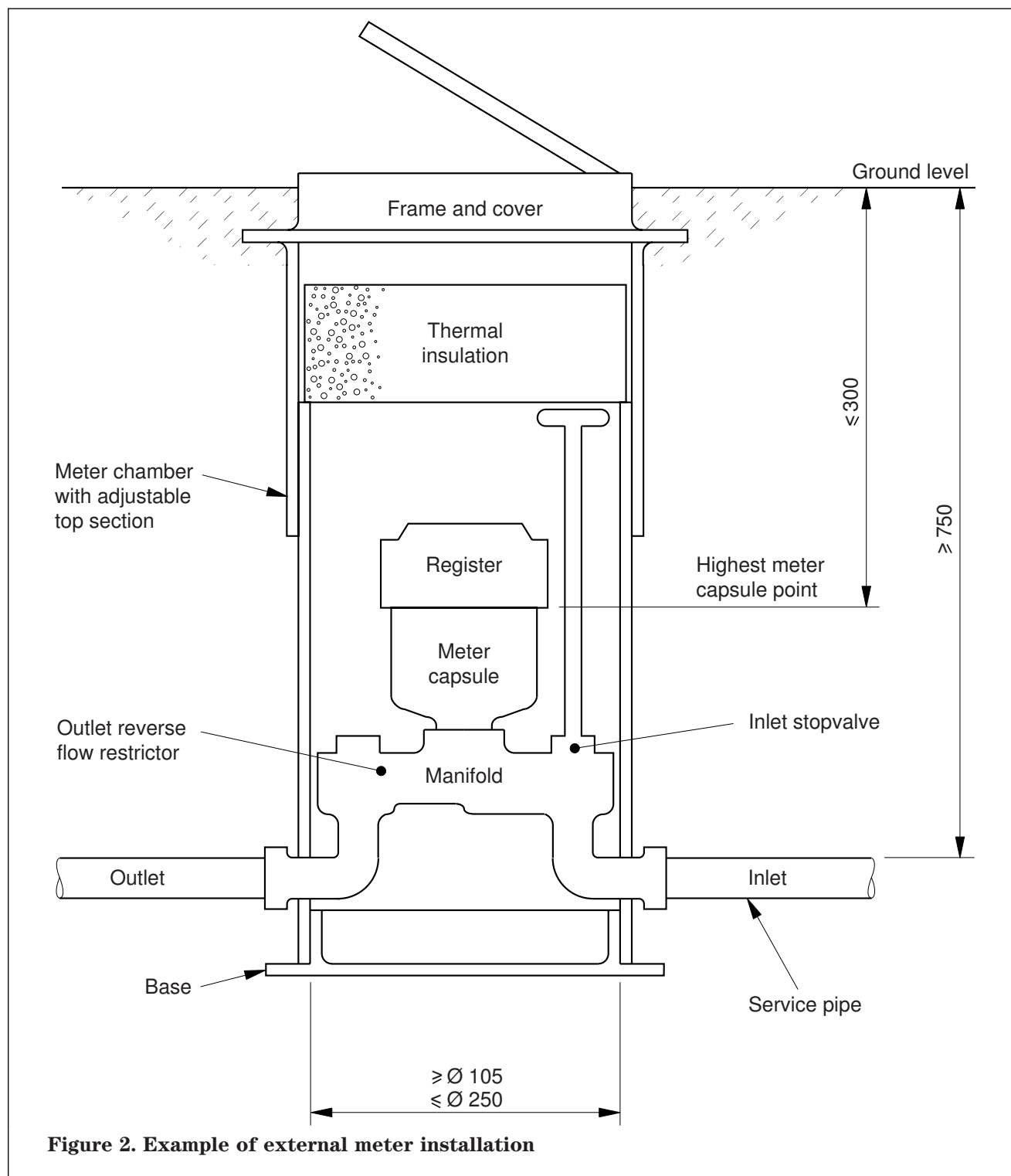
COMMENTARY AND RECOMMENDATIONS ON 2.2.8.4.1

For housing and other installations where the maximum water requirement does not exceed 3500 l/h the chamber may be constructed of glass reinforced plastics or PVC (see figure 2).

For meters where the water flow exceeds 3500 l/h the chamber should be constructed of brick or concrete.

The clear opening of the surface box should be the same as the internal dimensions of the chamber.

Steel framed, concrete filled covers to chambers are not recommended on account of their weight and their liability to flex causing the concrete to crack and the cover to jam.



2.2.8.4.2 Any stopvalve in a meter chamber shall conform to table 2.

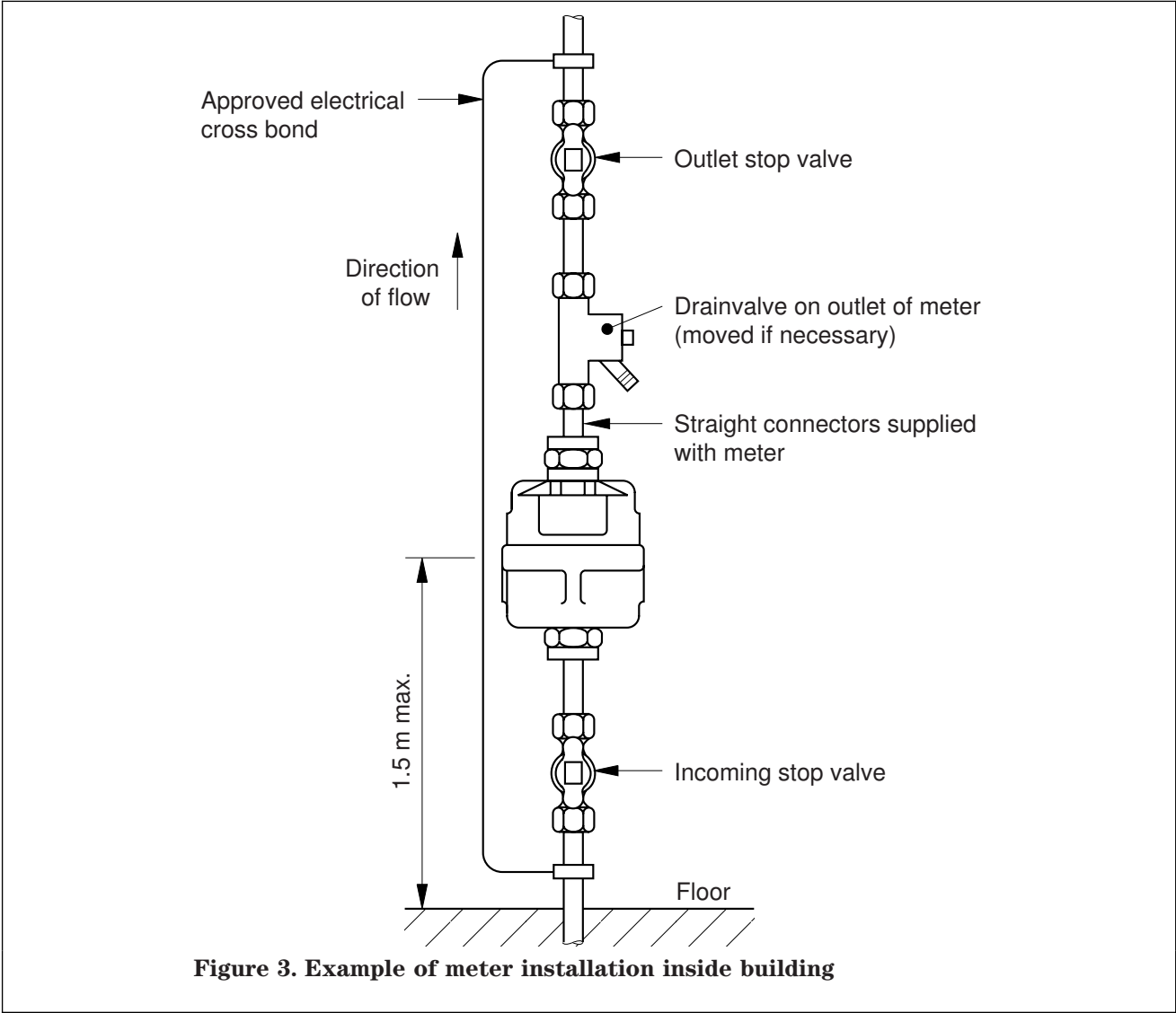
2.2.8.5 Internal meters

2.2.8.5.1 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.

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.

COMMENTARY AND RECOMMENDATIONS
ON 2.2.8.5.1

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



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

2.2.8.5.3 The meter shall be installed downstream of the 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 2.2.8.5.3

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 2.7.

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

2.2.8.5.5 Where the installation of meters in exposed locations, e.g. garages subject to frost, is unavoidable and agreed by the water supplier, adequate insulation in accordance with **2.7.3** shall be provided but not so as to seriously impede reading or changing the meter.

2.2.9 Non-revenue meters

The installation of non-revenue meters shall conform to 2.2.8 except that the water supplier need not be consulted.

2.3 Hot water services

2.3.1 General principles

The hot water service shall be designed to provide hot water at the point of use, in the quantities and at the temperatures required by the user.

COMMENTARY AND RECOMMENDATIONS ON 2.3.1

Under normal conditions 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. Minimum temperatures are given in 2.1.2.

The design should take account of maintenance, fuel costs, efficiency of the system and the safety of the user. The relevant codes of practice for installation should be used, e.g. BS 5546 for gas installations.

2.3.2 Choice of system

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, experience and convention.

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 (see figure 4).

COMMENTARY AND RECOMMENDATIONS ON 2.3.2

Data on which this assessment is made should include the following:

<i>Hot water (60 °C) used in dwellings:</i>	<i>35 l to 45 l per person per day</i>
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<i>Average bath:</i>	<i>60 l at 60 °C plus 40 l at 10 °C or 100 l at 40 °C</i>
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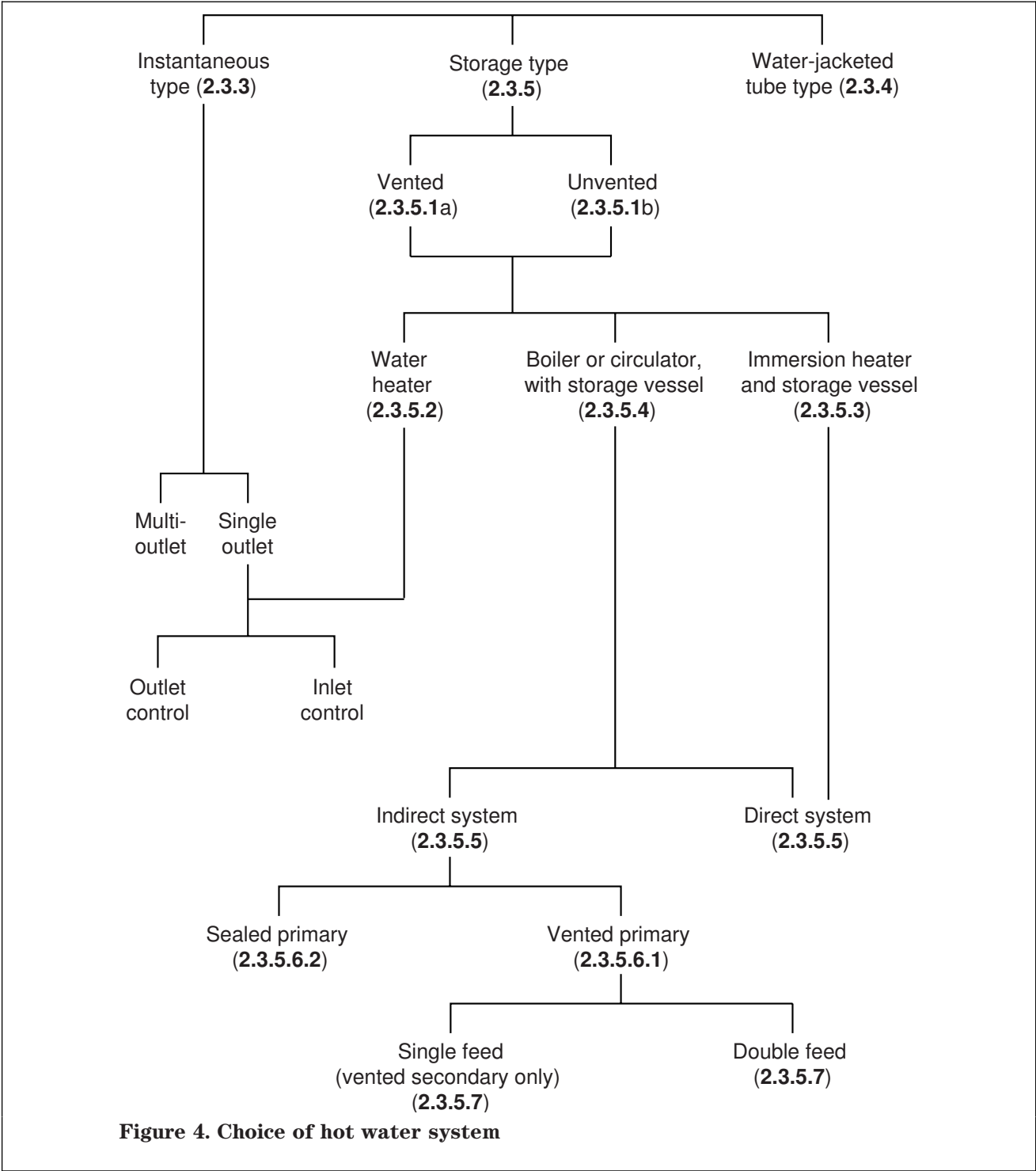
<i>Shower:</i>	<i>0.05 l to 0.10 l/s at 40 °C</i>
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<i>Power shower:</i>	<i>Up to 0.2 l/s at 40 °C</i>
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<i>Wash basin hot tap:</i>	<i>0.10 l to 0.15 l/s at 40 °C to 60 °C</i>
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<i>Kitchen sink</i>	<i>0.10 to 0.20 l/s at 60 °C</i>
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NOTE. Although temperatures of 40 °C are quoted above, these are achieved by mixing cold and hot water as required.



2.3.3 Gas water heaters in bathrooms

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

2.3.4 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 2.3.4

The cold water feed may be from a supply pipe or from a storage cistern. The water drawn 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.

2.3.5 Storage-type hot water systems**2.3.5.1 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 2.2.2). Whichever system is installed, it shall conform to the relevant requirements of 2.4.

COMMENTARY AND RECOMMENDATIONS ON 2.3.5.1

Except for supplies to dual stream fittings, mixing fittings should be supplied with comparable hot and cold water supply pressures.

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 water storage cistern, into which it is arranged to vent. Explosion protection involving no mechanical devices is provided by the open vent and the cistern.

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

- 1) Explosion protection is provided by safety devices.*
- 2) Systems depend upon pressure continuity and the hot water flow cannot be guaranteed if pressures fall.*
- 3) In unvented systems supplied from a supply pipe the absence of a storage cistern may reduce the risk of frost damage to property 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 the building regulations (see A.1).*

2.3.5.2 Storage water heaters**2.3.5.2.1 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 the outlet shall not be controlled by a valve or tap.

Commentary and recommendations on 2.3.5.2.1

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, provided the tap outlet remains unobstructed.

2.3.5.2.2 Pressure or outlet controlled type

The heater shall be suitable for the supply pressure and there shall be appropriate arrangements to accommodate expansion of the heated water.

COMMENTARY AND RECOMMENDATIONS ON 2.3.5.2.2

Many pressure-type water heaters are designed to be supplied from a storage cistern only and will not withstand mains water pressures.

For installations in small dwellings a capacity of 100 l to 150 l is sufficient to provide a hot water supply including a supply to a bath. Heaters designed to take advantage of off-peak electricity tariffs may have a capacity of 200 l or more.

2.3.5.3 Storage vessel with electric immersion heater

The storage vessel shall conform to the relevant requirements of 2.6 and shall be corrosion resistant. The immersion heater or heaters shall conform to BS 3456 : Section 2.21; all electrical controls shall conform to BS 3955.

Immersion heaters and controls shall be so located that insertion, removal and adjustment can easily be performed.

The insertion of an immersion heater into the storage vessel of an indirect system provides direct heating so far as the immersion heater is concerned and the safety controls appropriate to a direct system shall be fitted.

COMMENTARY AND RECOMMENDATIONS ON 2.3.5.3

This appliance is site assembled, and it is important to ensure that it is protected against bursting in accordance with 2.4 for a direct system and that any backflow prevention devices required by 2.6 are correctly fitted.

Immersion heaters form a convenient means of providing supplementary water heating in systems combining hot water supply and space heating (see 2.3.5.6).

2.3.5.4 Boiler heated hot water systems

Boiler heated hot water systems specified in this standard comprise a hot water storage vessel and an independent heating appliance, a back-boiler associated with an open fire or room heater, a boiler incorporated in a cooker, or a gas-fired circulator.

2.3.5.5 Direct and indirect systems

Direct systems shall be designed to achieve gravity circulation between boiler and storage vessel. In hard water areas where scale deposition may obstruct pipes an indirect system shall be used.

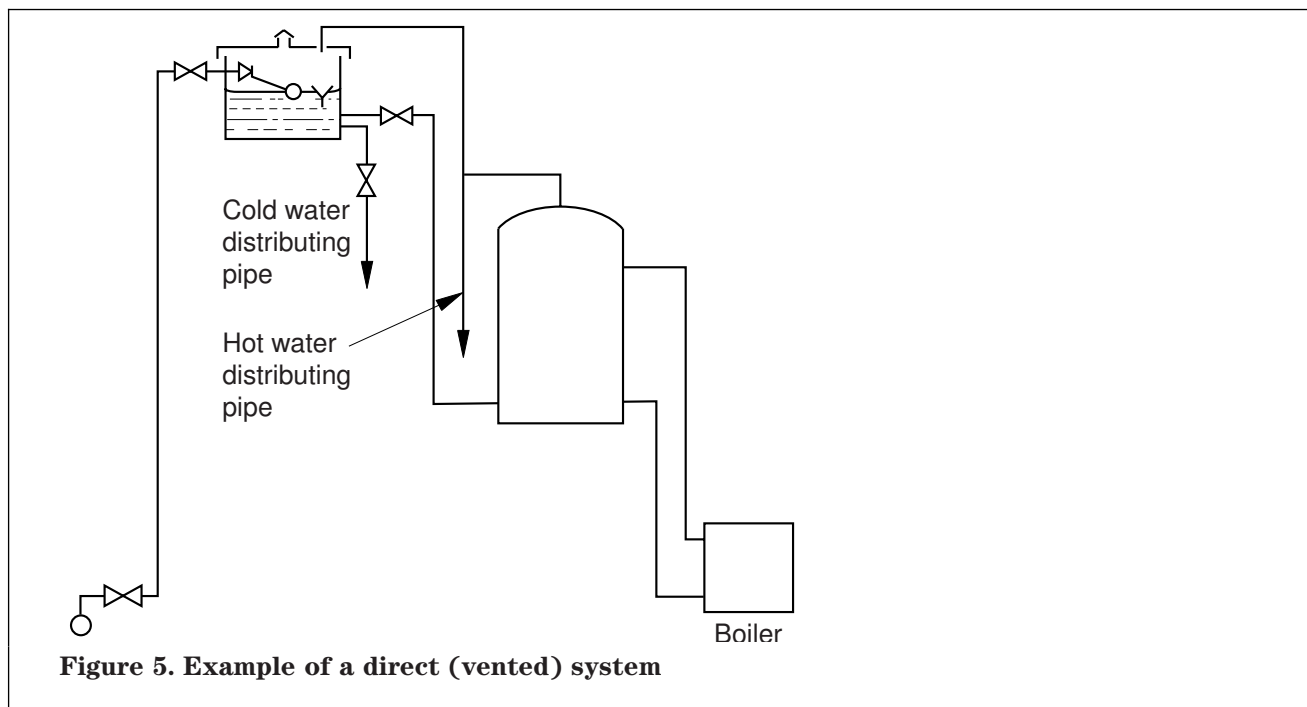
An indirect system shall be used when domestic hot water and hot water central heating are supplied by the same boiler. The primary circuit of an indirect system shall either be cistern fed and vented, or be filled and sealed.

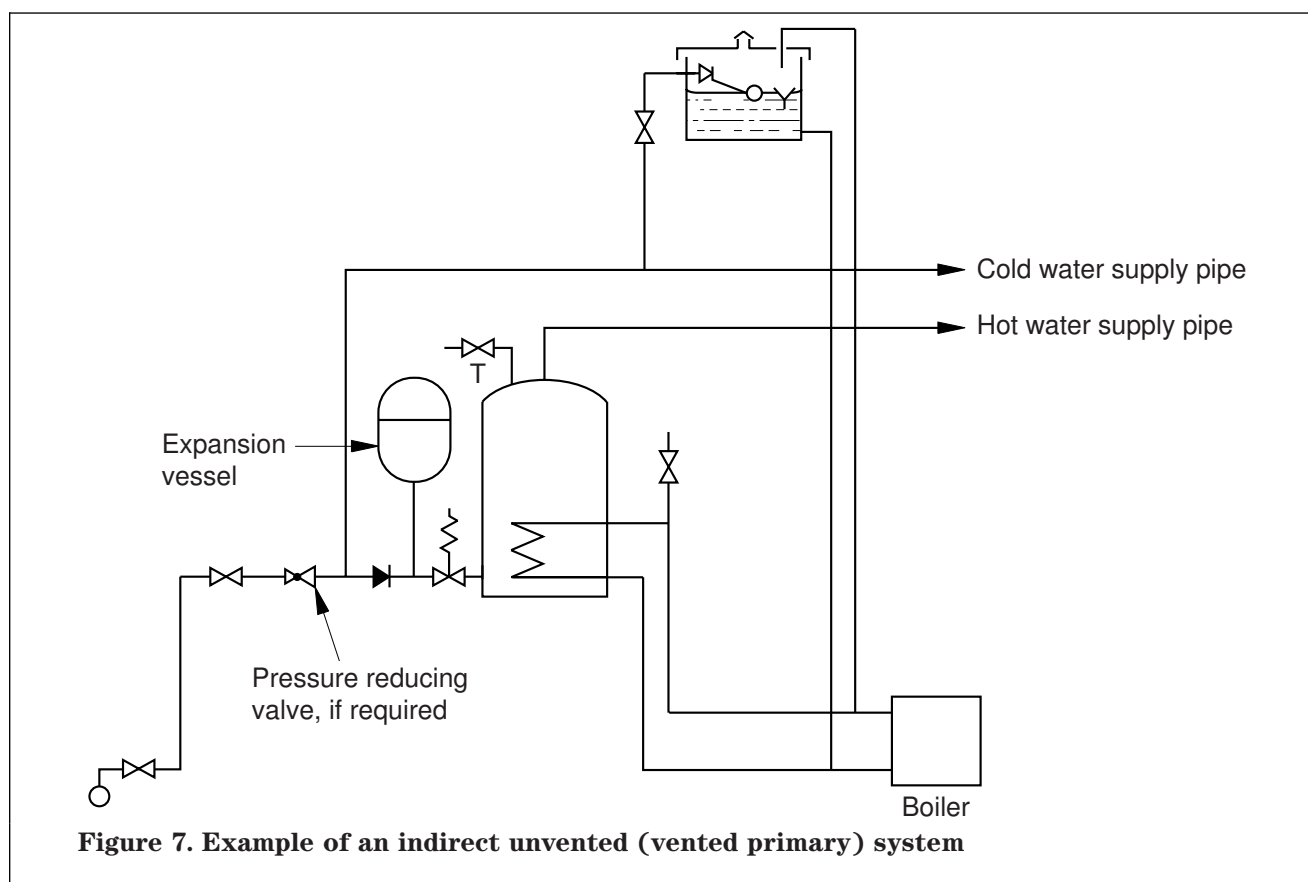
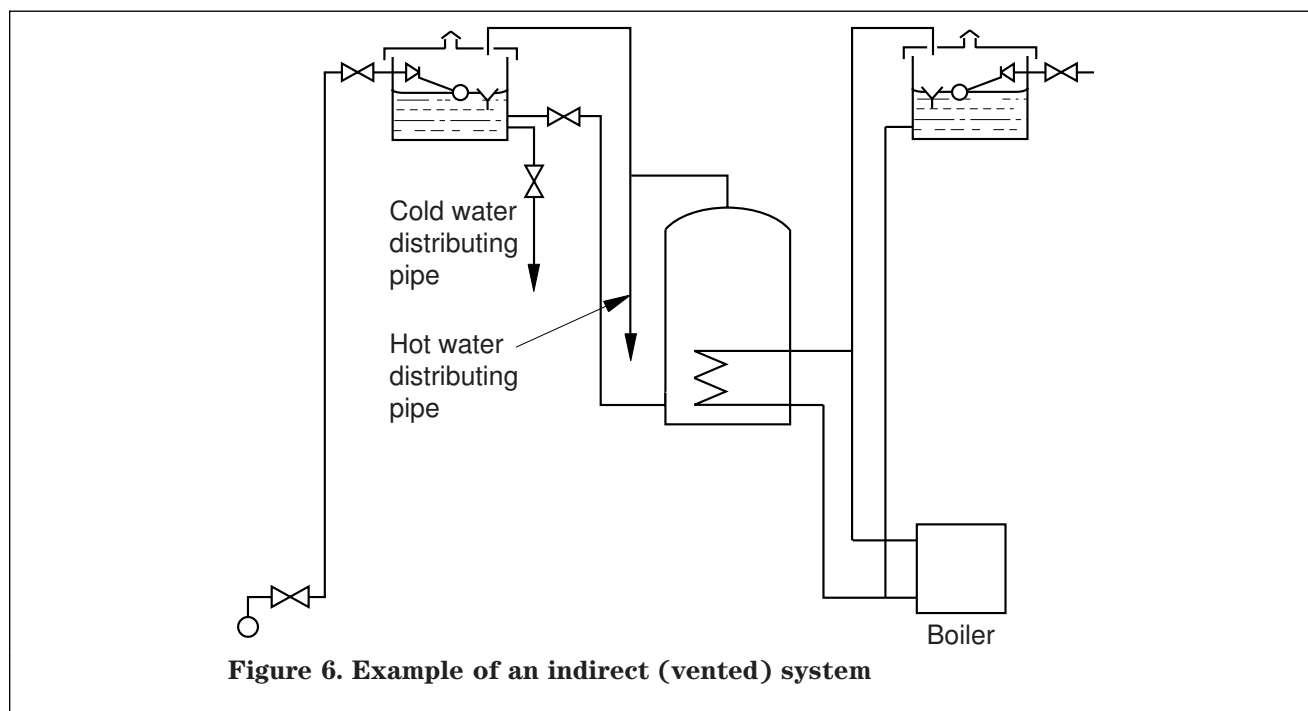
Primary circuits shall not be permanently connected to a supply pipe. A temporary connection via a double check valve assembly permanently installed in the primary circuit is permissible for filling, or flushing the primary circuit. Any temporary connection of this kind shall be made only for such time as is necessary to carry out the task in question.

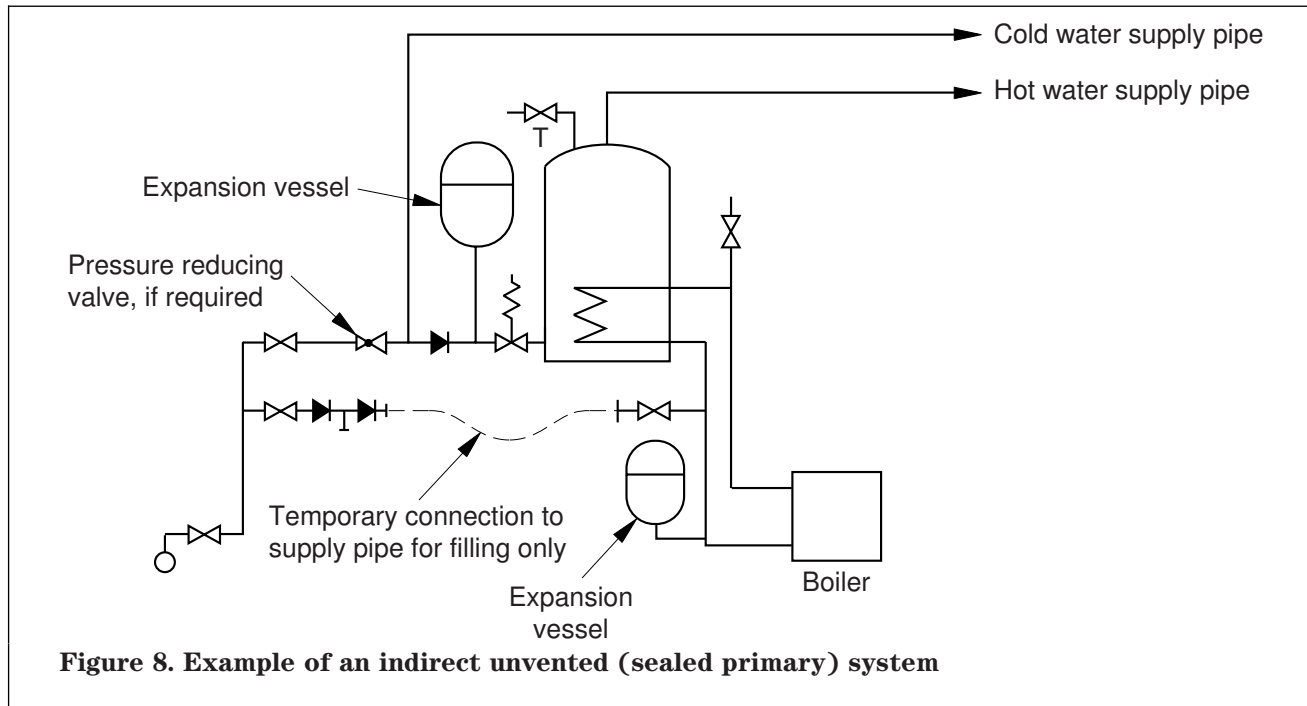
When gravity circulation is required the storage vessel shall be located at a sufficient height above the boiler. Flow and return pipes shall have a route and bore appropriate to the duty required and circulating head available.

COMMENTARY AND RECOMMENDATIONS ON 2.3.5.5

This standard includes direct and indirect, vented and unvented systems. Figures 5 to 8 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.







2.3.5.6 Domestic hot water primary circuits

2.3.5.6.1 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. A feed and expansion cistern for a double feed primary circuit shall accommodate 4 % expansion of the volume of the water in the circuit. 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 route are combined, the boiler and primary circuit shall have the protection specified in 2.4 for a sealed primary circuit and the combined route shall not include any valve, pump or any impediment to flow.

For domestic installations the vent shall not be less than 19 mm bore (see 2.4.2.3). 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.

COMMENTARY AND RECOMMENDATIONS ON 2.3.5.6.1

This requirement does not exclude the use of a close-coupled feed and vent where this is installed in accordance with BS 5449. Pipes should be installed to avoid air locks and laid to falls to facilitate draining.

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 should be connected to separate connections on the boiler or should be combined by means of an injector type fitting installed near the boiler, unless the manufacturers' instructions specify otherwise.

2.3.5.6.2 Sealed primary circuits

Pipes sizes in sealed primary circuits shall conform to the relevant requirements for vented primary circuits specified in 2.3.5.6.1. 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 2.4 and 2.6 shall be conformed to in every case.

2.3.5.7 Double feed and single feed primary circuits

The primary circuit shall either be fed independently of the secondary system, e.g. double feed primary circuit, or be fed from the secondary system by using a hot water cylinder incorporating a special primary heat exchanger, i.e. single feed primary circuit. 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 conform to BS 1566 : Part 2 and shall be installed in accordance with the cylinder and appliance manufacturers' instructions;
- b) where the primary circuit 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 followed.

2.3.6 Supplementary water heating and independent summer water heating

Where supplementary electric heating is to be used in conjunction with a boiler, the height of the storage vessel above the boiler shall not be less than 1 m in order to prevent circulation of hot water from the storage vessel to the boiler.

COMMENTARY AND RECOMMENDATIONS ON 2.3.6

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; a heat pump or from solar energy. Supplementary hot water may also be provided in the form of a single point gas or electric heater at the point of use.

2.3.7 Water heating by solar energy

Solar water heating shall be in accordance with BS 5918.

COMMENTARY AND RECOMMENDATIONS ON 2.3.7

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

2.3.8 Secondary distribution systems

In hot water systems incorporating a hot water storage vessel, the hot water supply or distributing pipe 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 2.3.8

Secondary water systems should be 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.

To promote maximum economy of fuel and water the hot water distribution system should be designed so that hot water appears shortly after the taps are opened. To this end terminal branches 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 delivery 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 closer to those delivery points or insulating and electrically trace heating the flow pipework (see 2.7.4).

As an alternative a secondary circuit with flow and return pipes to the storage vessel could be considered but secondary circuits inevitably dissipate heat and should be avoided where possible. 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 there is one. (see 2.4).

2.3.9 System components

2.3.9.1 Cold feed pipe

The cold feed pipe to the hot water storage vessel or water heater shall be sized in accordance with 2.5. It shall discharge near the bottom of the heaters or storage vessels and if the system is cistern fed this pipe shall not supply any other fitting. 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 servicing valve or stopvalve with a fixed washer plate shall be provided in a convenient and accessible position in every cold feed pipe other than those to a vented primary circuit which shall have a valve only when the capacity of the expansion cistern exceeds 18 l (see 2.3.5.6.1).

In direct type boiler systems the cold feed pipe and the return pipe to the boiler shall have their own connections to the hot water storage vessel.

2.3.9.2 Open vent pipe

The vent pipe to a storage type hot water system shall be taken 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 vent pipe and/or air entrainment into the system under normal working conditions. Due allowance shall be made for the head induced by any circulating pump used (see BS 5449 : Part 1).

For gravity circulation systems this height shall be not less than 150 mm plus 40 mm for every metre 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 end except where it is permitted to be bent so as to terminate downwards (see figures 5 and 6). Vent pipes shall not be 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:

- 1) the energy supply to each heater under thermostatic control;
- 2) the energy supply to each heater fitted with a temperature-operated manually reset energy cut-out independent of the thermostatic control; and
- 3) a temperature relief valve in accordance with BS 6283 : Part 2, or a combined temperature and pressure relief valve in accordance with BS 6283 : Part 3, e.g. as required by BS 7206 and BS 3456 : Part 102 : Section 102.21 and BS EN 60335-2-21.

2.3.9.3 Hot water storage vessels

2.3.9.3.1 General

Storage vessels shall conform to BS 699, BS 853, BS 1566 : Parts 1 and 2, BS 3198 or BS 7206, as appropriate.

COMMENTARY AND RECOMMENDATIONS ON 2.3.9.3.1

It is recognized that special copper cylinders, that are not covered by British Standards, may be required where standard cylinders will not fit. The primary heaters in these cylinders should conform to BS 1566 : Part 1 (double feed) and Part 2 (single feed).

Apart from pressure considerations, the grade (wall thickness) of copper storage vessels, and also the need for protector rods, should be determined on the basis of the type of water supplied in the area. If necessary, the water supplier's advice should be sought.

2.3.9.3.2 Hot water storage capacities

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

COMMENTARY AND RECOMMENDATIONS ON 2.3.9.3.2

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.

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

2.3.9.3.3 Insulation

The storage vessels shall be thermally insulated either by a jacket in accordance with BS 5615 or by factory applied thermal insulation in accordance with BS 699, BS 1566 or BS 3198, as appropriate, and in accordance with building regulations (see A.1). Where a segmented insulating jacket is used the segments of the jacket shall be taped together to provide a complete insulation cover for the storage vessel.

2.3.9.4 Cisterns and expansion vessels

Feed cisterns, expansion cisterns, combined feed and expansion cisterns and expansion vessels shall conform to BS 417, BS 4213, BS 4814 or BS 6144, as appropriate.

A cistern used only to feed the hot water supply system shall conform to all the requirements for a cold water storage cistern (see 2.2.3). 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 delivery 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 feed and 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 2.6.3.4.2) or shall conform to 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 close 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.

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.

COMMENTARY AND RECOMMENDATIONS ON 2.3.9.4

The use of float operated valves incorporating a drop lever is the preferred method of controlling a low level of water in the feed and expansion cistern to a primary circuit.