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Code of Practice for

Centralized hot water supply —

Part 2: Buildings other than individual dwellings

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Code drafting committee
BLCP/38- Hot water supply

Chairman	Mr D L Mumford
British Gas Corporation	Mr J V Sutton
	Mr A B Baldwin
British Waterworks Association	Mr J S W Bath
	Miss N C Popkin
Department of the Environment	Miss P R Tindale
Department of Health and Social Security	Mr D L Mumford
Domestic Solid Fuel Appliance Approval Scheme	Mr R J Godliman
Federation of Associations of Specialist and Sub-Contractors	Mr P A Curtis
Greater London Council	Mr R J Dickson
Heating and Ventilating Contractors' Association	Mr P D Emes
Institution of Gas Engineers	Mr J V Sutton
National Coal Board	Mr C E Knight

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

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

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 24, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

Amendments issued since publication

Amd. No.	Date of issue	Comments

Contents

0 Introduction

0.1 A centralized hot water supply installation may include the following:

1) a cold water feed cistern with cold water supply connection (see CP 310);

2) a cold water feed pipe from feed cistern;

3) a feed and expansion cistern or pressurizing unit;

4) *a*. a boiler which may be one of the following types: solid fuel, oil fuel, gas or electric together with a hot water storage vessel; or

b. a non-storage calorifier together with a hot water storage vessel; or

c. a storage calorifier;

5) a supplementary heating unit;

6) pipework, valves, and draw-off taps;

7) supplementary fittings, e.g. towel rails;

8) circulating pumps;

9) thermal insulation;

10) automatic controls;

11) electrical equipment, wiring and connections.

0.2 A complete installation may involve a variety of trades, and it is in the interest of safety and good workmanship that work and services applicable to specific trades be confined to such trades.

0.3 Where the main contractor supplies the following services they should be punctually provided when called for:

1) hoisting facilities;

2) supply and erection of scaffolding and ladders;

3) construction of plant bases;

4) cutting away and making good;

5) carpentry and joinery;

6) decorating and painting;

7) cold water storage cistern with cold water pipes to and from the cistern, also connections to hot water draw-off points from the stopvalve (where provided) for a single fitting and from the outlet tee on the float of a range of fittings;

8) electrical wiring and connections;

9) temporary artificial lighting and cold water supply for installation purposes;

10) fuel, power and water for testing and for application of thermal insulation.

0.4 Centralized hot water supply installations are to comply with the byelaws of the local water undertaking.

0.5 All electrical cables and apparatus used for the installation are to be installed in accordance with the current edition of the "Regulations for the Electrical Equipment in Buildings" published by the Institution of Electrical Engineers.

0.6 All gas fired installations are to comply with the requirements of The Gas Safety Regulations, 1972.

0.7 Where applicable the requirements of the following regulations are to be observed:

1) The Building Regulations 1972, applicable in England and Wales except Inner London,

2) The Building Standards (Scotland) (Consolidation) Regulations, 1971.

3) The London Building Acts 1930 to 1939 and constructional by-laws in force thereunder.

Where the expression "compliance with the relevant Building Regulations" is used, it means compliance with the above regulations or any revision currently in force.

1 General

1.1 Scope

Part 2 of this Code offers guidance on the designing, planning, installation, inspection and testing of systems of hot water supply in commercial, industrial or multiple dwelling buildings supplied from a central source, including district or group schemes.

Systems for use in individual dwellings are covered in Part 1.

This Code does not deal with the installation work required for the supply of steam or high pressure hot water to calorifiers (see **3.17.2**).

Non-storage hot water supply appliances are not included in this Code. Reference should be made to CP 333 and CP 324. 202.

NOTE The titles of the British Standards referred to in this Code are listed on pages 24 and 25.

1.2 Definitions

For the purposes of this Code of Practice, the following definitions apply:

1.2.1
automatic air eliminator

a self-operating device for automatically releasing air from a water system

1.2.2
battery

the internal heating element of a calorifier comprising tubes, coils or radiator sections

1.2.3
calorifier

a heat exchanger in which water is heated by another fluid, generally at pressures in excess of atmospheric, through the medium of an internal heating element

1.2.4
combined system

a system supplying space heating and domestic hot water from a single source

1.2.5
dead leg

a length of hot water pipe leading to a draw-off point and not forming part of a circuit

1.2.6
design flow rate

the rate of water flow used in the design calculations

1.2.7
direct system

a system in which the water supplied to the draw-off points has been directly heated in the boiler

1.2.8
distributing pipe

any pipe conveying water from a storage cistern, or from a hot water apparatus supplied from a feed cistern, and under pressure from that cistern or apparatus

1.2.9
draught stabilizer

a fitting for limiting the draught in a flue to a predetermined maximum

1.2.10
fan-diluted flue system

a forced draught flue system in which the products of combustion from a gas installation are diluted, normally to a value not exceeding 1 % CO_2, with air taken preferably direct from outside

1.2.11
indirect cylinder

a hot water storage vessel in which water is stored and heated by means of an internal element through which hot water is circulated in such a manner that it does not mix with the stored water

1.2.12
indirect system

a system in which the water supplied to the draw-off points has been indirectly heated in an indirect cylinder or calorifier

1.2.13
maximum demand

the total rate of water flow when all draw-off points are in use simultaneously

1.2.14
mechanical draught

the use of a fan, usually electrically driven, to promote the movement of gases passing through the boiler and/or chimney

1.2.15
pressurizing unit

a vessel that is connected to a hot water system for accommodating increases in volumes due to expansion and/or to provide an adequate pressure

1.2.16
primary circuit

a circuit in which water circulates between a boiler or other water heater and a hot water storage vessel

1.2.17
probable demand

a rate of flow less than the maximum demand rate based on the number of draw-off points which probably may be in use simultaneously

1.2.18
secondary circuit

a circuit in which water circulates from and back to a hot water storage vessel

1.2.19
service pipe

so much of any pipe, for supplying water from a main to any premises, as is subject to water pressure from that main, or would be so subject but for the closing of some stopvalve

1.3 Exchange of information

1.3.1 At the planning stage the following matters should be agreed or determined by the installation designer, in consultation, where appropriate, with the building designer:

1) fuel to be used;

2) location and dimension of boiler house or calorifier chamber and the plant loads imposed on the structure;

3) location and dimension of fuel store and access;

4) means of ash disposal;

5) location and dimensions of chimney;

6) location of the cold water cistern, having regard to its size in relation to the maximum demand, its elevation as determining the head available, protection against frost and the weight to be supported;

7) location of pipe runs and the size of all main ducts and trenches;

8) location and sizes of holes for pipes in the building which have to be preformed, e.g. in the case of prestressed or reinforced structural members;

9) drainage facilities for emptying the installation;

10) character of water supply;

11) details of gas and electricity supply, including location and size of meters;

12) adequate provision of air for combustion and ventilation;

13) details of boiler house noise attenuation relative to:

a. the plant and equipment

b. the structure.

1.3.2 The installation designer should be supplied with scale drawings of the premises including plans and sectional elevations.

1.3.3 The installation designer should issue:

1) drawings to scale, indicating the layout of the heating unit, storage vessel, circulating pump, cold water cistern and feed pipe, pipe runs and sizes, drying coils, towel rails, draw-off points, drain points, vent pipes and meters;

2) a full specification of the complete system stating capacities, ratings and conditions of performance to comply with the specific requirements;

3) a schedule of builders' work and a set of drawings of builders' work;

4) electrical wiring and control diagrams.

1.3.4 The installation contractor should provide and be responsible for all drawings relating to special fabrication of pipes and, where so covered by the contract, assemblies of plant items.

1.3.5 The installation contractor should provide record drawings on which all work as installed is clearly shown and a set of operating and maintenance instructions including a list of recommended spares.

1.4 Programming

1.4.1 The installation of the hot water supply system should proceed in accordance with the general programme of operations for the construction of the entire project. The general programme should be prepared in consultation with all interested trades, as it is desirable that the installation of the hot water supply should proceed concurrently and in phase with the work of other contractors.

Before the installation contractor's work is due to commence, space for an adequate lock-up store and workshop accommodation should be provided. Racking for the storage and protection of pipes should be provided.

The installation contractor should ensure that all builder's work necessary to meet the phased progress of the work has been completed.

Priority should be given to completion of the boiler house, fuel store and plant room so as to facilitate delivery and erection of boilers, calorifiers, storage vessels, mechanical stokers and any other heavy plant. Suitable access should be provided.

On completion of the installation or sections of the installation, the system should be tested and inspected for water-tightness; thermal insulation should then be applied and a test carried out under working conditions.

2 Materials, appliances and components

2.1 British Standards

All materials, appliances and components used in the work described in this Code should comply with the requirements of the latest edition of any applicable British Standard.

Where no British Standard exists, materials and equipment should be of suitable quality and workmanship and should be open to inspection at the manufacturer's works before despatch. The detailed specification of all materials for which there is no British Standard should be available.

2.2 Boilers

2.2.1 Boilers may be classified broadly under two headings:

1) hot water supply boilers which are designed for the direct heating of the water actually drawn off, and

2) hot water supply boilers which are designed for the indirect heating of water actually drawn off.

2.2.2 The British Standards applicable to boilers are as follows:

BS 779, *Cast iron boilers for central heating and hot water supply*.

BS 855, *Welded steel boilers for central heating and hot water supply*.

Boilers fired by gas preferably should be approved by the British Gas Corporation.

2.3 Combined boiler and cylinder units

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

2.4 Materials for boilers and internal treatment

The material of which the boiler is made or the protective treatment thereof should be suitable for the water supply, particularly in a direct system.

2.5 Boiler mountings

2.5.1 General. For the purpose of this Section, boiler mountings include relief valves, draining taps, thermometers, water temperature controllers, open vent pipe tappings and altitude gauges. Pending the issue of a British Standard dealing specifically with mountings for hot water boilers, this Code recommends that thermometers and relief valves should comply with the requirements for those items as set out in BS 759 or BS 779.

2.5.2 Relief valves. Boilers should be fitted with a direct acting spring loaded valve. Provision should be made for this to be mounted directly on the boiler.

2.5.3 Draining taps. Boilers should have provision for the fitting of draining taps which should comply with the requirements of BS 2879. Where provision is not made or where site conditions are such that the tap cannot be mounted directly on the boiler, it should be inserted in the lowest point of the system connected to the boiler.

2.5.4 Thermometers. Boilers should be fitted with a thermometer. Provision should be made for this to be mounted directly on the boiler preferably in a well.

2.5.5 Water temperature controls. Boilers should have provision for a water temperature controller.

2.5.6 Open vent pipes. Boilers should have a tapping for an open vent pipe.

2.5.7 Altitude gauges. Boilers should be fitted with an altitude gauge. Provision should be made for this to be mounted directly on the boiler and fitted with an isolating cock.

2.5.8 Safety controls for automatically fired and controlled boilers. Automatically fired and controlled boilers should be provided with safety controls in compliance with their respective British Standard specifications and Codes of Practice.

2.6 Flue pipes

2.6.1 The British Standards applicable to flue pipes are as follows:

BS 41, *Cast iron spigot and socket flue or smoke pipes and fittings*.

BS 567, *Asbestos cement flue pipes and fittings (light quality)*.

BS 835, *Asbestos cement flue pipes and fittings, heavy quality*.

Flue pipes should be of a material and grade suitable for the fuel to be used and for the outlet temperature of the flue gases.

2.6.2 Where mild steel flue pipe is used the thickness of plate should be not less than 4.5 mm for sizes up to 300 mm diameter or the equivalent area, and not less than 6.5 mm above that size.

Joints should be of the flanged type with internal spigot.

2.6.3 Asbestos-cement flue pipes for use with gas boiler installations, where the flue diameter does not exceed 150 mm, should be in accordance with BS 567 and where the flue diameter exceeds 150 mm should be in accordance with BS 835 (see CP 337).

Asbestos-cement flue pipes are not generally suitable for use with solid fuel or for the majority of liquid fuel boilers.

2.7 Tools for cleaning and maintaining boilers

A set of tools as recommended by the manufacturer should be provided for the cleaning and maintenance of the boiler.

2.8 Calorifiers

The British Standard applicable to calorifiers is as follows:

BS 853, *Calorifiers for central heating and hot water supply*.

2.9 Calorifier mountings

2.9.1 For the purpose of this Clause, calorifier mountings include thermometers, relief valves, altitude gauges, water temperature controllers, draining taps, air release valves and open vent pipe tappings. Pending the issue of a British Standard dealing specifically with mountings for calorifiers, this Code requires that thermometers, relief valves and bursting discs should comply with the requirements for these items as set out in BS 853.

2.9.2 Calorifiers should be fitted with the following items.

1) A thermometer, fitted in a well, to indicate the temperature of the storage water.

2) A relief valve, and in addition wherever possible an open vent pipe. Where an open vent pipe cannot be fitted, protection should be provided to prevent vacuum collapse of the calorifier.

3) A bursting disc on a water to water calorifier where the shell is not of sufficient strength to withstand the primary pressure in the event of failure of the primary element.

4) A water temperature controller for steam-to-water calorifiers; also for any water-to-water calorifier where the normal working temperature of the primary water could cause a rise in temperature of the secondary water above its designed working temperature. The sensing element of the controller should be fixed clear of the internal heating element.

5) A draining tap on the secondary side except where it is proposed to provide a draining facility by means of a connection to a tee in the cold feed pipe immediately below the vessel.

6) An air release valve or open vent pipe on the primary side where air is likely to be trapped.

7) An altitude gauge on the secondary side.

2.10 Hot water storage vessels (other than storage calorifiers)

The British Standards applicable to hot water storage vessels are as follows:

BS 417, *Galvanized mild steel cisterns and covers, tanks and cylinders.*

BS 699, *Copper cylinders for domestic purposes.*

BS 843, *Thermal-storage electric water-heaters (constructional and water requirements).*

BS 1563, *Cast iron sectional tanks (rectangular).*

BS 1564, *Pressed steel sectional tanks (rectangular).*

BS 156, *Galvanized mild steel indirect cylinders, annular or saddle-back type.*

BS 1566, *Copper indirect cylinders for domestic purposes — Part 1: Double feed indirect cylinders.*

Storage vessels should be of the grade appropriate to the working head.

2.11 Hot water storage vessel mountings

For the purpose of this Clause, mountings include thermometers and draining taps.

If a thermometer is fitted it should be of such a type and so fitted as to permit it to be readily replaced without emptying the vessel. It should be placed so as to be easily readable and at or near the mid-point of the vessel.

A draining tap should be fitted to each vessel which cannot be emptied through the boiler or calorifier, or where more than one vessel is connected to the boiler or calorifier.

2.12 Cold water feed cisterns

The British Standards applicable to cold water feed cisterns are as follows:

BS 417, *Galvanized mild steel cisterns and covers, tanks and cylinders.*

BS 1563, *Cast iron sectional tanks (rectangular).*

BS 1564, *Pressed steel sectional tanks (rectangular).*

BS 2777, *Asbestos-cement cisterns.*

BS 4213, *Polyolefin or olefin copolymer moulded cold water storage cisterns.*

2.13 Pipes and pipe fittings

The British Standards applicable to pipes and pipe fittings are as follows:

BS 21, *Pipe threads.*

BS 143, *Malleable cast iron and cast copper alloy screwed pipe fittings for steam, air, water, gas and oil & BS 1256.*

BS 864, *Capillary and compression tube fittings of copper and copper alloy — Part 2: Metric units.*

BS 1387, *Steel tubes and tubulars suitable for screwing to BS 21 pipe threads.*

BS 1740, *Wrought steel pipe fittings (screwed B.S.P. thread).*

BS 2871, *Copper and copper alloys. Tubes — Part 1: Copper tubes for water, gas and sanitation.*

BS 4127, *Light gauge stainless steel tubes.*

2.14 Electric immersion heating elements

The British Standard applicable to electric immersion heaters is as follows:

BS 3456, *The testing and approval of household electrical appliances — Section A8. Electric immersion heaters.*

2.15 Valves

2.15.1 Fullway gate valves should be used only for regulation and normal control purposes. They are not considered satisfactory for positive isolation purposes; for positive isolation in circulating pipes, stop valves of the screwdown pattern having oblique or inclined spindles complying with the requirements of BS 2060 or alternatively, lubricated plug valves, should be used. For positive isolation of dead leg pipes serving one or more draw-off taps, stopvalves of the screwdown pattern, complying with the requirements of BS 1010 should be used. Plug cocks having ground-in plugs should not be used.

Circuit isolating valves should be provided with a non-corrodible label of a size not less than 75 mm by 50 mm by 1.5 mm on which the valve function or reference number should be clearly marked.

The British Standards applicable to valves are as follows:

BS 1010, *Draw-off taps and stopvalves for water services (screwdown pattern).*

BS 1952, *Copper alloy gate valves for general purposes*.

BS 2060, *Copper alloy screw-down stop valves for general purposes*.

2.15.2 The British Standard applicable to ballvalves is as follows:

BS 1212, *Ballvalves (excluding floats) — Part 1: Piston type — Part 2: Diaphragm type (brass body) — metric units*.

2.15.3 The British Standards applicable to floats for ballvalves are as follows:

BS 1968, *Floats for ballvalves (copper).*

BS 2456, *Floats for ballvalves (plastics) for cold water*.

2.15.4 The British Standard applicable to manually operated non-thermostatically controlled mixing valves is as follows:

BS 1415, *Mixing valves (manually operated) for ablutionary and domestic purposes*.

2.16 Taps

2.16.1 The British Standard applicable to draw-off taps is as follows:

BS 1010, *Draw-off taps and stopvalves for water services (screwdown pattern).*

2.16.2 The British Standards applicable to draining taps are as follows:

BS 1010, *Draw-off taps and stopvalves for water services (screwdown pattern).*

BS 2879, *Draining taps (screwdown pattern).*

2.16.3 The British, Standard applicable to spray taps is as follows:

BS ...., *Spray taps*[1)].

2.17 Towel rails

Towel rails should be provided with control valves complying with the requirements of BS 2767 and an air cock, and any stay should be of finish equal to that of the towel rail.

Towel rails may incorporate a radiator, but if connected to a secondary circuit consideration should be given to the effects of internal corrosion.

2.18 Electrically driven circulating pumps

2.18.1 The British Standards applicable to electrically driven circulating pumps and associated motors and starters are as follows:

BS 170, *The electrical performance of fractional horsepower electric motors and generators*.

BS 587, *Motor starters and controllers*.

BS 1394, *Power driven circulators*.

BS 2613, *The electrical performance of rotating electrical machinery*.

2.18.2 Circulating pumps used in secondary circuits should have a non-overloading characteristic or alternatively, the motor should have a margin of power to avoid the overloading which may occur when operating against zero or even negative head at periods of considerable draw-off. Pumps should be constructed of materials suitable for the characteristics of the water supply. Where cast iron bodies have to be used they should be protected against rusting.

2.18.3 Electric motors should be suitable for the available electric supply conditions and for continuous running, having regard especially to the ambient temperature and conditions in the space in which the circulating pump is situated.

2.18.4 Couplings and belt drives should be protected by stoutly constructed guards, adequately supported and easily removable for maintenance purposes.

2.19 Thermal insulation

The British Standards applicable to thermal insulation are as follows:

BS 1334, *The use of thermal insulating materials for central heating and hot and cold water supply installations*.

[1)] In course of preparation

CP 3005, *Thermal insulation of pipework and equipment [in the temperature range of – 100 °F to + 1 500 °F (– 73 °C to + 816 °C)].*

The selection of the appropriate type of material should be governed by the considerations set out in 3.25.

3 Design

3.1 General

3.1.1 The design requirements for all types of buildings apply equally whether the system is direct or indirect and whether water is heated by solid fuel, gas or oil-fired boilers or by electricity, and whether the boiler or heating unit and storage vessel are close-coupled to form a single unit or are separate entities.

In multi-storey buildings the static head provided by a feed cistern at roof height may subject the lower draw-offs and components to excessive pressure. One alternative arrangement is that of vertical zoning, using feed cisterns and calorifier rooms at suitable intermediate heights.

3.1.2 Hot water is required for such purposes as ablutions, cleaning of buildings and apartments, laundering, dishwashing, and industrial purposes etc. The installation should supply hot water at the desired temperature and in sufficient quantity at the draw-off points without undue delay. A secondary circulation system, with flow and return pipes from and to the hot water storage vessel should therefore be used, and the length of a dead leg should be not greater than is shown in Table 1.

Table 1 — Maximum permissible lengths of dead legs

Largest internal diameter of pipe	Length
	m
Not exceeding 19 mm	12
Exceeding 19 mm but not exceeding 25 mm	8
Exceeding 25 mm	3

NOTE For a spray tap the maximum length of dead leg should be 1.0 m.

3.1.3 The performance of a hot water supply installation over a period of years is considerably influenced by the extent of the initial provision of facilities for efficient operation and maintenance; the responsibility for this should be shared by the building and installation designers. The requirements may be broadly classified under the following headings:

1) selection of suitable equipment and plant in respect of the character of water;

2) provision of access for servicing, maintenance and replacement of component parts of the installation;

3) provision of facilities for draining the installation;

4) provision of space for the operation of plant and the cleaning of flueways, waterways, burners, etc.

Adherence to the recommendations in the Code will provide a reasonable degree of facility for maintenance and operation, but these recommendations are not solely matters of engineering ingenuity and workmanship. At a very early stage of the planning of the building, consideration should be given by the building and installation designers, in the interests of the owner and the user, to the allocation of sufficient space for plant, pipe runs and fixings.

Indicating instruments, such as thermometers and pressure gauges, and safety appliances should be placed where the operating attendant is able to observe their readings and to satisfy himself that the safety appliances are maintained in a proper condition. The location should be well lit and have adequate headroom.

Where it is known that the plant room will be unattended then the installation contractor should satisfy himself that adequate automatic safety controls have been incorporated into the installation.

3.2 Temperatures

3.2.1 The following temperatures at the draw-off points are generally acceptable:

Baths	48 °C to 60 °C
Showers	43 °C
Basins	43 °C to 60 °C
Kitchen sinks	60 °C

The advice or guidance of the appropriate authority should be obtained for premises such as primary schools, hospitals and old peoples' homes where it may be necessary, for safety reasons, to supply hot water to the draw-off points at temperatures lower than those shown above. This may be achieved by the use of thermostatically controlled mixing valves, or by the use of locally sited hot water storage vessels or calorifiers, suitably controlled.

Higher temperatures, where specially required, e.g. in laundries, kitchens, etc., may be achieved by the use of local booster heaters.

It is recommended that, in general, the temperature of the stored hot water should not exceed 65 °C. A higher temperature may allow a reduction in the amount of water storage necessary, but should only be adopted after consideration of the character of the water and of the amount of scale likely to be formed in the system; it may be necessary to provide a water mixer to enable the water to be available at the desired temperature; it may also be necessary to increase the thickness of insulation.

3.3 Consumption and storage

In the absence of specific information or instructions regarding conditions of maximum consumption and draw-off the design should be based on the tables contained in the Guide published by the Institution of Heating and Ventilating Engineers.

3.4 Particular requirements for individual dwellings

For general recommendations see Part 1 of this Code.

3.5 Character of water

3.5.1 The type of system, the choice of materials and the jointing used in the installation should be based on a full knowledge of the character of water, and the experience and recommendations of the local water undertaking. The character of water may vary from hard to very soft, and due account should be taken of the liability to corrosion and the formation of scale or sludge. (See CP 310.)

3.5.2 Hard waters are liable to form scale or sludge, the amount of which depends not only upon the temporary hardness of the water but also upon the maximum temperature attained.

Electrolytic corrosion tends to occur whenever dissimilar metals are in contact in the presence of water, and such corrosion is normally relatively intense at the point of contact.

If copper pipes were to be used in conjunction with a galvanized steel hot water storage vessel, or vice versa, severe corrosion might occur at the point of contact; in addition, copper from a cupro-solvent water, which has passed through copper pipes or copper alloy fittings may be "plated out" on a galvanized steel surface, leading to severe local pitting. For these reasons the use of such dissimilar metals together cannot be regarded as good practice, though if it is considered desirable on economic grounds the metals may sometimes be separated by a fitting of non-metallic composition which should be capable of withstanding hot water at the design temperature. This will prevent the local attack at the junction but will not influence the general corrosion due to dissolved copper in the water.

Where the water is hard a protective layer of scale may be rapidly deposited in a hot water installation and may protect the underlying metal against electrolytic action. Experience is usually available in any particular area to indicate whether in fact dissimilar metals can be joined with safety, though it should be remembered that the possibility of electrolytic action is always present.

3.5.3 Soft waters whilst not conducive to scale formation may lead to severe corrosion of unprotected iron and steel and in such circumstances non-ferrous materials should be used. Where cast iron is essential the parts which come into contact with the water should be protected. Soft waters in certain cases may be plumbo-solvent or cupro-solvent (that is, capable of taking lead or copper into solution) and special precautions may be necessary.

3.5.4 Some supply waters cause water fittings made of duplex brass to suffer the form of corrosion known as dezincification, which converts the brass to porous copper and can result in seepage of water or failure of the fitting. The products of corrosion may obstruct the waterways by the formation of a white bulky adherent mass: this is known as meringue dezincification. Where this occurs fittings should be of copper, gun-metal or alpha brass (inhibited against dezincification), or other suitable copper alloy which is resistant to dezincification.

3.5.6 Where the water supply is particularly corrosive or scale forming, the storage vessel should be an indirect cylinder or calorifier.

3.6 Standby plant

3.6.1 Standby plant may be required to avoid interruption of hot water supply by failure of mechanical or electrical equipment or interruption of mains supplies.

3.6.2 Requirements vary according to the class and size of the building, the character of the water and the extent to which the installation is dependent upon mechanical and electrical equipment. In some buildings it will be sufficient to provide two water heating units, each of half capacity, instead of one unit of full capacity. In other cases, where such a reduction in capacity will cause inconvenience, two units each of two-thirds of the calculated load or a complete standby may be necessary.

When an electrically driven circulating pump is used standby provision may be provided by a duplicate pump and motor. Alternatively, if the arrangement allows for easy disconnection of the motor, a duplicate motor only may suffice. Where a constant hot water supply is essential consideration should be given to connecting all electrical equipment to local electrical generating plant, if available.

3.7 Sump pumps

Where draining pipes discharge into a sump that is below the level of the drainage system, a float-operated sump pump should be installed, to discharge into a convenient gully. The sump should be covered and the pump fitted with a foot-valve and strainer.

3.8 Boilers

3.8.1 Boiler power. In the absence of specific information or instructions regarding conditions of maximum consumption and draw-off, the boiler power should be based on a heat-up period as recommended in the tables contained in the Guide published by the Institution of Heating and Ventilating Engineers.

3.8.2 Delivery and storage of fuel and disposal of ash. For the satisfactory operation of a hot water supply installation using solid or liquid fuel the provision of adequate means for the delivery and storage of fuel and in the case of solid fuel for the disposal of ash is essential.

For the delivery and storage of solid fuel see IFA 2 Storage of Solid Fuel and Ash and IFA 3 Mechanical Handling of Solid Fuel and Ash, September, 1964, issued by the National Coal Board. For oil see CP 3002.

3.8.3 Ventilation of boiler house. Provision should be made for the correct size and location of air intakes for combustion and for the ventilation of the boiler house. Reference should be made to CP 332-3 and to BS 799. For gas fired boilers reference may also be made to "Combustion and ventilation air. Guidance notes for boiler installations in excess of 2 000 000 Btu/hr (586 kW) output", DCM/1/72, published by the British Gas Corporation.

3.8.4 Automatic controls. Every boiler should be fitted with automatic temperature control. In the case of hand-fired boilers this will normally take the form of thermostatically operated control over dampers to maintain a predetermined flow temperature. Where automatic firing is used the controls should be in accordance with the appropriate British Standard and Code of Practice.

3.9 Boiler siting

3.9.1 In siting boilers, provision should be made for sufficient working space to enable maintenance to be carried out. This is of particular importance with direct systems.

3.9.2 The dimensions of the necessary clearances should be obtained from the manufacturer of the boiler and of any other items such as oil or gas burners, etc. Generally, clearances are determined by the following considerations.

1) Space to enable all the mountings and equipment of the boiler to be periodically inspected and maintained after the associated pipework has been installed. Where covers on the boiler are provided for the cleaning of flue or water ways there should be space to enable cleaning tools to reach the internal areas to be cleaned.

2) Space and access for removal and replacement of the boiler.

3.9.3 Combustible material should not be located adjacent to a boiler or flue pipe (see relevant Building Regulations).

3.9.4 Clearance should be provided to allow for the efficient application and repair of the thermal insulation.

3.10 Chimney and flue pipes

3.10.1 Where relevant the design of chimneys and flue pipes should conform with the relevant Building Regulations and with the following Codes of Practice:

CP 131, *Flues for domestic appliances burning solid fuel.*

CP 332, *Selection and installation of town gas space heating — Boilers of more than 150 000 Btu/h (44 kW) and up to 2 000 000 Btu/h (586 kW) output.*

CP 337, *Flues for gas appliances up to 150 000 Btu/h rating.*

CP 3002, *Oil firing.*

Reference may also be made to "Flues. Technical notes on the design of flues for larger gas boilers" published by the British Gas Corporation.

3.10.2 Outlets of chimneys should be so sited as to minimize the risk of down draught due to adjacent buildings, trees, etc. Fan-diluted flue systems for gas boilers may be permitted to discharge products of combustion at low level adjacent to buildings. Such systems should be agreed by the Local Authorities and guidance should be sought from the local gas undertaking.

3.10.3 Except where mechanical draught is employed, the horizontal distance between the boiler flue outlet and the chimney should be as short as possible and should not exceed 25 % of the vertical chimney height.

3.10.4 Flues should preferably be circular in cross section. Bends in flues should be kept to a minimum. Bends less than 135° (included angle) and horizontal runs should not be used.

3.10.5 Flue pipes should not project beyond the inside surface of the chimney, all bends and off-sets should be provided with access or cleaning holes having a free area of not less than 50 % of the cross-sectional area of the smoke pipe with a minimum of 8 000 mm^2.

3.10.6 Except for flue pipes serving gas fired appliances access covers should be provided to enable brush cleaning to be carried out through every section of the flue pipe.

Access for cleaning should be provided at the base of a chimney and at or within 1.0 m of any bend in a flue pipe.

3.10.7 Chimneys should not be carried further below the flue pipe connection from the boiler than is necessary to accommodate a cleaning door. Frequently, in taking a flue pipe into a chimney, there is found to exist an air pocket below the point of entry; this should be dealt with by sealing off below that point allowing only space necessary for a cleaning door.

3.10.8 Where an existing chimney is to be used it should be examined and, if necessary it should be suitably lined.

3.10.9 Draught stabilizers may be provided in cases where the chimney draught is excessive, or where the draught requirements of the boiler are critical. If the installation designer considers a draught stabilizer necessary the cooling effect on the flue gases should be examined, and related to the fuel proposed, to ensure that the flue gases will not be chilled below dew-point. Experience shows this to be a cause of smut emission from chimneys.

3.10.10 An internal chimney should be suitably insulated to reduce the emission of unwanted heat into a building.

3.10.11 Chimneys for solid fuel, oil and gas fired boilers should be sized in accordance with the recommendations in the Guide published by the Institution of Heating and Ventilating Engineers or in accordance with CP 332-3 in the case of gas fired boilers.

Due regard should be taken of the Clean Air Acts 1956 and 1968 and of the current edition of the Ministry of Housing and Local Government's "Memorandum on Chimney Heights", where applicable. (In general, the Acts can be applied by local authorities to any new chimney serving a furnace burning solid, liquid or gaseous matter and the Memorandum gives guidance on calculating chimney heights to meet the requirements of the Acts.)

3.10.12 For multiple boiler installations consideration should be given to the advantages of multi-flue chimneys.

3.11 Hot water storage vessels, including storage calorifiers and indirect cylinders

3.11.1 Storage vessels, including storage calorifiers and indirect cylinders should preferably be installed vertically rather than horizontally, with pipe connections so arranged that advantage is taken of the tendency of heated water to stratify.

3.11.2 The draw-off connection or secondary flow pipe should be taken from the top of the vessel: the secondary return pipe should be connected at a point not lower than one quarter of the height down from the top of the vessel; the primary flow connection should be made at the same height as the secondary return; and the primary return and the cold-feed connection should be made as near the bottom of the vessel as is practicable.

Where the hot water storage is divided into two or more vessels of unequal capacity, care should be taken in arranging and sizing the pipe connections to ensure that the vessels discharge at a rate proportional to their capacity.

The cold water inlet to horizontal vessels should be fitted with a spreader tee or like device to preserve stratification.

3.11.3 Provision should be made for continuously venting air from the vessel and any internal heating element and for draining the vessel and any internal heating element.

3.11.4 The capacity of the storage vessel should be chosen having regard to the recommendations in the Guide published by the Institution of Heating and Ventilating Engineers. The capacity of any internal heating element should be determined having regard to the rate of recovery necessary to maintain an adequate supply of heated water and, to the amount of heat required to compensate heat losses from the vessel and the secondary circulation.

3.11.5 The supply of heat to any internal heating element should be thermostatically controlled where the temperature of the primary supply exceeds the required stored hot water temperature (see **3.17.2**). Where electric immersion heaters or gas heaters are employed, either as an auxiliary or as the main source of heat, provision should be made for automatic temperature control by a thermostat.

3.11.6 Where space heating and hot water supply are combined in the same system the storage vessel should be an indirect cylinder or calorifier.

3.12 Siting of hot water storage vessels

Storage vessels with removable end or ends should have adequate clearance to allow for internal cleaning.

Calorifiers having withdrawable batteries or shells should have sufficient clearance to enable the battery to be fully withdrawn from the shell or vice versa.

Clearance adjacent to a hand hole should be such that reasonable access is provided.

Sufficient clearance should be provided to allow for the efficient application and repair of the thermal insulation.

3.13 Safety and fire precautions

3.13.1 All electrical cables and apparatus used should be installed in accordance with the current edition of the "Regulations for the Electrical Equipment in Buildings" published by the Institution of Electrical Engineers.

3.13.2 Certain insulating materials are hazardous to health and should not be specified without due consideration (see CP 3005).

3.13.3 Where relevant, the fire precautions detailed in CP 413 should be observed.

3.14 Pipework

3.14.1 Concealment of pipes within a building should be effected by the provision of properly designed chases or ducts fitted with removable covers (see CP 413). Normally, pipes should not be buried in floors or walls. Where this is unavoidable for short distances reference should be made to the local water undertaking as to what is permitted.

Where pipes are run externally above ground they should be insulated and suitably protected against the weather and mechanical damage. Pipes run below ground should conform with the recommendations in CP 413 and CP 3009.

3.14.2 Provision for movement due to expansion and contraction should be made either by loops or expansion joints wherever the movement cannot be taken up by changes in direction of the pipework. Anchors capable of resisting the maximum stresses should be provided and fixed securely to the pipes and positioned so that all movement due to expansion and contraction is taken up by the loop, joint or change in direction. Guides should be provided where necessary to ensure that movement is confined to the designed direction. Where expansion joints are used it is essential that the type of guides and their positions should be in accordance with any recommendations made by the manufacturer of the expansion joint.

3.14.3 Pipes should be placed or protected so as to avoid the risk of damage from frost (see CP 99).

3.14.4 The practice of running hot water supply pipes under floors by means of notching of floor joists should be avoided. Where this is unavoidable the depth of each notch should not exceed 0.15 of the depth of the joist and each notch should not be further away than 0.25 of the span from the end of the joist. Notches should be lined with felt or similar material and should have radiused corners. Consideration should be given to the provision of protective saddles to prevent damage by nails when laying floorboards and carpets.

3.14.5 Pipe coils in airing cupboards and drying cabinets, and towel rails the use of which may be required outside the heating season, may be connected to a secondary circuit.

3.14.6 Gas installation pipes and meters should be installed in accordance with the recommendations of CP 331-2 and CP 331-3. Oil installation pipes and storage tanks should be installed in accordance with the recommendations of CP 3002.

3.15 Discharge rates and probable demand

3.15.1 The pipework should be so designed that the recommended rates of discharge from taps given in Table 2 are obtained.

Table 2 — Recommended rates of discharge

Appliance	Rate of flow
	litre/s
Bath	0.4
Sink	0.3
Basin	0.12
Shower, nozzle (spray head)	0.12
Shower, 100 mm rose	0.3

NOTE The use of shower roses results in wasteful consumption of water.

3.15.2 It is unlikely that all the taps in an installation will be used simultaneously. Therefore, when calculating the size of distributing pipes a design flow rate equal to the probable demand is used. The probable demand may be determined by the use of "loading" or "demand" units for each type of fitting, depending upon its size and location. Suitable units for use in calculating design flow rates are given in CP 310 and the Guide published by the Institution of Heating and Ventilating Engineers.

3.16 Pipe sizing data

The data for determining the bore of a pipe are the design flow rate, the length of the pipe, the pressure available for loss by friction in that length and the roughness of the internal surface of the piping. Formulae, diagrams and tables are given in CP 310 and the Guide published by the Institution of Heating and Ventilating Engineers. Allowance should be made for the pressure which is lost by friction in bends and fittings.

3.17 Primary circuits

3.17.1 For a low pressure direct system with natural circulation the flow and return pipes should be as short as possible with the minimum change of direction. The pipe should be sized for a temperature drop not exceeding 22 °C.

For a low pressure indirect system the circulation can be natural or pump assisted. Where a pump is installed the boiler or heater should be provided with automatic controls to prevent an excessive temperature rise in the boiler should the pump fail; the pipes should be sized for a temperature drop not exceeding 11 °C. Where the primary circulation of an indirect system is by natural means, the pipes should be sized for a temperature drop not exceeding 22 °C.

For medium pressure and high pressure systems greater temperature drops are commonly employed.

Where a non-automatic solid fuel boiler is used in an indirect system, the fullway type of pump may be provided to assist circulation, but to prevent an excessive temperature rise in the boiler in the event of pump failure the pipes should be sized for a temperature drop not exceeding 22 °C under natural conditions.

3.17.2 It is recommended that fast response type automatic isolating devices be fitted on the primary connections as close as possible to any calorifier served by high pressure/high temperature hot water. The sudden rapture of the primary element in such a calorifier not so protected could result in an immediate and uncontrolled discharge of superheated water and flash steam from open taps, vent points, etc., with obvious danger to users together with possible failure of secondary system components not designed to withstand the primary pressure. The device in the primary return connection could be a normal non-return valve to prevent reverse flow back to the calorifier but that in the primary flow should be a valve which closes instantaneously, operated automatically by any sudden abnormal increase in pressure on the secondary side of the calorifier. Facility for periodically testing the valve should be provided and it should be regularly maintained.

3.18 Secondary circuits

3.18.1 Secondary circuits may be designed for pumped or natural circulation, but, where practicable, natural circulation is preferable. Circulation depends upon the heat loss from the circuit, the circulation pressure available and the frictional resistance of the circuit.

The flow pipe of a secondary circuit is also the draw-off pipe and should be sized accordingly (see **3.19**). The return pipe of a secondary circuit should be sized so that the temperature drop of the secondary circuit is not less than 8 °C and not more than 22 °C dependent upon the temperatures required at the draw-off.

3.19 Draw-off pipes

3.19.1 The size of the draw-off pipes will depend upon the rate of flow required to meet the probable demand of the draw-off taps, the static head available, and the frictional resistance of the draw-off pipe and the cold feed pipe.

3.19.2 Dead legs should be as short as practicable and are not to exceed the lengths given in Table 1 (see **0.4**). Each dead leg serving an individual draw-off or a group of draw-offs should be provided with a stop valve in an accessible position.

Draw-off pipes should not be connected to the primary flow and return pipes.

3.20 Cold feed pipe

3.20.1 A cold feed pipe to a calorifier, indirect cylinder or hot water storage vessel should be sized to meet the probable demand of the draw-off taps and should be not less than 25 mm nominal bore.

A cold feed pipe should be connected directly to the storage vessel and should not be used for any other purpose than the supply of cold water to the storage vessel. The cold feed pipe connection should be positioned so as to minimize the mixing between hot and cold water.

3.20.2 A cold feed pipe from a feed and expansion cistern or from a pressurizing unit should be provided to the primary circuit of an indirect system.

3.20.3 A fullway stopvalve should be provided in the cold feed pipe and should be dose to the cistern in a convenient and accessible position. A further fullway stopvalve may be provided adjacent to the hot water storage vessel.

3.20.4 Precautions should be taken to prevent the freezing of cold feed pipes (see CP 99).

3.21 Open vent pipe

3.21.1 The function of an open vent pipe is to release air and to prevent a build up of pressure.

3.21.2 An open vent pipe should be provided from the top of the hot water storage vessel or from the highest point of the secondary system. A separate open vent pipe should be provided from the primary circuit of an indirect system. The nominal bore of the principal vent pipe should be not less than as shown in Table 3.

Vent pipes should rise continuously between the point of connection to the system and the bend before the point of discharge. Horizontal runs should be avoided.

Table 3 — Sizes of open vent pipes

Boiler or water-heater rating		Nominal size of bore	
	kW	mm	in
Up to and including	60	25–28	1
Over 60 Up to and including	150	32–35	1¼
Over 150 Up to and including	300	38–42	1½
Over 300 Up to and including	600	50–54	2
Over 600 Up to and including	1 500	65–76.1	3

3.21.3 One pipe should not serve as both open vent pipe and cold feed pipe.

3.21.4 Subsidiary vent pipes may be necessary wherever air would otherwise collect. They should be not less than 19 mm nominal bore. Where circumstances permit, hot water draw-off points may act as subsidiary vent pipes. Alternatively, air eliminators or bottles may be used.

3.21.5 All open vent pipes connected to a natural circulating system should rise above the overflow of the cold feed cistern at least 150 mm plus 12 mm for every 300 mm in height of the overflow level above the lowest point of the cold feed pipe.

Vent pipes connected to systems having pumped circulations should rise sufficiently to ensure that no discharge takes place when the water in the system is at maximum working temperature and the circulating pump is operating at maximum output.

3.21.6 Open vent pipes should terminate where a discharge of water, vapour or steam will not cause injury to persons or damage to property, and preferably through the side of the feed cistern of the system above the level of the overflow. Alternatively, open vent pipes may terminate over the cistern with the outlets discharging downwards. Where openings are cut in the cistern cover in excess of that necessary to allow the passage of the vent pipe, these openings should be made good.

3.21.7 Where a boiler, calorifier or indirect cylinder can be isolated by valves an open vent pipe should be connected directly to each boiler, calorifier or indirect cylinder. The nominal bore of the vent pipe should be not less than is recommended in Table 3.

A valve should not be fitted in a flow pipe between a boiler and an open vent pipe connection

Where two or more boilers, calorifiers or indirect cylinders are serving the same system and are fatted with isolating valves, individual vent pipes are preferred. Where a common vent pipe is used its nominal bore should be not less than is recommended for the total output of the appliances connected to it. Any method that is adopted for connecting water heating appliances to a common vent pipe should be such that isolation of an appliance from the atmosphere is not possible. This can be achieved by fitting a 3-way valve between the appliance and a common vent pipe so arranged that at all times there is a free passage to open air from the appliance either through the common vent pipe connection or through another outlet from the valve fitted with a pipe arranged to discharge safely and within sight when this valve is operated.

3.21.8 Precautions should be taken to prevent the freezing of vent pipes (see CP 99).

3.22 Automatic air eliminators and air bottles

Where it is not possible to fit a subsidiary vent pipe at a high point of a system, the air maybe released by fitting an automatic air eliminator. An air-bottle with a manually operated air release valve may also be used. Because the formation of scale may interfere with the operation of an automatic air eliminator, consideration should be given to the character of the water.

Where an automatic air eliminator is used, the point to be vented should be connected to an automatic air release valve and a drip pipe should be taken from the outlet of the valve to a suitable and visible discharge point. A valve should be provided so that an automatic air eliminator may be isolated from the system.

Where an air-bottle is used the point to be vented should be connected to the under side of the bottle, which may be fabricated from an enlarged section of tubing, with suitable connections. An air release cock should be provided to vent the air manually from the top of the bottle.

For the purposes of frost protection, automatic air eliminators and air bottles should have similar protection as recommended for vent pipes (see CP 99).

3.23 Draining

3.23.1 Suitable provision should be made for draining down all parts of the system by means of draining taps with removable keys. Where draining outlets are connected to a permanent draining pipe, this should discharge visibly over an open gully or sump.

3.23.2 Each boiler and cylinder should be provided with its own draining tap fitted at the lowest point; for direct systems a draining tap need only be fitted on the boiler. Pipework should be fitted with draining taps at all low points. For drip pipes from pump base plates, see **4.16.3**.

It is preferable that draining pipes should be connected to the taps and carried to discharge over a gully that is connected to the drains of the building. Where the boiler room floor is below the level of the building drains a sump should be provided fitted with an automatically operated electrically driven discharge pump, for discharging water into the drains of the building. If convenient, individual draining pipes may be connected to a common line.

Where it is impracticable to run a draining pipe to a gully, the taps should be fitted with a hose union connection.

3.24 Electrically driven circulating pumps

3.24.1 General

3.24.1.1 Pumped circulation is necessary in cases where the natural circulating pressure available is insufficient to circulate the water round the system (see **3.17** and **3.18**).

Pumped circulation in conjunction with a pressurizing unit may also be necessary to maintain a required outlet pressure.

3.24.1.2 Immersed rotor type circulating pumps should not be used on secondary circuits, unless specifically designed for such application.

3.24.1.3 Inlet and outlet connections to a circulating pump should be fitted with fullway valves.

3.24.1.4 Circulating pumps other than fullway types should be connected on a by-pass with a non-return valve fitted between inlet and outlet connections to the by-pass. The non-return valve should be of such a type that the valve is in the open position when the pump is not running. If the circulating pump is of the fullway type and fitted in the return pipe, a by-pass and non-return valve are not necessary. Circulating pumps can be of the direct coupled, belt driven, or inline pattern.

3.24.1.5 Circulating pumps and their motors should not be installed in hot and dusty positions unless special precautions are taken.

3.24.2 Duty of the circulating pumps. The circulating pump duty will be dependent upon the temperature drop, heat loss and the frictional resistance of the system.

3.24.3 Noise in operation. Where noise would be objectionable to the occupants or function of the building, the circulating pump should be quiet in operation and suitably mounted with anti-vibration materials (see **4.16**).

3.24.4 Bases. Bases should be of concrete or other solid material of sufficient thickness so as to enable holding down bolts to be fitted; where a noise and vibration membrane is to be used, extra mass may be required to prevent movement.

3.24.5 Clearances. The circulating pump and motor should be so arranged as to allow adequate access and clearance all round for cleaning, maintenance, replacement and for the operation of the valves.

3.24.6 Guards. Coupling and belt guards should be fitted to comply with statutory requirements. Guards should not be fitted in such a manner as to render noise insulation ineffective.

3.24.7 Electrical installation. The whole of the wiring, earthing, etc., should be carried out in accordance with the current edition of the "Regulations for the Electrical Equipment in Buildings" published by the Institution of Electrical Engineers. An electrical isolating switch should be fixed adjacent to and within sight of the circulating pump.

3.25 Extent of insulation work to be undertaken

3.25.1 All hot surfaces from which heat could be lost should be insulated, except those where the heat emitted serves a useful purpose, as for example, the warming where desired of kitchens, airing cupboards, bathrooms etc. This recommendation applies in general to boilers, calorifiers, indirect cylinders and hot water storage vessels and all pipes forming part of a circuit whether freely exposed or run in a roof space, under floors, a chase, a duct or a cupboard. Pipes should not be left uninsulated in order to obtain increased natural circulation.

3.25.2 The cold water feed cistern, cold water feed pipe and all vent pipes should be insulated as a protection against freezing as recommended in CP 99.

3.26 Mixing valves

3.26.1 Mixing valves and combined taps for mixing hot water and cold water and discharging the mixture through a single outlet should be supplied with hot water and cold water both under pressure from the same cistern or from cisterns coupled together to act as one; or both under pressure from the same water service pipe. There should be no cross-connection between a service pipe and a distributing pipe (see **0.4**). (One supply should not come from a service pipe and the other from a cistern.) This will promote the effective control of temperature of the mixed water, and is especially important with showers and spray fittings.

Thermostatic control of water temperature for ablutions is recommended, but is not a substitute for compliance with the above.

For combined taps of the double-outlet type, where the hot water and cold water are not mixed in the fitting but only after discharge, the precautions concerning water supply pressures do not apply.

3.26.2 Manually operated non-thermostatically controlled mixing valves may be used wherever a supply of mixed hot and cold water is required to a single appliance, but they should not be used to control the water supply to more than one appliance.

3.26.3 Thermostatically controlled mixing valves should be used where a predetermined temperature is required. They should be used wherever a single mixing valve is required to control the supply of mixed hot and cold water to a range of appliances and when so used should be guarded or placed so that unauthorized adjustment cannot take place. They should be fitted with a graduated scale and provision for limiting the maximum temperature of the mixed water.

Stop valves and dirt strainers should be fitted to both the hot and cold water supplies to each mixing valve.

3.27 Spray taps

Where spray taps or spray mixing taps are to be used they should be adjusted to deliver a maximum of 0.03 litre/s to 0.05 litre/s in order to promote economy of water use.

It is recommended that the hot water should be supplied through a pipe with a maximum dead leg length of 1.0 m so that there is no appreciable delay in obtaining hot water when the tap is opened.

The temperature of the hot water supply to spray taps should be between 38 °C and 43 °C. When spray mixing taps are used the temperature of the hot water need not exceed 50 °C and it is essential that both hot and cold water should be at the same pressure (see **3.26.1**).

3.28 Prefabrication

The designer should, where possible, allow in his design for the use of prefabrication techniques. Prefabrication is desirable in order to expedite erection, and should be resorted to wherever possible where the planning and requirements are identical repetitions.

It should be noted, however, that the extent to which prefabrication techniques can be successfully applied depends upon the following:

1) the form of building construction and tolerances to which the building trades can work;

2) the degree of standardization of sanitary appliances etc.;

3) the adoption of dimensionally co-ordinated standard units and assemblies;

4) the co-ordination of all other engineering services, including drainage; and

5) adequate space and facilities for the storage and handling of prefabricated units and assemblies.

4 Work on site

4.1 Cleanliness of installation

4.1.1 Care should be taken to store, handle and install all materials and components so as to avoid the introduction of foreign matter. This is particularly important when building operations are proceeding concurrently with the installation of the hot water system.

4.1.2 The open ends of all pipes and the connections on boilers and storage vessels should be effectively plugged or capped. Open tanks and cisterns should be provided with temporary covers.

4.1.3 During installation, all materials should be examined and cleared of any foreign matter before being embodied in the system and any pipework or equipment with open ends or connections should be temporarily sealed.

4.2 Boiler bases

Boilers should be mounted on non-combustible material and so founded on and/or insulated from the boiler room floor as to avoid:

1) undesirable shrinkage of the underlying ground;

2) damage to the structural floor; and

3) damage to any water proofing material that may be incorporated in the structural floor.

Attention should be paid by the building designer to the loads imposed on the structure by the boiler and its base.

4.3 Boiler installation

Boilers and their mountings should be installed to the manufacturer's instructions; particular attention should be paid to the airtightness of door frames, smoke hoods, ashpit stands and, in sectional boilers, the jointing between the sections and the base, as applicable. The boilers should be flushed out after installation.

4.4 Flue pipe

4.4.1 The flue pipe should be supported in such a manner as to avoid any lateral stressing of the joints. All joints should be made with incombustible and acid-resisting material and should be fume-tight.

4.4.2 Combustible material should not be located adjacent to a flue pipe. Where this cannot be achieved, such material should be protected with fire resisting material and should be kept at least 300 mm from the flue pipe.

4.4.3 Where a flue pipe enters a chimney, the pipe should finish flush with the inside surface of the chimney.

4.4.4 Where the flue pipe passes through structural brickwork or concrete, a separate full length metal sleeve should be interposed and the space between the sleeve and flue pipe should be well caulked with asbestos rope or other suitable material.

4.4.5 For flues serving gas-burning appliances reference should be made to CP 332-3 and CP 337.

4.4.6 The number of bends interposed between a boiler and a chimney should be kept to a minimum.

4.5 Storage vessel supports

4.5.1 Hot water storage vessels

4.5.1.1 Vertical calorifiers, indirect cylinders and storage vessels should be erected on substantial supports in one of the following ways:

1) On a brick or concrete base provided with air channels to ventilate the base of the vessel.

2) On fabricated steel brackets or floor pedestals. For a copper vessel, suitable pads e.g. lead, should be interposed between the vessel and the bracket beating surface.

4.5.1.2 Horizontal calorifiers, indirect cylinders and storage vessels should be erected on substantial supports in one of the following ways:

1) On brick or concrete piers with cast iron or steel cradles.

2) On wall bearers with floor supports and cross bracings of steel angle, tee or tubular section.

3) For vessels up to 700 litres capacity, on steel cradle cantilevers securely built into a structural wall of adequate strength.

In all cases the brackets should be of adequate bearing area and suitable pads e.g. lead should be inserted between copper vessels and their brackets.

4.5.2 Cold water feed cisterns. Continuous support should be provided for the base of asbestos or plastics cold water cisterns.

4.6 Pipework installation

4.6.1 All cut pipe ends should be reamed out to ensure that the full bore of the pipe is maintained; swarf from cutting, reaming and threading should be removed.

Jointing compound should be applied so that it does not protrude into the bore of the pipe when the joint is made.

Pipe ends to be welded should be carefully squared and prepared and so welded that metal does not protrude into the bore of the pipe.

4.6.2 Facilities for the internal cleaning of primary circulation pipes of a direct system should be provided by means of unions or flanged connections.

4.6.3 Tees should be of sweep pattern except that square tees should be used where draw-off connections are made to a secondary circuit, or where air may be trapped in the upper part of the tee.

4.6.4 Any galvanized pipe heat set should be re-galvanized inside and out. Hard-drawn thin wall copper tubes complying with the requirements of BS 2871-1 should not be bent.

4.6.5 All pipework including expansion loops and bends should be installed so as to avoid airlocks. Where horizontal pipes reduce in size towards an air vent, an eccentric reducing fitting should be fixed so that the top of the smaller pipe is level with the top of the larger one; bushes should not be used.

4.6.6 Where the release of the air is dependent on a pipe gradient the gradient should be not less than 1 : 250.

4.6.7 To facilitate cleaning, clearances between pipes and finished surfaces should be in accordance with the following:

1) 20 mm minimum clearance between the surface of insulation or uninsulated pipe and the finished surface of wall, partition or ceiling;

2) 75 mm minimum clearance between the surface of insulation or uninsulated pipe and the finished surface of floor.

4.6.8 Pipes in trenches and ducts should be spaced in a manner which will permit subsequent access to any pipe for maintenance or replacement without disturbance of the remaining pipes.

4.6.9 The installation of gas pipework should be in accordance with CP 331-3. The installation of oil pipework should be in accordance with CP 3002.

4.7 Pipe fixings, supports etc.

4.7.1 Pipe fixings and supports should be arranged at intervals not greater than those shown in Table 4; each support should take its due proportion of the pipe weight and should allow free movement for expansion and contraction, particularly at the end of long runs where a change of direction takes place.

Table 4 — Intervals between supports

a. Mild steel tube complying with the requirements of BS 1387

Nominal bore		Intervals for vertical runs	Intervals for horizontal runs
in	mm	m	m
½	15	2.4	1.8
¾	20	3.0	2.4
1	25	3.0	2.4
1¼	32	3.0	2.7
1½	40	3.6	3.0
2	50	3.6	3.0
2½	65	4.5	3.6
3	80	4.5	3.6
4	100	4.5	4.0

b. Stainless steel tubes complying with the requirements of BS 4127

Nominal size of tube	Intervals for vertical runs	Intervals for horizontal runs
in	m	m
½	2.4	1.8
¾	3.0	2.4
1	3.0	2.4
1¼	3.0	2.7
1½	3.6	3.0

Size of tube	Intervals for vertical runs	Intervals for horizontal runs
mm	m	m
12	2.4	1.8
15	2.4	1.8
18	3.0	2.4
22	3.0	2.4
28	3.0	2.4
35	3.0	2.7
42	3.6	3.0

Table 4 — Intervals between supports

c. Copper tube complying with the requirements of BS 2871-1

Size of tube	Intervals for vertical runs	Intervals for horizontal runs
mm	m	m
12	1.8	1.2
15	1.8	1.2
18	2.0	1.6
22	2.4	1.8
28	2.4	1.8
35	3.0	2.4
42	3.0	2.4
54	3.0	2.7
76.1	3.6	3.0
108	3.6	3.0

4.7.2 The types of support of pipes of 75 mm diameter and up should take account of the following:

1) provision should be made for guiding the pipe and to counteract any tendency of it to lift off its support;

2) where a common pipe hanger is used for two or more pipes, provision should be incorporated for the unequal pipe movement due to expansion;

3) where structural steel members are used to support pipe hangers, the drilling of the structural steel should be avoided by the use of girder clips;

4) hangers should be articulated to allow free movement; and

5) means to prevent damage to pipe insulation due to movement of the pipe should be provided.

Where drilling or welding of the structural steel is unavoidable, prior permission should be obtained from the structural engineer.

4.7.3 Sleeves should be provided where pipes pass through walls and solid floors, to allow movement of the pipes without damage to the building fabric or the pipe. The overall length should be such that the sleeves project 1.5 mm beyond the finished thickness of the wall or partition. In certain circumstances fire stopping will be necessary; reference should be made to the local Fire Officer (see also CP 413).

4.8 Vent pipes and venting generally

Vent pipes should rise continuously to ensure that air will not be trapped.

Vent pipes should be fabricated from the same materials as used for the remainder of the pipework.

4.9 Draining of system

Sufficient draining taps should be fitted in accessible positions (see **3.22**).

4.10 Joints for galvanized pipes and fittings

4.10.1 Screwed connections. Screwed joints should be British Standard Pipe thread, clean threaded and pulled up tightly (see BS 21). Screwed steel piping should be jointed with screwed fittings of galvanized iron, steel or malleable cast iron. A jointing compound or tape, which may be one of the many proprietary makes, should be used according to the maker's instructions. Compounds containing red lead should not be used because of the danger of contamination of the water.

4.10.2 Flanged joints. Flanged joints should be made by screwing drilled flanges on to the end of the pipe as for screwed joints. Drilling and dimensions of flanges should comply with the requirements of BS 10.

Flanges should be of steel or cast iron. The end of the screwed pipe should not project beyond the face of the flange. The two flanges forming a joint should be flush with one another when in position and all bolt holes should be accurately aligned. The jointing material between the flanges should be of good quality and should in no way obstruct the pipe bore. Compounds containing red lead should not be used because of the danger of contamination of the water. All flange bolts should be fitted with washers under the nuts and should project through the nuts.

4.10.3 Long screw connectors. Long screw connectors are not considered satisfactory for jointing and should not be used.

4.10.4 Unions. Unions should consist of two screwed halves, with ground spherical-faced or cone-faced joint between faces. Flat-faced unions should not be used.

4.10.5 Welding. Galvanized pipe should not be fusion welded. Bronze welding should comply with the requirements of BS 1724.

4.11 Joints for copper pipes and fittings

4.11.1 Light gauge copper pipe. Compression and capillary fittings for light gauge copper pipe should comply with the requirements of BS 864-2.

4.11.2 Hard drawn thin wall copper pipe. Compression and capillary fittings for hard drawn thin wall copper pipe should comply with the requirements of BS 864-2. If compression type fittings are used only Type A compression fittings are suitable.

4.11.3 Screwed copper pipes. Joints should be threaded in accordance with BS 61.

4.11.4 Copper pipes with ferrous materials. (See **3.5**.) Where it is necessary to make a connection between copper pipes and items of ferrous materials, the connection should be made with an appropriate connector.

NOTE Copper pipes should not be connected to galvanized mild steel hot water storage vessels.

4.11.5 Welding of copper pipes. Welding of copper pipes should be carried out in accordance with BS 1724.

4.12 Joints for stainless steel pipes

Compression and capillary fittings for stainless steel pipes should comply with the requirements of BS 864-2. Special fluxes are required for capillary jointing and the manufacturer's instructions should be adhered to. Where Type A compression fittings are used, it is important that the outside surface of the tube will accept these fittings and give a sound joint without undue tightening. Where it is proposed, to use Type B compression fittings the manufacturer should be consulted.

4.13 Lead joints to copper and iron

Lead and lead-alloy piping should be jointed to cast-iron, spun-iron, steel or copper piping by the use of copper or copper-alloy unions or union ferrules and wiped soldered joints.

4.14 Location of valves

All valves should be accessible for operation and maintenance and should be suitably labelled. Where valves are concealed, removable access covers should be provided.

4.15 Identification of pipes

All pipework should be painted or otherwise provided with identification legends in accordance with BS 1710.

4.16 Circulating pumps

4.16.1 Bases. Circulating pumps requiring concrete or other bases should be supported from the floor and not from, or be in contact with, the wall.

The top of the base should be levelled and the final adjustment should be made by shims. Any holding down bolts and the space between the base plate and the concrete base should be grouted up solidly except where special anti-vibration mountings are fitted.

Where insulation is provided in the form of special anti-vibration devices these should be arranged so that there is no metallic contact between the pumping unit and the base.

Where noise and vibration insulation is provided in the form of a membrane this should be located below and, if necessary, around the base so as to isolate the base and the holding down bolts completely from the building fabric.

4.16.2 Connections to pipe work. Flanges or screwed pipe connections should be in alignment with the pump connections. The connecting pipework should be supported independently of the pump to avoid undue strain on the pump body.

Where noise and vibration insulation is provided for the pump and motor, flexible connections should be provided and brackets supporting adjacent pipework should be insulated from the building fabric.

Where the bore of the pump connections is less than that of the connecting pipework reduction in diameter should be effected by properly designed taper pieces.

4.16.3 Draining or drip pipes. The outlet from the drip tray or gland should be fitted with a short spout with a visible discharge either turned directly over a gully adjacent to the pump base or turned over a tundish with pipe connection not less than 25 mm bore carried to the nearest gully or sump.

4.16.4 Alignment. Attention should be given to the final alignment of the pump and motor, particularly where these are directly coupled. Where the pump and motor are mounted on a combined base-plate and there is a risk of distortion due to bolting down or excessive loads being placed on the pump by the weight or "springing" of pipework connections, it is essential that the correct alignment of the pump and motor should be checked after final erection. This is particularly important where solid couplings are used; in this case, it should be done by checking the alignment of the half couplings when these are freed.

4.17 Thermal insulation

4.17.1 The application of thermal insulation materials should not be completed until the hydraulic pressure and heat tests (see **5.3.1** and **5.3.2**) have been successfully completed.

4.17.2 Thermal insulation should conform with the recommendations of CP 3005.

4.17.3 All insulating material, however fixed, should be in close contact with the surface to which it is applied, and all joints should be sealed after ensuring that edges or ends of any section butt up close to one another over the whole surface to be insulated. Edges or ends should be cut or shaped on site as necessary to allow access to valves, flanges, etc.

4.17.4 Each pipe should be insulated separately.

4.17.5 Where insulation is exposed to the weather or subject to impact damage it should be suitably protected (see CP 3005).

5 Inspection, testing and commissioning

5.1 Tests off site

All materials, appliances and components should be tested and certificates issued, if required, in accordance with any relevant British Standard, before delivery to site.

If required by the local water undertaking, arrangements should be made for components to be approved and stamped.

5.2 Cleaning and filling

5.2.1 Upon completion, the exterior surfaces of the entire installation should be cleaned down and all dust etc. removed and the system thoroughly flushed out.

5.2.2 Prior to commissioning and any tests being carded out, the installation should be filled, proper precautions being taken to overcome air locks, and thoroughly examined for any defective workmanship or materials and the defects rectified.

5.2.3 Automatic air eliminators should be removed and flushed out, after the initial filling of the apparatus, to remove foreigh matter.

NOTE In order to provide sufficient velocity to flush the system adequately it may be advisable to remove a section of pipe at low level.

5.3 Tests on site, (see 4.17.1)

5.3.1 Hydraulic pressure tests

5.3.1.1 *Boilers and calorifiers.* An hydraulic pressure test should be made at one and a half times the normal working head with all mountings (except the relief valve) and connections complete. The test pressure should be maintained for 30 min after making good any leaks. The relief valve should be tested separately.

5.3.1.2 *Pipework.* The whole of the completed pipework should be tested by hydraulic pressure to one and a half times the normal working head unless otherwise specified. The test pressure should be maintained for 30 min after making good any leaks.

5.3.1.3 *Pipes in ducts, etc.* In certain circumstances it may be necessary to carry out the hydraulic pressure test on sections of the pipework prior to completion of the whole installation, as for example, sections which are to be concealed from view in trenches, ducts, chases, etc., and appliances where rectification of faulty materials or workmanship is likely to involve disturbance to finished structural features. Such tests should be made at twice the normal working pressure.

5.3.2 Heat test. A heat test should be made for at least 2 h, during which time the boiler temperature should be maintained reasonably close to the maximum working temperature. The temperature should then be allowed to fall to the cold condition and the installation should remain full in such condition for a further period of 3 h.

During this test the entire installation should be closely examined for leakage and other defects, and where these occur they should be corrected and the test repeated.

5.3.3 Thermal insulation

5.3.3.1 *Preformed.* The material delivered to site should be subjected to a thickness inspection test as described in BS 1334 and any decision to reject a consignment should be based upon the sampling conditions stated in that British Standard.

5.3.3.2 *Plastic composition, flexible and dry filled.* In all cases the thickness of the insulating materials should be determined after application, and in the case of plastic composition materials when finally dry.

5.3.4 Performance test

5.3.4.1 *General requirements.* A performance test should be applied to all installations, but where a large number of identical installations (as on a housing estate) are involved, a typical installation selected at random should be tested. The test should be carried out by the installation contractor under the supervision of the designer, with fuel, water and power supplied by the client. The test should not be undertaken until the boiler has been at work for sufficient time to dry the flues and chimney and should be carried out as described in the following clauses.

Before starting the test the designer should satisfy himself about the following matters:

1) that the fuel is suitable for the boiler;

2) that the chimney complies with the recommendations of **2.6** and **3.10** and is warm and dry;

3) that the air inlet to the boiler chamber is as specified;

4) that dampers or draught stabilizers, if provided, are correctly adjusted;

5) that the burners of gas boilers are suitable and correctly adjusted for the gas supply;

6) that any automatic controls are in working order;

7) that the boiler is clean and has been lit for at least 2 h;

8) that the secondary circulation is open and the circulating pump (if any) runs at the rated speed;

9) that suitable thermometers have been provided in the necessary positions;

10) that all thermal insulation has been completed, and if applied in plastic form, is dry;

11) that if required a suitable water meter has been fixed and thermographs provided. Any instruments used should be calibrated before and after the test; and

12) that any radiators or other heating surfaces served by an indirect system are in working order.

5.3.4.2 *Heating-up period.* This part of the performance test is to confirm that the content of the hot water storage vessel can be heated-up in the design period of time. It is in three stages.

1) The installation is operated for a time long enough to bring it into normal working conditions.

2) A volume of water equal to the capacity of the hot water storage vessel is then drawn off and the water heater operated for the designed heating-up period.

3) The same quantity of water is again drawn off and its temperature measured at the taps.

Details are as follows:

1) The installation should be operated in a normal manner to heat the water to the design temperature. During this time the temperature of the water in the hot water storage vessel should not be allowed to rise more than 3 °C above the design storage temperature.

2) A volume of water equal to the capacity of the hot water storage vessel should be drawn off as rapidly as possibly and at the same time the temperature of the feed water entering the storage vessel should be measured. When the feed pipe is not subjected to appreciable heat gains, this temperature may be measured in the cold water cistern supplying the hot water storage vessel. If the temperature of the feed water is 10 °C the water heater should be operated in the normal manner for the design period, otherwise the period should be varied according to the following table:

Temperature of cold feed	Variation from designed heating-up period
°C	%
5.0	+ 10
10.0	0
15.0	– 10
20.0	– 20

During this period no water should be drawn off. If on a large installation, this is impracticable, either a recorder should be fitted to the meter and thermographs to the main secondary flow and return pipes, or readings should be taken at these every 10 min, so that allowance for the heat in the water so drawn away may be made by proportionate extension of the heating-up period. Generally for this computation, it should be assumed that three-quarters of the water drawn off passes through the flow pipe and one-quarter through the return pipe.

At the end of the heating-up period, the same quantity of water as was drawn off at the start of stage (2) should be drawn off at the same taps as rapidly as possible; the temperature of the water so drawn off should not be lower than 3 °C below the design storage temperature.

5.3.4.3 *Primary circuit.* Separate testing of the primary circuit will not normally be necessary if the heating-up test is satisfactory. Where the heating-up test is unsatisfactory the temperature of the flow and return pipes of the primary circulation should be measured close to the water heater at the end of the design heating-up period. The circulation may be deemed satisfactory where the design return temperature drops are achieved (see **3.17**) with a flow temperature of 65 °C for a low pressure direct system and 82 °C for a low pressure indirect system.

The flow temperature and temperature drop for medium pressure and high pressure systems should be in accordance with the design intent.

Immediately prior to the start of the test a quantity of water equal to the design storage volume should be drawn off. No water should be drawn off during the test, and the boiler should be operated at the normal rate of firing.

5.3.4.4 *Secondary circuits.* Separate testing of the secondary circuits will not normally be necessary if the test for the temperature of the water at the taps at the recommended rate of flow is satisfactory. Where this test is unsatisfactory then the temperature of the flow and return pipes at well distributed points on the circuits should be measured. If the temperature of the water in the storage vessel is 65 °C the circuits may be considered satisfactory if at no point is the measured temperature less than 43 °C. No water should be drawn off whilst these temperatures are being measured.

5.3.4.5 *Temperature of water at the taps.* When the temperature of the water in the storage vessel is 65 °C the outflow temperature within a minute of opening fully any taps should be not less than 55 °C or, if fitted, as determined by the setting of a mixing valve.

5.3.4.6 *Outflow from taps.* The following test should be made in respect of each pipe to which draw-off taps are connected. Ascertain the design flow rate for the pipe to be tested as calculated by the method of "loading" or "demand" units as referred to in **3.15**. Select a number of taps which, if each discharging at the recommended rate given in Table 2, would give rise to a total flow rate in the pipe equal to the design flow rate for the pipe. Open fully each of the selected taps, and, while all are discharging, check that each one gives a rate of flow not less than the recommended rate and check also that air is not drawn in at any one of the remaining taps when opened. For larger installations the test should be repeated with differing selections of taps as many times as may be necessary to prove the design.

5.3.4.7 *Towel rails.* The temperature of the return pipe from each towel rail connected to a secondary circuit should be not lower than 43 °C when the primary flow at the boiler is 65 °C with a direct system, or 82 °C with an indirect system. No water should be drawn off during the test or the preceding half-hour.

5.3.4.8 *Electrically driven pumps.* An inspection should be made to check that the recommendations of **4.16** have been carried out.

The pump should be operated under normal working conditions with water at the design temperature for a period of 6 h. At the end of this test, the temperature conditions in the motor should not exceed those prescribed in the relevant British Standard. The current taken by the motor should not exceed the rated value.

If the temperature of a pumped circuit is not satisfactory then the duty of the circulator should be checked.

5.4 Commissioning

5.4.1 The objective of commissioning is to provide a controlled bringing into operation of an installation, the instruction of those responsible for operating the installation and the handing over of the relevant documents appropriate to the operation, safety and maintenance of the installation.

5.4.2 On completion of the work, but before handing over, the installation contractor should confirm that the installation has been examined, tested, that it will operate, is ready for use, can be maintained efficiently and meets the requirements of the performance test.

5.4.3 When handing over, the installation contractor should demonstrate to those responsible for operating the installation the method of operation, the limitations, the maintenance requirements and the safety precautions to be observed and should also hand over any tools for operating, cleaning and maintenance of the installation.

5.4.4 On acceptance, the installation contractor should provide an operational manual, manufacturer's operating instructions, maintenance instructions, record drawings, control and wiring diagrams and any other documents or information apertaining to the installation.

Commissioning, particularly for large installations, can be considerably facilitated by including in the documentation a clear statement of the requirements of the brief to the designer and the design intent.

6 Maintenance

6.1 General

6.1.1 Maintenance has the objective of keeping or restoring a service to a good operating condition and functioning efficiently at all times. Normally the work that may be required to be undertaken includes:

1) servicing, oiling, greasing and replacement of defective parts;

2) general inspection of the installation for defects;

3) general overhaul of plant and equipment;

4) regular operation of standby plant;

5) minor capital work for adaptation, extension or replacement;

6) breakdown and emergency contingencies.

6.1.2 The needs to provide access and space for the maintenance work to be undertaken should be a consideration of design and of supervision during installation to ensure that the design intent is realised.

Though the design intent should be to provide unrestricted access this may not always be possible to achieve. But whatever the situation, the degree of restriction should be related to the frequency of maintenance, in that where there is a frequent demand for attention, the access should be unrestricted, where the demand is likely to be infrequent restricted access will be more acceptable.

6.1.3 Whatever the degree of access there should be adequate space not only for servicing but also for the removal and replacement of defective parts without undue interference to surrounding plant, equipment, services or building components.

6.1.4 Provision to facilitate the major replacement or the extension of a service, other than for a phased development, may not be economic when it is considered that this will often be coincident with or the occasion for upgrading of the service or more significant general reconstruction.

6.1.5 The provision of accurate record drawings of the work, as installed, with the access points and ways of gaining access clearly indicated, together with documented information on all the plant, equipment and components requiring any attention is essential for good maintenance.

6.2 Planned maintenance

6.2.1 The complexity and cost of large installations point the need for a systematic programme of inspection and work to keep a service in good working order. The benefits that can accrue from a well organized planned maintenance scheme are:

1) depreciation of the plant and equipment is controlled with inspection and corrective maintenance;

2) working life of the plant and equipment is extended;

3) emergency maintenance is reduced;

4) preventive maintenance can be undertaken at convenient times with a minimum of disruption;

5) minor capital works can be programmed and co-ordinated with the maintenance schedule;

6) work load can be more evenly spread over the year making for a more positive assessment and control of staff and financial resources.

6.2.2 For a planned maintenance scheme to be initiated and operated a great deal of accurate information on the performance capacity, etc., of plant, equipment and components will need to be documented. Though much of this information will not be available until after design is completed, planned maintenance documentation can be facilitated by detailed scheduling of plant, equipment and components during the design stage.

Publications referred to

This Code makes reference to the following British Standards and British Standard Codes of Practice:

BS 10, *Flanges and bolting for pipes, valves and fittings.*

BS 21, *Pipe threads.*

BS 41, *Cast iron spigot and socket flue or smoke pipes and fittings.*

BS 61, *Threads for light gauge copper tubes and fittings.*

BS 143 & BS 1256, *Malleable cast iron and cast copper alloy screwed pipe fittings for steam, air, water, gas and oil.*

BS 170, *The electrical performance of fractional horsepower electric motors and generators.*

BS 417, *Galvanized mild steel cisterns and covers, tanks and cylinders.*

BS 567, *Asbestos cement flue pipes and fittings (light quality).*

BS 587, *Motor starters and controllers.*

BS 699, *Copper cylinders for domestic purposes.*

BS 759, *Valves, gauges and other safety fittings for application to boilers and to piping installations for and in connection with boilers.*

BS 779, *Cast iron boilers for central heating and hot water supply.*

BS 799, *Oil burning equipment.*

BS 835, *Asbestos cement flue pipes and fittings, heavy quality.*

BS 843, *Stationary non-instantaneous electric water-heaters (constructional and water requirements).*

BS 853, *Calorifiers for central heating and hot water supply.*

BS 855, *Welded steel boilers for central heating and hot water supply.*

BS 864, *Capillary and compression tube fittings of copper and copper alloy.*

BS 864-2, *Metric units.*

BS 1010, *Draw-off taps and stopvalves for water services (screwdown pattern).*

BS 1212, *Ballvalves (excluding floats).*

BS 1212-1, *Piston type.*

BS 1212-2, *Diaphragm type (brass body) — metric units.*

BS 1334, *The use of thermal insulating materials for central heating and hot and cold water supply installations.*

BS 1387, *Steel tubes and tubulars suitable for screwing to BS 21 pipe threads.*

BS 1394, *Power driven circulators.*

BS 1415, *Mixing valves (manually operated) for ablutionary and domestic purposes.*

BS 1563, *Cast-iron sectional tanks (rectangular).*

BS 1564, *Pressed steel sectional tanks (rectangular).*

BS 1565, *Galvanized mild steel indirect cylinders, annular or saddle-back type.*

BS 1566, *Copper indirect cylinders for domestic purposes.*

BS 1566-1, *Double feed indirect cylinders.*

BS 1710, *Identification of pipelines.*

BS 1724, *Bronze welding by gas.*

BS 1740, *Wrought steel pipe fittings, (screwed BSP thread).*

BS 1952, *Copper alloy gate valves for general purposes.*

BS 1968, *Floats for ballvalves (copper).*

BS 2060, *Copper alloy screw-down stop valves for general purposes.*

BS 2456, *Floats for ballvalves (plastics) for cold water.*

BS 2613, *Electrical performance of rotating electrical machines.*

BS 2767, *Valves and unions for hot water radiators.*

BS 2777, *Asbestos-cement cisterns.*

BS 2871, *Copper and copper alloys, tubes.*

BS 2871-1, *Copper tubes for water, gas and sanitation.*
BS 2879, *Draining taps (screw-down pattern).*
BS 3456, *Testing and approval of household electrical appliances.*
BS 3456-A8, *Electric immersion heaters.*
BS 4127, *Light gauge stainless steel tubes.*
BS 4213, *Polyolefin or olefin copolymer moulded cold water storage cisterns.*
BS ...., *Spray taps (in course of preparation).*
CP 99, *Frost precautions for water services.*
CP 131, *Flues for domestic appliances burning solid fuel.*
CP 310, *Water supply.*
CP 324.202, *Provision of domestic electric water-heating installations.*
CP 331, *Installation of pipes and meters for town gas.*
CP 331-2, *Metering and meter control.*
CP 331-3, *Installation pipes.*
CP 332, *Selection and installation of town gas space heating.*
CP 332-3, *Boilers of more than 150 000 Btu/h (44 kW) and up to 2 000 000 Btu/h (586 kW) output.*
CP 333, *Selection and installation of town gas hot water supplies.*
CP 337, *Flues for gas appliances up to 150 000 Btu/h rating.*
CP 413, *Ducts for building services.*
CP 3002, *Oil firing.*
CP 3005, *Thermal insulation of pipework and equipment [in the temperature range of – 100 °F to + 1 500 °F (– 73 °C to + 816 °C)].*
CP 3009, *Thermally insulated underground piping systems.*

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