BRITISH STANDARD

BS 5449:1990
Incorporating
Amendment No. 1

Specification for

Forced circulation hot water central heating systems for domestic premises

ICS 91.140.10

Committees responsible for this British Standard

The preparation of this British Standard was entrusted by the Refrigeration, Heating and Air Conditioning Standards Policy Committee (RHE/-) to Technical Committee RHE/24, upon which the following bodies were represented:

Association of British Solid Fuel Appliances Manufacturers

Association of Manufacturers of Domestic Unvented Supply Systems Equipment (MODUSSE)

British Coal Corporation

British Gas plc

Chartered Institution of Building Services Engineers

Consumer Policy Committee of BSI

Domestic Solid Fuel Appliances Approval Scheme

Electricity Supply Industry in England and Wales

Heating and Ventilating Contractors' Association

Hevac Association

Institute of Domestic Heating Engineers

Institute of Plumbing

Institution of Gas Engineers

Manufacturers' Association of Radiators and Convectors Limited

National Association of Plumbing, Heating and Mechanical Services Contractors

Sealed Expansion Vessel Association

Society of British Gas Industries

Solid Fuel Advisory Service

Solid Smokeless Fuels Federation

Waterheater Manufacturers' Association

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Contents

Foreword

This revision of BS 5449 has been prepared under the direction of the Refrigeration, Heating and Air Conditioning Standards Policy Committee. It supersedes BS 5449-1:1977 which is withdrawn. In 1977 there was an intention to produce a Part 2 on warm air heating systems, but as this was not proceeded with, Part 1 is deleted from the title of this revision.

In this revision, the opportunity has been taken to present BS 5449 in the format of a practice specification as defined in PD 6501-1. This allows the use of a format where the requirements of the specification are supported by recommendations. To comply with this specification, the user has to comply with all its requirements. He may depart from recommendations but this would be on his own responsibility and he would be expected to have good reasons for doing so.

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. In particular, attention is drawn to the Gas Safety (Installation and Use) Regulations and the Building Regulations of England and Wales and of Scotland, and to Water Supply Bye-laws.

Summary of pages
This document comprises a front cover, an inside front cover, pages i to iv, pages 1 to 38, an inside back cover and a back cover.

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Sidelining in this document indicates the most recent changes by amendment.

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Section 1. General

1 Scope

This British Standard specifies requirements and gives recommendations on good practice in the work involved in the general planning, designing and installation of forced circulation hot water central heating systems with heat requirements, which may include those for domestic hot water, up to a total of 45 kW.

The standard covers the following types of heating systems:

a) open-vented smallbore and microbore;

b) sealed smallbore and microbore.

NOTE The titles of the publications referred to in this standard are listed on page 37.

2 Definitions

For the purposes of this British Standard the following definitions apply.

2.1
heat emitters
a generic term including radiators, convectors, skirting heaters and radiant panels

2.2
boiler
an appliance designed for heating water either for space heating or for space heating combined with hot water supply

2.3
central heating
heating from a single central source within the dwelling, defined in detail as follows

2.4
whole house central heating
the simultaneous heating of all spaces in a dwelling so as to maintain specified temperatures (see Table 1 and clause **9**), based upon calculated heat losses

2.5
part house central heating
the simultaneous heating of some of the spaces in a dwelling so as to maintain specified temperatures (see Table 1 and clause **9**), based upon calculated heat losses

2.6
background central heating
the simultaneous heating of all or some of the spaces in a dwelling to temperatures below those specified in Table 1 and clause **9**, based upon calculated heat losses

2.7
combined system
a system which, as well as providing central heating for rooms or spaces, heats water for domestic use

2.8
immersion primary heater
a unit which is fitted into a direct cylinder consisting of an element such as a coil of pipe through which is passed a heating fluid (e.g. hot water) in such a way that the heat is transferred through the walls of the element without mixing of the primary water in the element and the secondary water to be heated outside the element

2.9
smallbore heating system
a heating system incorporating circulation pipework normally within the size range of 15 mm to 35 mm outside diameter (1½ in to 1¼ in nominal bore)

2.10
microbore heating system
a heating system incorporating circulation pipework normally within the size range of 6 mm to 12 mm outside diameter

2.11
open vented heating system
a heating system which is open to the atmosphere and incorporates a feed and expansion cistern

2.12
sealed heating system
a heating system which is not open to the atmosphere but which incorporates a sealed diaphragm expansion vessel

2.13
designer
the consulting engineer, heating contractor, installer or other person responsible for the design of the heating installation

2.14
design heat requirement
the design heat requirement of a room or space is the total heat required to provide space heating under design conditions

it is the calculated heat loss, with the addition of any intermittency factor for ensuring faster heat-up after a period out of operation

the design heat requirement of a dwelling is the sum of the design heat requirements of each heated room or space within the dwelling

2.15
ventilation heat loss
the ventilation heat loss of a room or space within a dwelling is the heat lost to outside air by the replacement of heated internal air by cooler external air due to the design ventilation rate and design temperature differences

2.16
structural heat loss
the structural heat loss of a room or space within a dwelling is the heat which is conducted through the enclosing surfaces of the room or space (walls and windows, floor and ceiling) due to the design temperature differences across them

it should take into account the exposure of external walls to climatic influence and any heat gain from those surfaces where the adjoining room or space is at a higher design temperature than that of the considered room or space

2.17
calculated heat loss
the calculated heat loss of a room or space within a dwelling is the total heat loss from the room or space due to the design temperature differences and ventilation rate

it is the sum of the structural heat loss and the ventilation heat loss

2.18
pump overrun device
a facility for allowing the circulation pump to operate for a period after the boiler has switched off to dissipate residual heat remaining in the appliance at the end of a cycle

2.19
room-sealed appliance
an appliance which has the combustion system isolated from the room in which the appliance is installed

2.20
open-flued appliance
an appliance which draws its combustion air from the room or internal space in which it is installed

3 Exchange of information

3.1 Preliminary design information

The designer shall consider with the potential customer and settle at the planning stage the following matters:

a) Thermal characteristics of the building for calculation of heat requirements and possible improvements for energy conservation.

b) Fuel to be used.

c) Position of the boiler, bearing in mind access for maintenance, means of flueing and provision of combustion air.

d) Type, location, dimensions, construction and suitability of chimney and flue terminal, where required.

e) Location and size of fuel storage and access thereto, where required. For solid fuel, ash removal and disposal will require consideration.

f) Position of feed and expansion cistern for open systems or expansion vessel, filling point and pressure gauge for sealed systems.

g) Facilities for filling and draining the system.

h) Requirements for domestic hot water supply.

i) Position of any domestic hot water supply equipment, e.g. hot water storage cylinder, if required.

j) Temperatures required to be maintained and the manner in which the dwelling and system are to be used, bearing in mind ventilation and condensation.

k) Type and position of heat emitters.

l) System control of heating and hot water including frost protection.

m) Route and method of installing pipework.

n) The need for compliance with relevant Building Regulations, Gas Safety (Installation and Use) Regulations 1998, BS 7671, Building Regulations 2000 (as amended), Building Regulations (Scotland) 1990 (as amended), Water Supply (Water Fittings) Regulations 1999 and relevant Bye-laws.

3.2 Contractual specification and presentation of scheme

3.2.1 The designer shall obtain sufficient details of the structure of the premises and dimensions of the rooms and spaces to be heated to enable heat losses to be calculated.

COMMENTARY AND RECOMMENDATIONS ON **3.2.1**. *The room temperatures and ventilation rates which are recommended for the purpose of heat loss calculations are given in* Table 1.

3.2.2 The designer shall provide the customer and the installation contractor with a written specification for the scheme stating type and output of the boiler and heat emitters and the room temperatures that will be attained at stated design conditions. This shall also detail the controls and other ancillary equipment to be fitted and the capacity of the domestic hot water storage vessel and associated water temperature controls, if provided. The method of providing any required ventilation and combustion air shall be stated.

COMMENTARY AND RECOMMENDATIONS ON **3.2.2**. *The designer's specification should indicate the locations of the boiler, heat emitters (including dimensions), exposed pipework, feed and expansion cistern or expansion vessel, the domestic hot water storage vessel (if provided) and where an open-flued boiler is used, the flue.*

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Section 2. Materials, appliances and components

4 General

Wherever possible, all materials, appliances and components to be used shall comply with the requirements of applicable British Standards.

COMMENTARY AND RECOMMENDATIONS ON CLAUSE **4**. *Where no British Standard exists, materials and equipment should be fit for their purpose and of suitable quality and workmanship.*

5 Boilers

5.1 General

Boilers fired by solid mineral fuel shall:

a) have a water temperature operated thermostat or,

b) in the case of open fires with back boilers and room heaters complying with BS 3378 without water temperature actuated combustion controls, have a heating system design which ensures adequate heat dissipation in compliance with **22.1**.

NOTE 1 For reasons of safety and ease of control it is essential that solid fuel appliances not having water temperature actuated combustion controls are installed and operated strictly in accordance with the manufacturer's instructions.

In all cases these boilers shall be selected from the list of "Approved domestic solid fuel appliances", or shall have been approved since publication of the latest list.

NOTE 2 Selection from this list will ensure that the boiler conforms to BS 1252, BS 3378, BS 4433 or BS 4834 as appropriate and is suitable for use in clean-air zones.

Boilers fired by gas shall be suitable for the gas with which they are to be supplied and shall be certified to BS 5258-1 or BS 5258-8 or BS 5258-15, and BS 6332-1 or BS 6332-3.

Boilers fired by oil shall comply with the requirements of BS 4876 and be suitable for the oil with which they are to be fired.

Electrical heating appliances shall be selected from the Supplementary List of Household Electrical Appliances issued by the Electricity Council.

5.2 Sealed systems

Boilers for use with sealed systems require specific controls (see clause **7** and clause **16**) and shall therefore be selected only from those designed specifically for this purpose and shall be installed in accordance with BS 7074-1.

COMMENTARY AND RECOMMENDATIONS ON CLAUSE **5**. *The British Standards applicable to boilers are as follows:*

BS 1252 BS 4876
BS 1894 BS 5258-1, BS 5258-8 and BS 5258-15
BS 3378 BS 6332-1 and BS 6332-3
BS 4433

6 Pipes and pipe fittings

The feed and expansion pipe, open vent, circulation pipes and pipe fittings shall comply with the following standards as appropriate: BS 21, BS 143 and BS 1256, BS 864-2, BS 1010, BS 1387, BS 1740, BS 2051-1 and BS 2051-2, BS 2767, BS 2871-1, BS 2879, BS 4127, BS 5154, BS 7291-1, BS 7291-2 and BS 7291-3.

7 Safety valves

For sealed systems a safety valve shall be fitted having the following features.

a) It shall be non-adjustable, spring loaded, preset to lift at a gauge pressure not exceeding 3 bar[1)]

b) It shall have a manual testing device.

c) It shall have a valve or seating face material which will prevent sticking in the closed position and will give effective resealing.

d) It shall have provision for connecting a full bore discharge pipe.

1) 1 bar = 10^5 N/m^2 = 100 kPa.

Section 3. Design considerations

8 General

8.1 A central heating system shall be designed on the basis of calculated heat losses and shall include temperature and system operating controls (clause **22**).

COMMENTARY AND RECOMMENDATIONS ON **8.1**. *In order to reduce unnecessary heat losses and operating costs of the installation, consideration should be given to the following.*

a) *Minimizing air leaks through the structure, e.g. excessive air infiltration may be reduced by sealing cracks in boarded floors over a ventilated cavity, and by weather-stripping badly fitting external doors and windows and by closing unused open fireplaces. Some care and judgement should be exercised in carrying out such measures. An air change rate of about one room volume per hour is necessary in occupied rooms for fresh air supply and odour removal; even more is needed in kitchens for the removal of steam and odours from cooking and laundry (see Table 1). Too severe a restriction of the ventilation of the dwelling can augment the risk of condensation on cool surfaces. Although this standard requires the provision of an air inlet to supply combustion air for gas, oil and solid fuel boilers (other than room sealed appliances), allowance should be made for the supply of combustion air necessary for any other appliance (independent fire, cooker, water heater) in the room in which the boiler is situated.*

b) *Insulation of ceilings and roof.*

c) *Filling of cavity walls with insulating materials.*

d) *Internal insulating linings and external cladding.*

e) *Double glazing.*

f) *Reflective or insulating surfaces behind radiators on external walls.*

8.2 If an open fireplace is to be closed at the base of the chimney, a small opening shall be retained to avoid dampness within the flue.

COMMENTARY AND RECOMMENDATIONS ON **8.2**. *Steps should be taken at the chimney terminal to prevent rain ingress to a disused flue. Any opening for ventilation should be at least* 300 mm *above the fireplace base.*

9 Heating requirements

9.1 The calculated heat losses shall be based on an outside air temperature no higher than –1 °C.

COMMENTARY AND RECOMMENDATIONS ON **9.1**. *Reference should be made to appendix A for U-values of thermal transmittance and to Table 1 for room temperatures to be used for the calculation of structural heat losses and for air change rates to calculate ventilation heat losses. The calculated heat losses should normally be based on an outside air temperature of* –1 °C. *External design air temperatures should be adjusted for the degree of exposure as well as altitude and latitude, and therefore outside air temperatures lower than* –1 °C *should be considered for design purposes. Consideration should also be given to air change rates where small changes from the design rates may affect the actual operational heat losses significantly. This is particularly relevant in the case of highly insulated dwellings.*

Unless the system is to operate continuously, an addition to the calculated heat loss should be made and applied to the room heat emitters. This addition should be at least 10 %. *A greater percentage addition is recommended for well-insulated dwellings because of their low design heat requirements, or where the heating system is in operation for short periods only. Account should be taken of the degree to which secondary heating systems are used.*

In all types of dwelling there is a risk of condensation and consideration should be given to a minimum set-back temperature control.

Table 1 — Temperatures and ventilation rates

Room	Room temperature[a] °C	Ventilation rate (air changes per hour)
Living room	21	1.5
Dining room	21	1.5
Bedsitting room	21	1.5
Bedroom[b]	18	1
Hall and landing	18	1.5
Kitchen	18	2
Bathroom	22	2
Toilet	18	2

[a] These temperatures are those recommended for whole house central heating and for heated rooms with part house central heating. In rooms where open-flued appliances are installed the rate of air change should be increased (see Table 2).
[b] When used part time as bedsitting rooms or for study purposes a higher room temperature may be required.

Table 2 — Air change rates for rooms with open fires and flues up to 40 000 mm² (200 mm × 200 mm)

Approximate room size m^3	Throat restrictor	Ventilation rate (air changes per hour)
40	no	5
40	yes	3
70	no	4
70	yes	2

9.2 The design flow temperature shall not exceed 82 °C. The design return temperature shall be not less than 66 °C unless the boiler is of special condensing design or of the electric storage type.

COMMENTARY AND RECOMMENDATIONS ON **9.2**. *In practice the system flow temperature may be significantly lower than the design flow temperature due to boiler cycling frequencies and intermittent operation. The system design temperature drop should be* 10 °C *unless the boiler is of special condensing design or of the electric storage type. In the case of condensing boilers the operating efficiency is improved by the use of lower return temperatures.*

Electric water storage boilers are not restricted to minimum return temperatures nor to a 10 °C *temperature drop across the heating system. However, the temperature drop would not normally exceed* 20 °C *nor would the return temperature be below* 40 °C. *These values relate to the system controllability and to the heat emission from the system.*

A greater design temperature drop may be advantageous but will require the use of correspondingly larger heat emitters. The boiler manufacturer's instructions should be consulted.

10 Domestic hot water requirements

The capability for providing hot water shall be related to the likely demand, as established in **3.1**h). In highly insulated dwellings the peak demand for domestic hot water may be considerably in excess of the space heating requirement (by a factor of two or three). Where fast recovery of domestic hot water is required the boiler shall be sized taking into account the requirement of the domestic hot water rather than the overall heating load.

COMMENTARY AND RECOMMENDATIONS ON CLAUSE **10**. *The capacity of the storage vessel should not be less than* 114 L, *but larger dwellings may require more. There are, however, circumstances, e.g. pumped primaries, as well as the use of specially designed appliances with integral storage, which permit the use of smaller capacities (see BS 6700).*

Where an electric immersion heater is provided the length and position of the element should be such as to heat the bulk of the stored water.

In order to reduce both delay in arrival of hot water at taps and the subsequent energy wastage from residual hot water in the draw-off pipes the hot water storage vessel should be sited as near as practicable to the most frequently used draw-off point, usually the kitchen sink.

The trend towards greater hot water usage (e.g. by second bathrooms and/or en-suite showers) does make it possible to place exceptional demands on the hot water system and subsequently the peak boiler loads. If allowance is not made in such circumstances, i.e. at times of peak hot water demand, the performance of the space heating may be affected and consideration should be given to the effect of prioritizing domestic hot water recovery.

Some central heating appliances incorporate means for the instantaneous production of hot water and for these no, storage vessel is required. The rate of delivery of hot water from such appliances is normally less than with a storage system and manufacturers' published performance figures should be checked to ensure that they satisfy all requirements for both heating and hot water.

11 Boilers

11.1 The boiler output rating shall be at least equal to the sum of the design heat requirement of the dwelling and the non-useful emission from the system pipework.

In the case of a boiler of condensing design the output when operating in the non-condensing mode is the output that shall be considered.

Electric off-peak storage boilers shall be sized on the 24-hour heat requirement of the dwelling taking due regard of the available heat gains and of the direct acting heat available during the off-peak period.

COMMENTARY AND RECOMMENDATIONS ON **11.1**. *Where a boiler supplies both heating and hot water service without priority controls, additional boiler power of up to* 2 kW *may be required depending upon the likely consumption of hot water, secondary circulation heat losses and the storage capacity of the indirect cylinder. Where priority controls are used the provision of domestic hot water should be in accordance with clause* **10**.

11.2 The boiler shall be so located as to provide ready access for inspection, repair and maintenance. Boilers of the open-flued type shall not be installed in bathrooms, shower rooms, bedrooms or garages.

COMMENTARY AND RECOMMENDATIONS ON **11.2**. *The boiler should be located where its emitted heat may be useful to the occupants. Locations internal within the dwelling are preferred.*

Where boilers are located where flammable liquids or materials may be stored, they should be of the room-sealed type or enclosed in a fireproof structure. See the manufacturers' instructions and local bye-laws.

When selecting the location for a boiler of condensing design, consideration should be given to the need to dispose of the condensate (see clause **29**).

11.3 For sealed systems a safety valve shall be fitted, either:

a) directly to the boiler, or

b) in the flow pipe, as near as practicable to the boiler, with no intervening valve or restriction.

COMMENTARY AND RECOMMENDATIONS ON **11.3**. *The safety valve should be fitted in accordance with the manufacturer's instructions and be accessible for testing during the filling procedure (see* **16.4***). The method of fitting should ensure that discharge of water or steam cannot create a hazard to persons in or about the premises, or damage to electrical components or wiring, and the point of discharge should be clearly visible.*

11.4 Where two oil-fired boilers are used in the same dwelling, the burners shall be suitable for the same grade of oil (see BS 5410-1).

11.5 Systems using a solid fuel boiler shall be designed so as to ensure that all heat generated when the boiler is slumbering is dissipated.

COMMENTARY AND RECOMMENDATIONS ON **11.5**. *Dissipation of heat generated when the boiler is slumbering may be ensured by installing the necessary heating surface in a gravity circuit to cylinder and/or radiator(s), or incorporated in a suitably designed fully pumped system with special controls. Such a circuit should not be provided with user-operated valves.*

12 Chimney and flue

12.1 The boiler manufacturer's installation instructions shall be followed for boilers which incorporate special means of disposal of the products of combustion e.g. those with fan-assisted flues.

12.2 Appliances using dissimilar fuels shall not be connected to the same flue.

COMMENTARY AND RECOMMENDATIONS ON CLAUSE **12**. *Chimneys and flue pipes should be constructed of materials appropriate to their location to avoid overheating of combustible structures and the effects of condensation in the flue, and should be terminated in a freely exposed position to minimize the risk of downdraught or the creation of a nuisance.*

Detailed recommendations are given in BS 6461-1 and BS 6461-2, BS 5440-1 and BS 5410-1.

13 Velocity and pressure loss in circuits

13.1 To ensure quietness in operation the pipe circuits shall be designed such that the velocity of water does not exceed 1.5 m/s.

13.2 The circulation pump shall be selected to circulate the designed flow of water through the pipes, heat emitters and boiler against the calculated pressure loss.

COMMENTARY AND RECOMMENDATIONS ON CLAUSE **13**. *Values for the determination of pipe pressure loss due to friction are given in appendix B. When calculating the pipework pressure loss, an extra one third should be allowed for fittings.*

In the case of systems plumbed in plastics, reference should be made to BS 5955-8 for pipework pressure loss.

14 Feed and expansion cistern (open vented systems only)

14.1 A feed and expansion cistern complying with BS 417 or BS 4213 shall be provided for supplying water to the heating system and accommodating the expansion of the system water. It shall be used for no other purpose.

COMMENTARY AND RECOMMENDATIONS ON **14.1**. *The feed and expansion cistern should be fitted at least* 1 m *above the highest point of the circulation system, or such lesser height as permitted in the boiler manufacturer's instructions. The cistern should be fully supported and in a position to permit maintenance of any components and its base should be protected from corrosion and abrasion. Where a plastics cistern is used it should be provided with a solid platform no smaller than its base.*

14.2 The cistern shall be fed by a mains or low pressure cold water supply via a float-operated valve conforming to BS 1212-2 or BS 1212-3, or other equivalent device which shall discharge into the cistern higher than the overflow warning pipe. An independent stop valve shall be fitted in this supply close to the water level maintaining device. The capacity of the cistern shall be at least one twentieth of the total system volume.

COMMENTARY AND RECOMMENDATIONS ON **14.2**. *The cistern should have a cold water supply pipe not less than* 13 mm *internal diameter and should be installed in accordance with Figure 1.*

It should be equipped with a removable moisture proof self-supporting cover penetrated only by the turned down end of the open vent pipe and so fitted that condensation on the underside of the cover will be retained in the cistern.

14.3 The overflow warning pipe shall be a minimum of 20 mm internal diameter and shall be properly supported throughout its full length. It shall have a continuous falling gradient from the cistern to a visible external termination point. If the material of the pipe is not capable of withstanding a temperature of 100 °C it shall have continuous support to avoid sagging. It shall serve only one cistern and not have any other connection to it.

NOTE The support required for the overflow warning pipe will be dependent on the length and material of the pipe.

14.4 The tank cover and all materials in normal contact with the water e.g. the tank itself and the float shall be capable of withstanding a temperature of 100 °C. When fitted in the roof or in an exposed position precautions against freezing shall be taken.

15 Feed and expansion pipe and open vent pipe for open systems

15.1 A feed and expansion pipe of minimum internal diameter 13 mm shall be taken from the feed and expansion cistern to the system and shall not supply water for any other purpose.

No valve shall be fitted in the feed and expansion pipe.

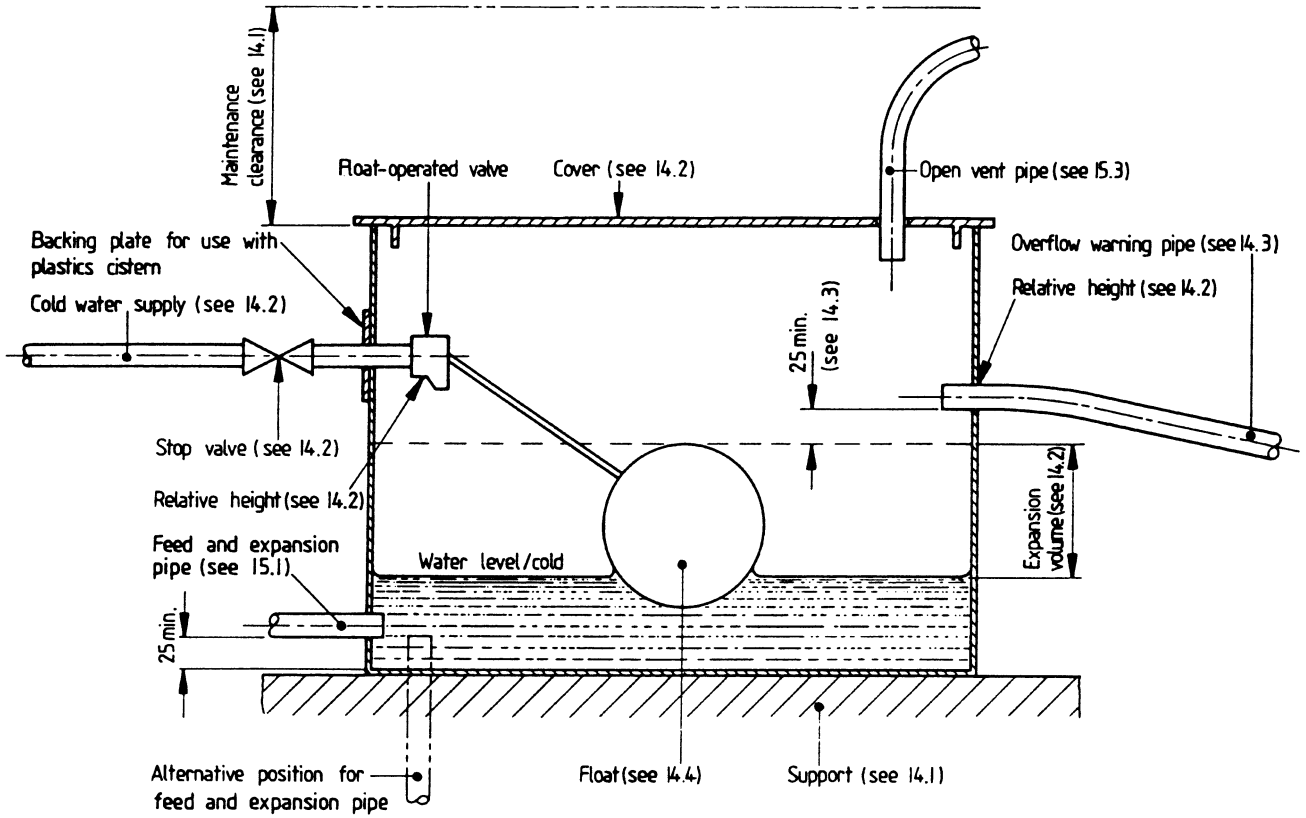
COMMENTARY AND RECOMMENDATIONS ON **15.1**. *The feed and expansion pipe and the open vent pipe should be separate. Where a boiler suitable for sealed systems is used a single pipe of minimum internal diameter of* 20 mm *is acceptable [see Figure 2(c)]. It should be noted that larger system water volumes (e.g. thermal storage) may require a feed and expansion pipe of diameter greater than the minimum stated above. It should be noted that larger system water volumes (e.g. themal storage) may require a feed and expansion pipe of diameter greater than the minimum stated above.*

15.2 When specific requirements are given in the boiler manufacturer's instructions relating to the feed and expansion pipe and the open vent pipe then these shall be applied by the installer.

15.3 An open vent of minimum internal diameter 20 mm shall be taken from the primary circuit to discharge at a level above the overflow of the feed and expansion cistern. Unless the boiler is suitable for sealed systems, the open vent pipe shall rise continuously from the boiler to discharge over the cistern through the cover. No valve shall be fitted in the open vent pipe.

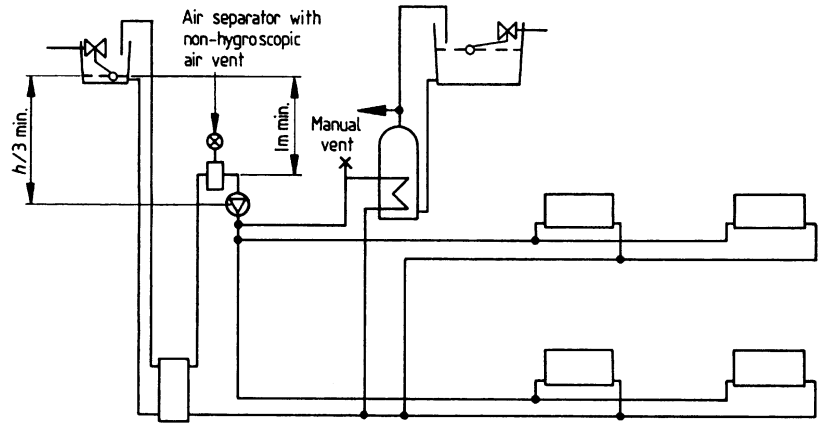
COMMENTARY AND RECOMMENDATIONS ON **15.3**. *The open vent pipe may be used as part of the circulation system. A separate open vent pipe for the primary circuit of a single-feed indirect cylinder is not normally required.*

Due consideration should be given to the position of the connections of the feed and expansion pipe and the open vent pipe to the circulation pipework of the system relative to the position and head of the circulation pump. The pressure differences between these two connections should be kept to a minimum in order to avoid excessive water movement in the open vent pipe and therefore they should normally be installed close together. Incorrect selection of the point of connection may result in discharge of water from the open vent pipe and/or air entrainment into the system which can give rise to corrosion (see Figure 2).

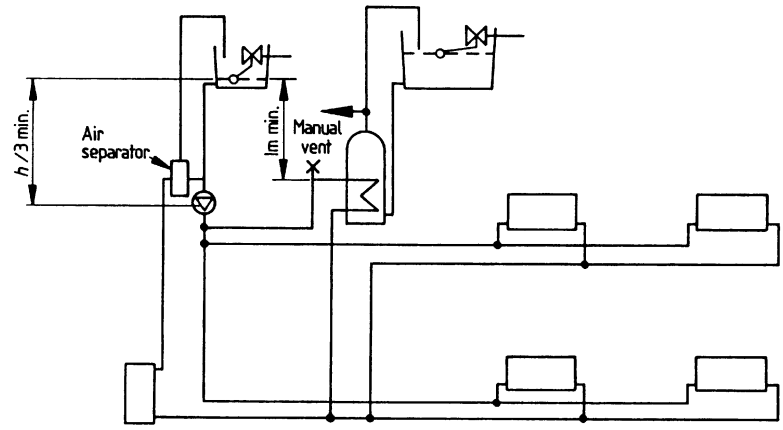


All dimensions are in millimetres.

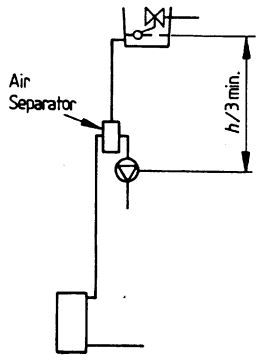
Figure 1 — Diagrammatic arrangement of feed and expansion cistern installation



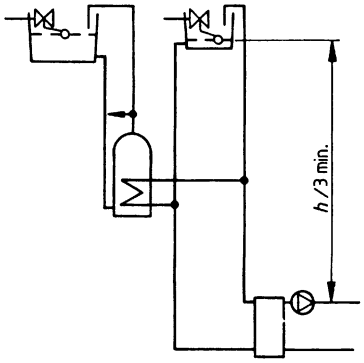
(a) Feed and open vent arrangement for fully pumped systems. Recommended only for boilers with low hydraulic resistance



(b) Close coupled feed and open vent. Recommended particularly for boilers with high hydraulic resistance



(c) Feed and expansion arrangement suitable only for boilers designed for use with sealed systems



(d) Feed and expansion and open vent arrangement where a gravity primary circuit is required

NOTE h is the maximum head developed by the pump.

Figure 2 — Diagrammatic arrangement for feed and expansion and open vent pipes

16 Sealed systems

16.1 A sealed system shall be provided with a diaphragm expansion vessel complying with BS 4814, a safety valve, a pressure gauge and means for system filling, make-up and venting.

16.2 The diaphragm expansion vessel shall have an acceptance volume sufficient to accommodate the volume change of system water when heated from 10 °C to 110 °C.

COMMENTARY AND RECOMMENDATIONS ON **16.2**. *The practical acceptance volume is that which the vessel will accept when the gauge pressure developed rises to* 0.35 bar (5 lb/in^2) *less than the safety valve setting. Guidance on vessel sizing is given in Table 3. For full method of calculation reference should be made to section one of BS 7074-1:1989.*

Care should be taken in the installation of boilers that incorporate an expansion vessel to ensure that adequate expansion capacity is provided; an additional expansion vessel may be required.

The vessel charge pressure should be not less than the static head pressure at the centre of the expansion vessel.

It should be connected with pipework in such a manner as to ensure that natural convection currents in the pipework or vessel are retarded and the diaphragm within the vessel is maintained at the lowest practicable temperature. It may be supported remotely from the system provided the connecting pipe has an internal diameter of not less than 13 mm. *Installation should be in accordance with the manufacturer's instructions.*

The vessel should be connected to the system at a point close to the pump inlet in order to maintain positive pressures throughout the system.

16.3 A pressure gauge with a fill pressure indicator shall be fitted permanently to a sealed system.

COMMENTARY AND RECOMMENDATIONS ON **16.3**. *The pressure gauge should be easy to read from the filling point and should preferably be connected at the same point as the expansion vessel. Where the pressure gauge is combined within the temperature gauge the combined gauge should be fitted to the boiler or to the flow pipe: it should not be fitted to a non-circulation pipe.*

Table 3 — Capacities of expansion vessels

Safety valve setting	bar 3.0			bar 2.5			bar 2.0	
Vessel charge and initial system pressure	bar 0.5	bar 1.0	bar 1.5	bar 0.5	bar 1.0	bar 1.5	bar 0.5	bar 1.0
Total water content of system	**Vessel volume**							
L	L	L	L	L	L	L	L	L
25	2.1	2.7	3.9	2.3	3.3	5.9	2.8	5.0
50	4.2	5.4	7.8	4.7	6.7	11.8	5.6	10.0
75	6.3	8.2	11.7	7.0	10.0	17.7	8.4	15.0
100	8.3	10.9	15.6	9.4	13.4	23.7	11.3	20.0
125	10.4	13.6	19.5	11.7	16.7	29.6	14.1	25.0
150	12.5	16.3	23.4	14.1	20.1	35.5	16.9	30.0
175	14.6	19.1	27.3	16.4	23.4	41.4	19.7	35.0
200	16.7	21.8	31.2	18.8	26.8	47.4	22.6	40.0
225	18.7	24.5	35.1	21.1	30.1	53.3	25.4	45.0
250	20.8	27.2	39.0	23.5	33.5	59.2	28.2	50.0
275	22.9	30.0	42.9	25.8	36.8	65.1	31.0	55.0
300	25.0	32.7	46.8	28.2	40.2	71.1	33.9	60.0
Multiplying factors for other system volumes	0.0833	0.109	0.156	0.094	0.134	0.237	0.113	0.2

16.4 The connections for filling a sealed system shall include a stopvalve and double check valve assembly to prevent system water from travelling back into the main supply (see Figure 3).

COMMENTARY AND RECOMMENDATIONS ON **16.4**. *The method of filling should be either by:*

a) *a temporary hose connection to mains water. A stopvalve should be fitted to the service main outlet and a double check valve assembly and stopvalve should be fitted to the system side of the temporary hose; or*

b) *a cistern used for no other purpose connected to mains water. The static head provided by the cistern should be a minimum of* 300 mm *measured to the highest point of the heating system. The supply pipe from the cistern should include the double check valve assembly and stop valve.*

The filling connections to the system should be on the return side of all heat emitters and/or hot water storage vessel. The temporary hose should be removed after use.

16.5 Provision shall be made for replacing water lost from the system.

COMMENTARY AND RECOMMENDATIONS ON **16.5**. *Replacement water should be provided either:*

a) *automatically, by one of the following methods:*

1) *from an independent cistern used for no other purpose as in* **16.4**b) *above, or*

2) *from a manually-filled make-up vessel mounted in a position higher than the top point of the system and connected through a double check valve assembly. This should be connected either to the return side of all heat emitters or to the return side of the hot water storage vessel; or*

b) *manually, by a temporary hose connection as in* **16.4**a).

17 Venting

Provision shall be made to enable the system to be vented.

COMMENTARY AND RECOMMENDATIONS ON CLAUSE **17**. *Air may be vented from high points either by automatic or manual air vents. Hygroscopic types of automatic air vent should not be used as these allow continuous evaporation of small quantities of water. To assist in venting, an air separating device (with automatic air vent in the case of sealed systems) is recommended and should be fitted in accordance with the manufacturer's instructions.*

18 Heat emitters

Radiators and convectors shall comply with BS 3528 and shall be capable of meeting the design heat requirement of the room in which they are fitted making due allowance for the heat emission from the exposed pipes in the room. Each heat emitter shall be provided with supports and means of venting air.

In special cases, like kindergartens, schools, nurseries and homes for the elderly/infirm or adults with learning dissabilities, the surface temperatures of heat emitters shall be limited in accordance with local or statutory requirements.

COMMENTARY AND RECOMMENDATIONS ON CLAUSE **18**. *Wherever practicable individual heat emitters (other than fan convectors) should be located on outside walls preferably beneath windows to offset the cooling effect: it is an advantage to choose an emitter of such a length that it occupies the full width of the window.*

The enclosure of heat emitters will reduce the emission depending upon the type of enclosure.

Radiator outputs should be checked against any variation in catalogue data with the mean water temperature and room temperature which applies.

19 Valves

19.1 Where the boiler system requires it, and the manufacturer's instructions so specify, a key-operated or automatic system by-pass valve shall be fitted.

19.2 A full-way key-operated valve shall be fitted to both sides of a circulation pump so that the pump can readily be replaced without emptying the system.

COMMENTARY AND RECOMMENDATIONS ON CLAUSE **19**. *Valves should normally be fitted to all heat emitters, to provide control, balancing and replacement of the emitter without emptying the system.*

All sub-circuits in one-pipe systems should be provided with a valve to regulate the flow through these circuits.

A balancing valve should not normally be included in the primary circuit of the domestic hot water storage cylinder. Such a valve will prolong the recovery time of the cylinder impairing system efficiency.

20 Thermal insulation

20.1 Dead legs, feed and expansion pipes, cold water supply pipes, open vent pipes and any circulation pipes fitted in positions likely to be subjected to frost shall be insulated.

20.2 Hot water storage cylinders shall be insulated either at manufacture to BS 1566 or BS 3198 or by the application of an insulating jacket to BS 5615.

COMMENTARY AND RECOMMENDATIONS ON CLAUSE **20**. *Insulation of cold water pipes should also be carried out where condensation due to warmth and humidity of the atmosphere is objectionable. The insulation should incorporate a vapour seal.*

Where the expansion cistern is likely to be subjected to frost it should be insulated with not less than 25 mm *thickness of insulating material Where the cistern is positioned on joists in a roof space, insulation should not be fitted under the cistern; any insulation should be removed.*

Insulation should be securely applied to any circulation pipework not forming part of the useful heating surface. Insulating material should be mineral fibre [K = 0.04 W/(m·K)*] to a minimum* 18 mm *thick, or its thermal equivalent, and where exposed to the weather should be rendered waterproof. The insulation should be continuous over pipes, valves and fittings.*

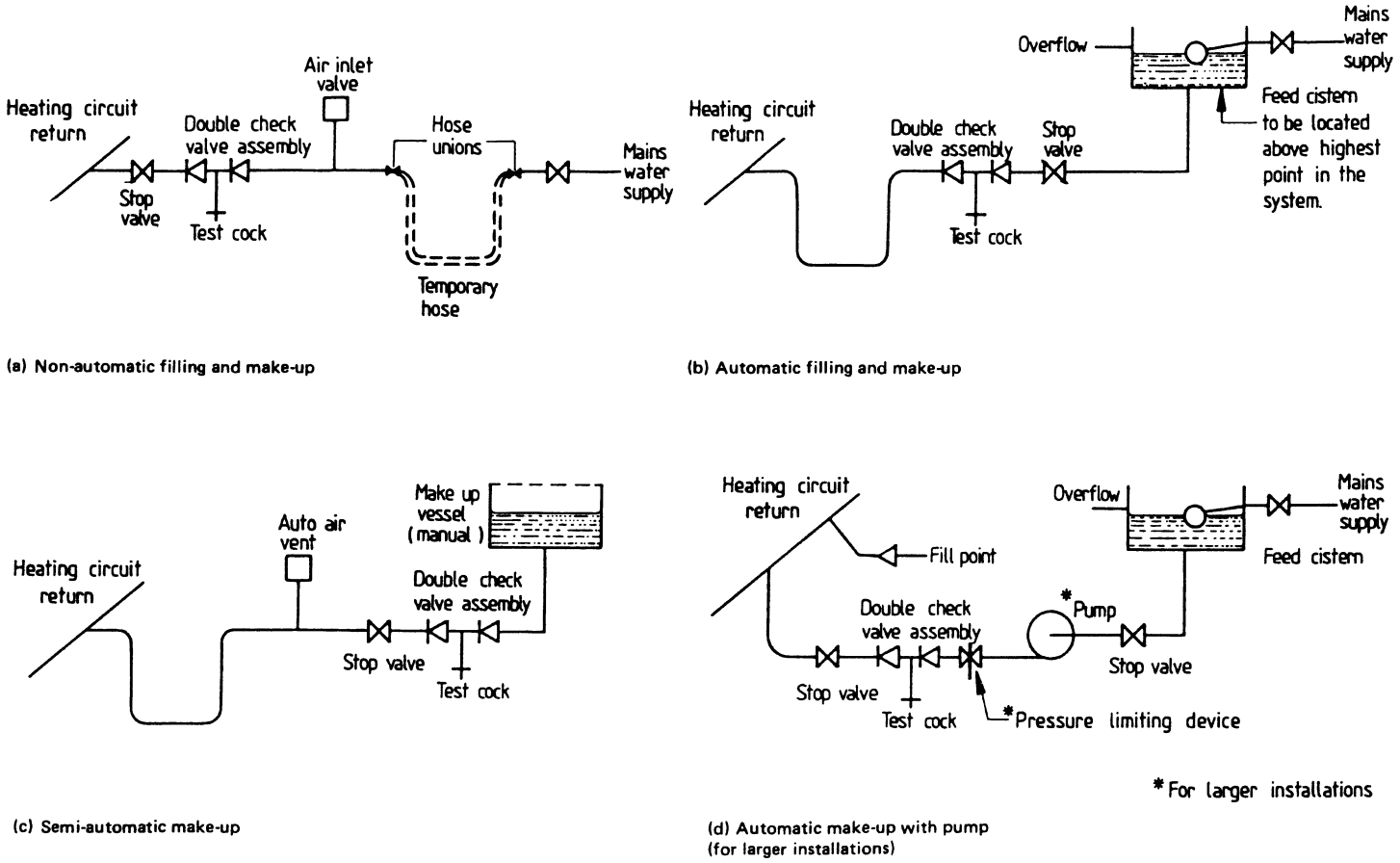


Figure 3 — Sealed system filling and make-up

21 Domestic hot water storage

21.1 In a combined system an indirect cylinder shall be used as the hot water storage vessel.

COMMENTARY AND RECOMMENDATIONS ON **21.1**. *The storage cylinder should conform to BS 1566 or BS 3198 but it should be noted that cylinders are available with a heat exchanger surface area greater than that required by these standards and which have improved performance and are capable of providing improved water heating efficiency, especially during the summer.*

An immersion primary heater may be used to convert a direct hot water cylinder for indirect use. Such heaters should have a heat transfer rate of at least equal to that of BS 1566 cylinders of the same capacity and should only be fitted where the primary circulation is pumped. The probable life of any existing direct cylinder should be considered.

Provision of an electric immersion heater to BS 3456-2.21, as an alternative form of water heating, may be considered, e.g. for use during the summer.

It is recommended that primary circulation to the cylinder should be pumped from the boiler. However, where primary circulation is by gravity the cylinder should be fitted at a sufficient height above the boiler to ensure good circulation and the pipes should be connected to the boiler in accordance with the manufacturer's instructions. Where no such guidance is provided, the flow and return pipes should be at least 25 mm *internal diameter. To ensure correct circulation in the hot water circuit, the return boiler pipe should be connected to a separate return tapping on the boiler or into an injector type fitting in the return pipe of the heating circuit. Pipework should be so designed that heat loss from stored water does not occur by gravity circulation.*

NOTE In considering domestic hot water supply by solid fuel boilers particular attention should be given to manufacturer's instructions.

21.2 Indirect cylinders fitted in sealed heating systems shall be of the coil type, to BS 1566-1 or BS 3198.

Single feed cylinders shall not be used for sealed systems.

Where the domestic hot water storage is of the unvented type the installation shall conform to the requirements of Part G schedule 1 of the Building Regulations (England and Wales) 1985.

COMMENTARY AND RECOMMENDATIONS ON **21.2**. *Single feed cylinders to BS 1566-2 may be used for open vented systems provided that:*

a) *the principle is acceptable to the local water supply undertaking, and to the radiator and boiler manufacturers;*

b) *the cylinder is installed in accordance with the manufacturer's instructions;*

c) *the inner heater has sufficient capacity to contain the expansion of the primary water, including that contained within the whole of the heating circuit at maximum design conditions, without overflow taking place into the secondary section of the cylinder;*

d) *where the primaries are pumped the static head of the system is in excess of the maximum pump head;*

e) *no corrosion inhibitor or additive be introduced into the system.*

21.3 Connections to the storage cylinder shall be of non-ferrous materials not subject to de-zincification.

22 System control

22.1 General considerations

Consideration shall be given to the system of control to be used for both heating and domestic hot water circuits.

Control systems which prevent water circulation through the boiler shall only be used when this complies with the boiler installation instructions.

In the interests of fuel economy and to prevent wasteful boiler cycling the system controls shall shut off the boiler when heat is no longer required, or in the case of a solid fuel boiler, shall reduce it to the minimum burning rate.

In the case of a boiler fired by solid fuel and not fitted with a water temperature actuated combustion control, adequate heat dissipation shall be made available in accordance with the manufacturer's recommendations.

COMMENTARY AND RECOMMENDATIONS ON **22.1**. *Various forms of system control are available and a selection should take account of the fuel or power to be used. The purpose of the controls is to provide the user with means to adjust the operation of the system to meet requirements and to achieve fuel economy.*

Care should be exercised when selecting the various system controls for the heating and hot water circuits so as to ensure that they are compatible with each other and with the boiler controls.

If, after the control system has been selected, unwanted gravity circulation can occur, a means of preventing this circulation should be included.

22.2 Timing controls

Where intermittent operation of the heating system is required, consideration shall be given to the provision of a time-switch.

COMMENTARY AND RECOMMENDATIONS ON **22.2**. *A time switch can be used to switch on and off automatically as required. Where the system consists of both heating and hot water circuits a combined time switch and programmer can be used to control both circuits independently.*

A time switch should not be used to switch off a mechanical fuel feed and/or a fan fitted to a solid fuel boiler.

22.3 Temperature control of heating system

The heating system shall be provided with means to limit the temperature of the spaces it is heating.

Where the system consists of two or more circuits each controlled by a separate circulation pump, zone valves shall be used in each circuit to ensure that when only one pump is operating, flow cannot take place in the other circuits.

Where individual thermostatic radiator valves (TRVs) are used they shall not be the sole means of control for the heating circuit but shall be used in conjunction with other controls which ensure that the boiler is shut off, or reduced to minimum burning rate for solid fuel, when not required.

Where the circulation pump is not shut off with the boiler because of a pump overrun device a bypass circuit shall be provided. Where thermostatic radiator valves are used they shall not be fitted in the same room or area in which the air temperature sensor (room thermostat) is situated.

COMMENTARY AND RECOMMENDATIONS ON **22.3**. *In the case of a single heating circuit the air temperature sensor (room thermostat) should control both the circulation pump and, except in the case of a solid fuel boiler, the boiler.*

Care should be taken when siting an air temperature sensor to ensure that the position chosen is representative of that part of the system which it controls. It should be sited so as not to be exposed to draughts or cooling effects and away from any heat sources, e.g. radiators and direct sunlight. The sensor should be fitted 1.5 m *from floor level and in a position readily accessible to the user.*

The air temperature of any area or zone in a dwelling, e.g. upstairs or downstairs, may be controlled by installing a valve (zone valve) into the heating circuit which provides water circulation to that zone. The zone valve may be activated by an air temperature sensor positioned remotely from, or in direct contact with, the valve body.

A two-port zone valve may be used to open or close a single circuit supplying one zone. A three-port valve may be used to control water circulation to two zones only, e.g. heating and hot water.

Motorized valves which include switch contacts capable of controlling the pump and, except in the case of a solid fuel boiler, the boiler are recommended.

A mixing valve may be used to control the circuit water flow temperature by blending return water and boiler flow water in response to heating demand and is normally controlled by an integral and/or external temperature sensor.

Where a circuit is so designed that circulation can take place only when the circulation pump is in operation, then some measure of control can be obtained by operating the pump directly from an air temperature sensor.

A thermostatic radiator valve consists of an air temperature sensor connected to a valve. The valve may be fitted to any individual heat emitter to control directly the water circulation through it. The valve is normally fitted to the inlet of the heat emitter although others are available for outlet use also. The sensor may be fitted directly to the valve but valves are available with remote sensors and these should be used to provide improved control in cases where the use of a directly fitted sensor would be ineffective or impractical.

22.4 Temperature control of stored domestic hot water

22.4.1 Where the cylinder is served by a gas- or oil-fired boiler an adjustable thermostat shall be fitted to control the temperature of the stored water. This thermostat shall be capable, either directly or in conjunction with other devices, of shutting off the primary water circulation.

Any electrical immersion heater fitted into the cylinder shall incorporate a thermostat.

For solid fuel fired systems, a means of heat dissipation shall also be provided (see **11.5**), and in the event of electrical failure with a fully pumped system, the primary flow and return pipes to the cylinder shall revert to gravity circulation.

COMMENTARY AND RECOMMENDATIONS ON **22.4.1**. *The thermostat sensor should be fitted at a height of one-quarter to one-third of the way up the cylinder and normally be adjusted to give a water temperature of* 60 °C. *In hard water areas it may be advantageous to adjust to a lower setting to minimize scale formation in the cylinder.*

22.4.2 Any valve fitted in the primary flow or return pipe of the cylinder for actuation by the cylinder thermostat shall be capable of switching to control the boiler (except for solid fuel) and pump (where the system is fully pumped).

COMMENTARY AND RECOMMENDATIONS ON **22.4.2**. *The valve may be a two-port valve for independent control of the cylinder circuit or a three-port valve fitted in the common flow. In the latter case it is recommended that a mid-position valve be used which can allow shared flow distribution to the cylinder and heat emitter circuits. A "diverter" type of three-port valve which allows circulation to either the cylinder circuit or the heat emitter circuit may be used if the system design is intended for a priority flow arrangement.*

22.4.3 Where a cylinder circuit is supplied by an independent pump controlled by the cylinder thermostat, it shall be wired to be capable of switching to control the pump and, except in the case of a solid fuel boiler, the boiler. With such a multiple pump system, non-return valves shall be used to prevent the pump on one circuit affecting the flow in the others.

23 Draining

Fittings shall be provided to enable the system to be drained.

COMMENTARY AND RECOMMENDATIONS ON CLAUSE **23**. *Key-operated drain taps to BS 2879 should be provided in accessible positions in all low parts of the system. However, it should be noted that there may be short sections of pipework, e.g. when passing under doorways, that it may not be possible to drain.*

24 Delivery, storage and metering of fuel

24.1 Solid fuel

A weatherproof, robustly constructed fuel store shall be available with easy access for delivery and removal of fuel.

COMMENTARY AND RECOMMENDATIONS ON **24.1**. *The fuel store provided should be capable of containing at least six weeks' supply of fuel, but in any case not less than* 1 t. *The opening through which the fuel is tipped should be not less than* 0.6 m *square and not more than* 1.4 m *high.*

The minimum capacity of fuel storage should be based upon boiler output rating and type of fuel as given in Table 4.

Table 4 — Solid fuel storage capacities

Boiler output rating	Types of fuel			
	Dense		Coke	
	Capacity	Floor area	Capacity	Floor area
kW	t	m^2	t	m^2
≤ 15	1	1	1	1.5
> 15 ≤ 25	1.5	1.5	1.5	2.25
> 25 ≤ 35	2	2	2	3
> 34 ≤ 45	3	3	3	4.5

NOTE The figures given in the above table assume a six weeks' fuel supply, a stacking height of 1.4 m (4.5 ft) above floor level, a specific volume of dense fuel of 1.4 m^3/t (50 ft^3/ton) and a specific volume of coke type fuel of 2.2 m^3/t (80 ft^3/ton).

24.2 Gas

BS 6400 shall be complied with.

24.3 Liquefied petroleum gas

BS 5482 shall be complied with.

24.4 Fuel oil

Any oil storage tank shall be provided with an accessible filling point.

COMMENTARY AND RECOMMENDATIONS ON **24.4**. *The oil storage tank should have a minimum storage capacity based upon boiler output rating in accordance with* Table 5.

Table 5 — Fuel oil storage capacities

Rating of boiler	Size[a]		Practical capacity	
kW	feet	(gallons)	L	(gallons)
0 to 15	6 × 4 × 2	(300)	1 100	(250)
15 to 30	6 × 4 × 4	(600)	2 200	(500)
30 to 45	6 × 4 × 6	(900)	3 400	(750)

[a] The method of sizing is that used in the industry.

24.5 Electricity

The requirements of the local Electricity Board shall be complied with.

25 Air supply

25.1 Except in the case of electric or room-sealed boilers, a permanent opening shall be provided for air supply into the room where the boiler is situated. The opening shall be direct to outside air or to an adjacent room or internal space (other than a bedroom or a room or internal space containing a bath, shower or WC) which itself has a permanent opening to outside air.

25.2 For solid fuel or oil-fired boilers the air opening provided shall have a free area of at least 550 mm^2 per kilowatt of rated output over 5 kW.

25.3 For gas-fired boilers the air opening provided shall have a free area of at least 500 mm^2 per kilowatt of rated input over 7 kW (based on net calorific value).

25.4 If a solid fuel or oil-fired boiler is fitted with a draught break or stabilizer in the same room, an additional free area of 300 mm^2 per kilowatt rated output shall be provided.

COMMENTARY AND RECOMMENDATIONS ON **25.1**, **25.2**, **25.3** AND **25.4**. *If the room or internal space from which the air is drawn has an extract fan fitted then the permanent air openings should be designed so that the operation of the boiler flue is not affected when all doors and windows are closed and the extract fan is running.*

If the air entry communicates with another part of the building rather than with outside air, then that part should be provided with the same area of opening from the outside air.

All air entry arrangements should be made so as to cause as little discomfort as possible to the occupants of the room and thus offer the least temptation to obstruct the openings.

25.5 Where any boiler is installed in a compartment or confined space, in addition to air for combustion, provision shall be made for ventilation in order to prevent overheating.

Permanent openings shall be provided, one at high level and one at low level, both communicating with the same room or space or both on the same outside wall.

The minimum free areas of the openings for both ventilation and combustion air shall be in accordance with Table 6.

Table 6 — Air openings sizes in mm² per kW output

Type of boiler	Position of opening	Opening to room mm²/kW	Opening to outside mm²/kW
Open-flued	High level Low level	1 100 1 650	550 1 100
Room-sealed	High level Low level	1 100 1 100	550 550

26 Corrosion inhibitor

Where it is known that the water supply in the area can give rise to corrosion, consideration shall be given to the addition of an inhibitor to the heating system taking into account the factors in the commentary and recommendations in this clause. Where an indirect cylinder is used it shall be of the type having a sacrificial anode.

COMMENTARY AND RECOMMENDATIONS ON CLAUSE **26**. *Experience has shown that corrosion within a well-designed and installed system is extremely low and inhibitors should only be used where specified (see clause* **38***). The use of an unsuitable inhibitor can even have detrimental effects. It should be noted that many types of inhibitor can be used only with certain materials and the manufacturer's literature should be consulted concerning compatibility with all the materials in the system.*

Section 4. Installation work on site

27 Boiler

27.1 The boiler shall be installed in accordance with the manufacturer's instructions.

COMMENTARY AND RECOMMENDATIONS ON CLAUSE **27**. *The structure upon which a boiler is supported, and its immediate surroundings, should be adequate for the weight imposed and where necessary be suitably protected against the risk of fire or damage by heat. Special considerations may apply in the case of installations in timber framed buildings. General principles for the installation of appliances and services in timber framed dwellings may be found in IGE/UP/7, Guide for gas installations in timber framed housing.*

27.2 Where plastics pipework is used, this shall not be connected directly to the boiler.

COMMENTARY AND RECOMMENDATIONS ON **27.2**. *A transition piece, i.e. metal or plastic, should be used for the connection in accordance with BS 5955-8.*

28 Flueing and air supply

Flues and air supply shall comply with BS 6461 for solid fuel, BS 5440-1 and BS 5440-2 for gas or BS 5410-1 for fuel oil.

Where a decorative fuel effect appliance is to be flued into an existing chimney, any damper or restrictor plate shall be removed.

COMMENTARY AND RECOMMENDATIONS ON **28**. *An existing chimney should be checked for suitability, soundness, continuity and freedom from obstructions and, where necessary, swept clean before connecting a boiler to it.*

Where a decorative fuel effect appliance is to be flued into an existing chimney, and where it is not reasonably practicable to remove a sliding damper, it will need to be fixed in the fully open position.

29 Condensate disposal

Boilers designed to be used in the condensing mode shall be installed in accordance with the manufacturer's instructions which will describe any particular additional requirements for the disposal of condensate.

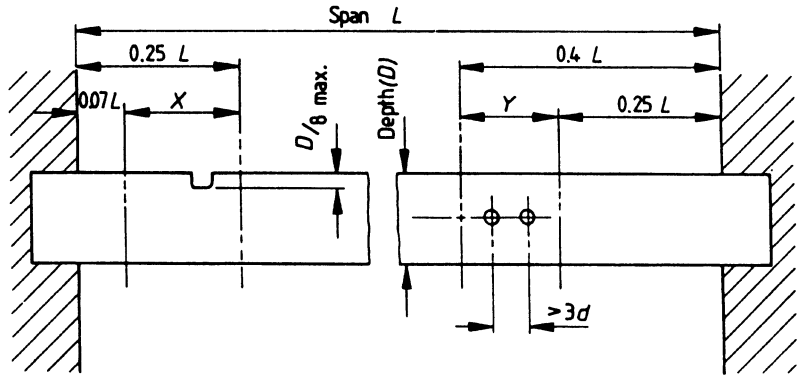
COMMENTARY AND RECOMMENDATIONS ON CLAUSE **29**. *For boilers of the condensing type the boiler should be fitted with a condensate drain pipe which may run into an internal soil stack or waste pipe e.g. from a dishwasher or a washing machine, an external gulley, hopper or soakaway, and may require the use of a trap or break. Any pipework should be of a diameter described in the boiler manufacturer's instructions. Any external pipework should be kept to a minimum length to minimize the risk of freezing. The condensate pipe should have a fall of at least 1:20 and be run in a standard drain pipe material i.e. PVC, UPVC, ABS or PP. It should be noted that the connection of the condensate pipe to the drain may be subject to local building control requirements.*

30 Circulation pipework

30.1 The positioning and supporting of pipes shall allow for free movement for expansion and contraction and shall be designed to prevent sagging and the formation of local high points in which air could accumulate.

NOTE Particular attention will need to be paid to this where the circulation is by gravity.

Structural timber joists up to 250 mm depth and studs shall only be notched or drilled within the limits given in Figure 4.



NOTE.
X is the allowable limits of location for cut notches, to be in either the top or bottom surface, not both.
Y is the allowable limits of location for drilled holes.
The diameters (*d*) are not to exceed $\frac{D}{4}$.

Figure 4 — Limitations on notching and drilling in structural joists

Notches in structural joists shall be cut in either the top or the bottom surface, but not in both.

The diameter of the holes drilled in structural joists shall be not greater than ¼ the depth of the joist (see Figure 4).

Pipes passing through brickwork and masonry shall be sleeved to prevent corrosion and to allow movement.

Circulation pipework shall be routed and secured in a manner which will prevent contact with all electric cables.

Circulation pipework shall not be buried in concrete.

COMMENTARY AND RECOMMENDATIONS ON **30.1**. *Where practicable, pipes should be fitted clear of timber joists, floor boards, other pipes etc. Where this is not possible suitable pads of material resistant to damage by insects and vermin should be fitted between the pipe and structure to minimize noise.*

Notches should be lined with felt or similar material

Consideration should be given to the inclusion of protective saddles to prevent damage by nails when laying floor boards and carpets. It is recommended that floor surfaces are marked to show the pipe runs.

Where it is necessary to run short lengths of circulation pipework in concrete floors or in walls they should:

a) *be in purpose made ducts or chases with removable covers;*

b) *be adequately protected from damage and corrosion; and*

c) *be at least* 25 mm *from the finished surface.*

30.2 Where pipework manufacturered to Table 2 of BS 2871-1:1971 is used, the pipe shall not be bent.

30.3 In order to minimize the risk of corrosion care shall be taken to prevent contamination of the system by entry of sawings, swarf, wire wool or excess flux into pipework during assembly.

COMMENTARY AND RECOMMENDATIONS ON **30.3**. *To prevent the ingress of debris into the system via open pipe ends, temporary plugs or caps should be used during the course of installation.*

Where soldered joints are used it is recommended that a resin/organic based flux is used, applied only to the outside of the pipe and never to the inside of the pipe or fitting. It is important that only the minimum amount necessary to ensure a good joint is used.

Some fluxes are more aggressive than others but all fluxes should be considered to be corrosive to some extent. Any excess flux should be wiped off the assembly before applying heat to melt the solder and any residue removed immediately the joint has cooled. The system should be cleared of any internal residues (see clause **38***).*

30.4 Where plastics pipework systems are used these shall be suitable for the maximum temperatures and pressures for their intended application as specified in BS 7291-1. Components of PE-X and PB shall comply with the requirement appropriate to their class as given in the relevant following British Standard:

PB	Pipe	BS 7291-2
	Fittings	BS 7291-2
PE-X	Pipe	BS 7291-3
	Fittings	BS 7291-3

COMMENTARY AND RECOMMENDATIONS ON **30.4**. *Systems of pipe and fittings complying with BS 7291 are classified according to their suitability for use in central heating and hot water applications as follows:*

a) *Class H systems are intended for use in domestic vented or unvented hot water supply, and domestic open vented central heating installations*;

b) *Class S systems are intended for use in unvented (sealed) central heating installations in addition to the uses for which Class H systems are intended.*

Although plastics do not corrode, diffusion of oxygen may occur in pipes made from PB and PE-X, which could contribute to the corrosion of metal components in circulation systems. This may be reduced by the use of appropriate additives (e.g. corrosion inhibitors) in accordance with the plastics components manufacturer's instructions. Alternatively, the use of such pipes with barrier films should be considered. These are impermeable to the passage of oxygen through the pipe wall.

The application and installation of thermoplastic pipes and fittings should be in accordance with BS 5955-8.

31 Pipe fixings and supports

31.1 Pipe fixing and supports for materials other than plastics shall be fitted at intervals no greater than those given in Table 7.

31.2 The positioning and supporting of pipes shall allow for free movement for expansion and contraction.

31.3 The support brackets shall be purpose designed and provide a permanent fixing.

COMMENTARY AND RECOMMENDATIONS ON **31.3**. *Clips that fully encompass the pipe are preferred.*

Table 7 — Piping support intervals

Nominal size of pipe (outside diameter) mm	Interval for vertical runs m	Interval for horizontal runs m
8	0.5	0.5
10	0.8	0.8
12	1.0	1.0
15	2.0	1.2
22	2.5	1.8
28	2.5	1.8
35	3.0	2.5

31.4 Pipe fixings and supports for plastics piping systems shall be designed and fitted in accordance with BS 5955-8.

COMMENTARY AND RECCOMMENDATIONS ON **31.4**. T*he linear expansion of plastics is approximately 10 times that of copper and it is recommended that long pipe runs are installed out of sight, e.g. under floors or in ducts with removable covers.*

32 Heat emitters

Heat emitters shall be fitted in accordance with manufacturers' instructions taking into account minimum clearances above, behind and below for free circulation of air and for access for cleaning.

COMMENTARY AND RECOMMENDATIONS ON CLAUSE **32**. *Where wall coverings are fitted behind radiators care should be taken to ensure that the free circulation of air is maintained.*

Where heat emitters are fitted in positions where entrained dust in the convection currents is likely to discolour decorations, the customer should be advised on the fixing and sealing of appropriate deflecting shelves.

Where fitted, shelves should permit access to valves and the air release cock. They should preferably be positioned between 75 mm *to* 150 mm (3 in *to* 6 in) *above the emitter, and extend* 75 mm *to* 100 mm (3 in *to* 4 in) *at each end and* 25 mm *to* 50 mm (1 in *to* 2 in) *beyond the front and should provide a close fit against the surface of the wall. The shelves should also have side valances.*

33 Circulation pump

The pump shall comply with BS 1394 and be fitted in accordance with the manufacturer's instructions, in a position that provides easy access for adjustment, maintenance and replacement. Isolating valves shall be fitted at both inlet and outlet connections.

COMMENTARY AND RECOMMENDATIONS ON CLAUSE **33**. *The position of the pump should take into account the recommendations in* **15.3**. *A rigid supporting bracket should be fitted to the pipework adjacent to each side of the pump. Each bracket should fully encompass the pipe and be lined with a resilient material to reduce noise transmission.*

34 Indirect cylinder

A draining tap shall be fitted to permit removal of the stored water from the cylinder.

COMMENTARY AND RECOMMENDATIONS ON CLAUSE **34**. *Suitable connections should be made to facilitate easy removal of the cylinder. An accessible key-operated draining tap with hose connection should be fitted at the lowest point of the adjacent cold water feed pipe, or, if provided, to a draining boss on the cylinder.*

35 Electrical work

All electrical work connected with the system shall comply with BS 7671. Particular care shall be taken with any electrical equipment in bathrooms to ensure that it cannot be touched by a person using the bath or shower.

COMMENTARY AND RECOMMENDATIONS ON CLAUSE **35**. *Central heating systems using metallic circulation pipework and installed in accordance with this standard are electrically continuous, and therefore the requirements of BS 7671 on supplementary earth bonding are met by ensuring that the boiler earth connection is properly made.*

Where plastics circulation pipework is used, this does not provide electrical continuity between metallic parts and supplementary earth bonding as required by BS 7671 may be necessary in some circumstances.

In general, plastics are poor conductors of electricity and cannot be used for earthing.

36 Gas pipework

The gas supply shall be installed and tested in accordance with BS 6891.

37 Oil pipework

The oil supply shall be installed and tested in accordance with BS 5410-1.

Section 5. Commissioning

38 Filling

The completed installation shall be filled, checked for leaks, and rinsed to minimize the presence of solid particles and chemical residues which may cause corrosion and damage within the system.

COMMENTARY AND RECOMMENDATIONS ON CLAUSE **38**. *The following procedure is recommended for filling.*

a) *Fill system and vent at high points, pump(s) and radiators.*

b) *Examine system for leaks.*

c) *Rapidly drain down the system.*

d) *Where recommended by the boiler manufacturer, add a chemical cleanser in accordance with the chemical manufacturer's instructions and refill.*

e) *Put boiler and pump(s) into operation and allow all parts of the system to heat up to normal operating temperature making further check for leaks. Where a chemical cleanser has been added sufficient time should be allowed for the cleanser to work in accordance with the chemical manufacturer's instructions.*

f) *Extinguish boiler, switch off pump(s) and rapidly drain system from all points while still hot. The system should be flushed through when a chemical cleanser has been used to ensure all cleanser is removed.*

g) *Refill and vent as in a). If an inhibitor is to be used, this should be added in accordance with the manufacturer's instructions (see clause* **26***). The manufacturer's label stating type and date of application should be tied to the main draining tap.*

h) *Re-check system for leaks.*

In the case of a new boiler fitted to an existing (old) system it is essential that the system is clean before the new applicance is fitted. The following procedure is recommended.

With the old boiler in place, rapidly drain down the system.

THEN:

If the old boiler is still working, refill the system, add cleanser, heat up to normal operating temperature and allow sufficient time for the cleanser to operate in accordance with the cleanser manufacturer's instructions, then rapidly drain down the system. Flush the system through (to ensure all cleanser is removed).

Fit the new boiler, fill the system (add an inhibitor if recommended by the boiler manufacturer).

OR:

If the old boiler is not working, ensure the system is fully drained down and flushed through.

Fit the new boiler, fill, add cleanser (only if recommended by the boiler manufacturer), heat up to the normal operating temperature and allow the sufficient time for the cleanser to operate in accordance with the cleanser manufacturer's instructions, then rapidly drain down the system. Flush the system through. Fill the system (add an inhibitor if recommended by the boiler manufacturer).

Systems which have been installed and commissioned in unoccupied properties should, at the time year when freezing conditions can be expected, be either under the control of a frost thermostat or left with the system operating continuously with the room thermostat set at 6 °C. *Draining down the system is not recommended as this can accelerate radiator corrosion.*

39 Boiler

The boiler shall be commissioned in accordance with the manufacturer's instructions.

NOTE It is essential that satisfactory evacuation of any products of combustion is confirmed.

COMMENTARY AND RECOMMENDATIONS ON CLAUSE **39**. *Commissioning of boilers should comply with the relevant standards BS 4876, BS 6798 and BS 8303*

40 Balancing

Balancing of the heating circuits and/or radiators shall be carried out.

COMMENTARY AND RECOMMENDATIONS ON CLAUSE **40**. *The system should be balanced by regulating the flow rate of the pump to ensure the design temperature difference across the boiler (see* **9.2***). The water flow rate through individual heat emitters should then be adjusted to ensure a mean water temperature at each heat emitter according to design.*

41 Handing over

Upon completion of the commissioning procedures, the method of economic and efficient operation of the system shall be demonstrated to the user by the installer.

The user shall be advised on the method of summer and winter operation of the system (see commentary on clause **38**).

The user shall be supplied with manufacturers' instructions relating to all the components of the system, together with an air vent key and any special lockshield valve keys etc., required for the installation.

COMMENTARY AND RECOMMENDATIONS ON CLAUSE **41**. *The installer should also leave attached to the boiler, on a permanent card or cards:*

a) *the date of installation;*

b) *the name and address of the installer.*

The user should be offered, or made aware of, a regular service contract to ensure that the equipment is maintained in an efficient and safe operating condition.

Appendix A
Heat loss coefficients (*U*-values)

A.1 General

The following tables give heat loss coefficients (known as *U*-values, in $W/m^{2.}°C$) for typical elements of building constructions.

A.2 Solid walls

Brickwork and plaster and concrete block wall constructions and their *U*-values are given in Table 8. Construction details are given outside to inside.

Table 8 — *U*-values for solid walls

Brickwork mm		Plaster mm			*U*-value
220		13			2.0
335		13			1.6
Concrete block		**Air gap**	**Expanded polystyrene**	**Plaster board**	
Heavy mm	**Light** mm	mm	mm	mm	
200	—	25	—	10	1.8
200	—	25	25	10	0.79
—	200	25	25	10	0.46

A.3 Timber framed walls

Walls constructed of timber studwork with bracing plywood incorporating 100 mm minimum gap (or wider, according to the thickness of mineral fibre insulation mat) are covered in Table 9. The figures given assume that there is a vapour check and 12.7 mm of plaster internally.

Table 9 — *U*-values for timber framed walls

Outer cladding	Thickness of mat mm	*U*-value
Concrete tiles hung externally	60	0.47
	80	0.38
	100	0.34
	120	0.29
	140	0.25
Shiplap boarding fixed externally	60	0.44
	80	0.36
	100	0.32
	120	0.28
	140	0.24
Brick outer cladding	60	0.43
	80	0.36
	100	0.32
	120	0.28
	140	0.24

A.4 Cavity walls

Walls of brick, brick and block, and block and block cavity construction are covered in Table 10.

Table 10 — *U*-values for cavity walls

(a) Brick: Cavity: Brick (+ 13 mm plaster)				
Brick mm	**Air gap** mm	**UF foam** mm	**Brick** mm	***U*-value**
105	25	—	105	1.5
220	25	—	220	1.0
105	—	50	105	0.55

(b) Brick: Cavity: Block (+ 13 mm plaster)						
Brick mm	**Air gap** mm	**Mineral fibre** mm	**UF foam** mm	**Concrete block**		***U*-value**
				Heavy mm	**Light** mm	
105	25	—	—	100	—	1.6
105	—	50	—	100	—	0.49
105	25	—	—	—	100	0.92
105	—	50	—	—	100	0.43
105	—	—	50	—	100	0.46

(c) Block: Cavity: Block (+ 13 mm plaster)						
Concrete block		**Air gap** mm	**Air gap plus UF foam** mm	**Concrete block**		***U*-value**
Heavy mm	**Light** mm			**Heavy** mm	**Light** mm	
100	—	25	—	100	—	1.8
100	—	—	50	100	—	0.61
—	100	25	—	—	100	0.67
—	100	—	50	—	100	0.39

A.5 Pitched roofs

The *U*-values given in Table 11 are for pitched roofs of timber trussed rafters, covered with slates or concrete tiles on wood battens. The joists are finished with 9.5 mm plasterboard, and mineral fibre mat is laid between ceiling joists.

Table 11 — *U*-values for pitched roofs

	Thickness of mat mm	***U*-value**
	60	0.55
	80	0.43
	100	0.36
With sarking felt underlay	60	0.51
	80	0.40
	100	0.34
With felt laid on sarking board	60	0.48
	80	0.39
	100	0.32

A.6 Windows

The *U*-values given in Table 12 are for windows in which the frame occupies 20 % of the area.

Table 12 — *U*-values for windows

Frame		Thermal break		Glazing		*U*-value
Aluminium	Wooden	Yes	No	Single	Double	
	•			•		5.0
	•				•	2.9
•			•	•		6.4
•			•		•	4.3
•		•		•		5.8
•		•			•	3.7

A.7 Ground floors

The *U*-values given in Table 13 are for a medium 15 m × 7.5 m plan detached house. Figures should be decreased by 50 % for a terraced house. Increase figures by up to 25 % for a small house of 5 m × 10 m plan.

Table 13 — *U*-values for ground floors

Floor		Under floor		Above floor		*U*-value
Solid on earth	Ventilated on joints	Air brick on one side	Air brick on more than one side	Bare boards	Parquet, lino, rubber	
	•	•		•		0.61
	•	•			•	0.59
	•		•	•		0.82
	•		•		•	0.68
•						0.36

A.8 Party and partition walls

Table 14 gives *U*-values for various constructions of party and partition walls.

A.9 Intermediate floors

Table 15 gives *U*-values for various constructions of intermediate floors.

Table 14 — *U*-values for party and partition walls

Brick mm	Air gap	Air gap plus fibre glass mm	Breeze block mm	Wooden slats on timber frame	Plastered both sides	Plasterboard both sides mm	*U*-value
105					•		1.9
220					•		1.5
			50		•		2.3
			75		•		2.0
	•			•		12.7	1.7
		100		•		12.7	0.34
	•			•	• (on slats)		1.9

Table 15 — *U*-values for intermediate floors

Flooring	Underside finish		Heat flow		*U*-value
	12.7 mm Plasterboard	16 mm Plaster	Upward	Downward	
Timber joists finished with 19 mm timber boarding	•		•		1.62
	•			•	1.36
150 mm dense concrete slab finished with 19 mm timber boarding on battens		•	•		1.49
		•		•	1.26
150 mm dense concrete slab and 50 mm screed		•	•		2.62
		•		•	2.13

Appendix B
Resistance to hot water flow

Pressure losses per metre run in the flow of hot water through the circulation pipework where copper tubing in accordance with Table X of BS 2871-1:1971 is used and a limiting velocity of 1.5 m/s (see **13.1**) is given in Table 16.

Manufacturers' tables should be consulted for microbore tubing in accordance with Table W of BS 2871-1:1971.

Table 16 — Pressure loss per metre run due to flow of hot water through copper tubes

Tube size	6 mm	8 mm	10 mm	12 mm	15 mm	22 mm	28 mm	35 mm
Flow								
kg/s	N/m²	N/m²	N/m²	N/m²	N/m²	N/m²	N/m²	N/m²
0.00175	59.0							
0.00180	62.0							
0.00185	65.0							
0.00190	68.0							
0.00195	71.0							
0.0020	74.0							
0.0021	80.5							
0.0022	87.0							
0.0023	94.0							
0.0024	101							
0.0025	108							
0.0026	116							
0.0027	124							
0.0028	132							
0.0029	140							
0.0030	148							
0.0031	156							
0.0032	165							
0.0033	174							
0.0034	183							
0.0035	192	37.8						
0.0036	201	39.6						
0.0037	211	41.6						
0.0038	221	43.5						
0.0039	231	45.5						
0.0040	241	47.5						
0.0042	262	51.5						
0.0044	283	55.8						
0.0046	305	60.2						
0.0048	328	64.8						
0.0050	352	69.5						
0.0052	376	74.2						
0.0054	400	79.0						
0.0056	426	84.5						
0.0058	452	87.5						
0.0060	478	95.0	28.0					
0.0062	505	100	29.6					
0.0064	535	106	31.3					
0.0066	565	112	32.9					
0.0068	595	117	34.6					
0.0070	625	123	36.5					
0.0072	655	129	38.3					
0.0074	685	136	40.2					

Table 16 — Pressure loss per metre run due to flow of hot water through copper tubes (*continued*)

Tube size	6 mm	8 mm	10 mm	12 mm	15 mm	22 mm	28 mm	35 mm
Flow								
kg/s	N/m²	N/m²	N/m²	N/m²	N/m²	N/m²	N/m²	N/m²
0.0076	715	142	42.0					
0.0078	745	148	44.0					
0.0080	780	155	46.0					
0.0084	850	169	50.0					
0.0088	920	183	54.0	20.3				
0.0092	990	197	58.5	21.9				
0.0096	1 070	212	63.0	23.6				
0.0100	1 150	228	67.3	25.3				
0.0105	1 250	247	73.5	27.6				
0.0110	1 360	268	80.0	30.0				
0.0115	1 460	290	86.0	32.4				
0.0120	1 580	311	92.5	34.8				
0.0125	1 700	333	99.0	37.4				
0.0130	1 820	356	106	40.0				
0.0135	1 940	381	113	42.7				
0.0140	2 060	405	120	45.5	15.3			
0.0145	2 190	430	128	48.3	16.2			
0.0150	2 330	455	136	51.0	17.2			
0.0155	2 460	482	144	54.1	18.2			
0.0160	2 600	510	153	57.2	19.2			
0.0165	2 740	537	161	60.4	20.3			
0.0170	2 880	565	170	63.5	21.4			
0.0175	3 030	595	178	67.0	22.5			
0.0180	3 180	625	187	70.5	23.6			
0.0185	3 340	654	196	74.0	24.7			
0.0190	3 500	684	205	77.5	25.8			
0.0195	3 600	714	215	81.0	27.0			
0.020	3 810	746	224	84.5	28.3			
0.021	4 150	810	244	92.0	30.8			
0.022	4 500	880	264	100	33.4			
0.023	4 860	950	286	108	36.1			
0.024	5 230	1 030	307	117	38.8			
0.025	5 600	1 100	330	125	41.6			
0.026	6 000	1 180	353	134	44.6			
0.027		1 260	376	143	47.6			
0.028		1 340	400	152	50.7			
0.029		1 420	425	162	54.0			
0.030		1 500	452	171	57.0			
0.031		1 590	478	182	60.5	9.1		
0.032		1 680	505	192	64.0	9.6		
0.033		1 770	532	202	67.5	10.1		
0.034		1 870	560	213	71.0	10.6		
0.035		1 960	587	224	74.5	11.2		
0.036		2 050	615	234	78.5	11.8		
0.037		2 160	645	246	82.0	12.4		
0.038		2 260	675	257	86.0	13.0		
0.039		2 370	705	269	90.0	13.6		
0.040		2 480	740	281	94.0	14.2		
0.042		2 690	805	306	103	15.5		
0.044		2 920	870	332	112	16.8		

Table 16 — Pressure loss per metre run due to flow of hot water through copper tubes (*continued*)

Tube size	6 mm	8 mm	10 mm	12 mm	15 mm	22 mm	28 mm	35 mm
Flow kg/s	N/m²	N/m²	N/m²	N/m²	N/m²	N/m²	N/m²	N/m²
0.046		3 150	940	358	120	18.2		
0.048		3 380	1 010	385	129	19.5		
0.050		3 620	1 080	413	138	21.0		
0.052		3 870	1 160	442	148	22.5	6.48	
0.054		4 120	1 240	472	158	24.0	6.9	
0.056			1 320	503	168	25.6	7.35	
0.058			1 400	535	180	27.2	7.85	
0.060			1 480	568	191	28.8	8.3	
0.062			1 570	600	202	30.5	8.8	
0.064			1 660	634	213	32.3	9.3	
0.066			1 750	668	224	34.1	9.8	
0.068			1 840	702	236	35.8	10.3	
0.070			1 940	736	248	37.8	10.8	
0.072			2 030	772	261	39.8	11.4	
0.074			2 130	680	273	41.7	12.0	
0.076			2 230	848	286	43.7	12.6	
0.078			2 330	890	298	45.6	13.2	
0.080			2 430	930	312	47.7	13.8	4.85
0.084			2 640	1 010	341	52.0	15.0	5.3
0.088			2 850	1 100	368	56.3	16.3	5.75
0.092				1 180	397	60.8	17.6	6.23
0.096				1 270	430	65.5	19.0	6.70
0.100				1 370	462	70.5	20.4	7.20
0.105				1 490	502	77.0	22.3	7.55
0.110				1 620	545	83.5	24.2	8.55
0.115				1 740	588	90.5	26.1	9.25
0.120				1 880	633	97.0	28.2	9.95
0.125				2 020	680	104	30.2	10.7
0.130				2 160	728	113	32.4	11.5
0.135				2 310	775	121	34.6	12.3
0.140					828	128	36.8	13.1
0.145					880	136	39.3	13.9
0.150					930	144	41.7	14.7
0.155					980	153	44.2	15.5
0.160					1 040	162	46.6	16.4
0.165					1 090	171	49.3	17.4
0.170					1 150	180	52.0	18.3
0.175					1 210	189	54.8	19.3
0.180					1 270	199	57.5	20.3
0.185					1 340	209	60.3	21.3
0.190					1 400	218	63.0	22.3
0.195					1 460	229	66.0	23.4
0.20					1 530	240	69.0	24.4
0.21					1 670	261	75.5	26.5
0.22					1 810	283	82.0	28.8
0.23						305	88.5	31.2
0.24						330	95.5	33.7

Table 16 — Pressure loss per metre run due to flow of hot water through copper tubes (*concluded*)

Tube size	6 mm	8 mm	10 mm	12 mm	15 mm	22 mm	28 mm	35 mm
Flow kg/s	N/m²	N/m²	N/m²	N/m²	N/m²	N/m²	N/m²	N/m²
0.25						355	103	36.2
0.26						380	110	38.7
0.27						405	118	41.3
0.28						432	126	44.1
0.29						457	134	47.0
0.30						485	142	49.7
0.31						513	150	52.8
0.32						543	159	55.8
0.33						574	168	59.0
0.34						606	177	62.0
0.35						637	186	65.0
0.36						668	195	68.5
0.37						700	205	72.0
0.38						735	215	75.5
0.39						770	225	79.0
0.40						805	235	82.5
0.42						875	256	90
0.44						950	278	97
0.46						1 030	300	105
0.48							324	114
0.50							348	123
0.52							372	132
0.54							398	140
0.56							425	149
0.58							453	158
0.60							480	168
0.62							507	178
0.64							533	189
0.66							562	199
0.68							595	211
0.70							628	222
0.72							660	233
0.74							690	245
0.76							725	256
0.78							755	268
0.80								280
0.84								304
0.88								331
0.92								358
0.96								385
1.00								415
1.05								453
1.10								490
1.15								530
1.20								570
1.25								
1.30								

Publications referred to

BS 21, *Specification for pipe threads for tubes and fittings where pressure-tight joints are made on the threads (metric dimensions).*

BS 143 & BS 1256, *Specification for malleable cast iron and cast copper alloy threaded pipe fittings.*

BS 417, *Specification for galvanized low carbon steel cisterns, cistern lids, tanks and cylinders.*

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

BS 864-2, *Specification for capillary and compression fittings for copper tubes.*

BS 1010, *Specification for draw-off taps and stopvalves for water services (screw-down pattern).*

BS 1212, *Specification for float operated valves (excluding floats).*

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

BS 1212-3, *Diaphragm type (plastics body) for cold water services.*

BS 1252, *Specification for domestic solid-fuel free-standing cookers with integral boilers.*

BS 1387, *Specification for screwed and socketed steel tubes and tubulars and for plain end steel tubes suitable for welding or for screwing to BS 21 pipe threads.*

BS 1394, *Stationary circulation pumps for heating and hot water service systems.*

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

BS 1566-1, *Specification for double feed indirect cylinders.*

BS 1566-2, *Specification for single feed indirect cylinders.*

BS 1740, *Specification for wrought steel pipe fittings (screwed BS 21 R-series thread).*

BS 1894, *Specification for electrode boilers of riveted, seamless, welded and cast iron construction for water heating and steam generating.*

BS 2051, *Tube and pipe fittings for engineering purposes.*

BS 2051-1, *Copper and copper alloys capillary and compression tube fittings for engineering purposes.*

BS 2051-2, *Specification for olive type copper alloy compression tube fittings.*

BS 2767, *Specification for valves and unions for hot water radiators.*

BS 2871, *Specification for copper and copper alloys. Tubes.*

BS 2871-1, *Copper tubes for water, gas and sanitation.*

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

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

BS 3378, *Specification for roomheaters burning solid mineral fuels.*

BS 3456, *Specification for safety of household and similar electrical appliances.*

BS 3456-2.21, *Electric immersion heaters.*

BS 3528, *Specification for convection type space heaters operating with steam or hot water.*

BS 4127, *Specification for light gauge stainless steel tubes.*

BS 4213, *Specification for cold water storage and feed and expansion cisterns (polyolefin or olefin copolymer) and cistern lids.*

BS 4433, *Specification for solid smokeless fuel boilers with rated outputs up to* 45 kW.

BS 4814, *Specification for expansion vessels using an internal diaphragm, for sealed hot water heating systems.*

BS 4834, *Specification for inset open fires without convection.*

BS 4876, *Specification for performance requirements for domestic flued oil burning appliances (including test procedures).*

BS 5154, *Specification for copper alloy globe, globe stop and check, check and gate valves.*

BS 5258, *Safety of domestic gas appliances.*

BS 5258-1, *Specification for central heating boilers and circulators.*

BS 5258-8, *Combined appliances: gas fire/back boiler.*

BS 5258-15, *Specification for combination boilers*.

BS 5410, *Code of practice for oil firing*.

BS 5410-1, *Installations up to* 44 kW *output capacity for space heating and hot water supply purposes*.

BS 5440, *Installation and maintenance of flues and ventilation for gas appliances of rated input not exceeding 70 kw net (1st, 2nd and 3rd family gases).*

BS 5440-1, *Specification for installation and maintenance of flues*.

BS 5440-2, *Specification for installation and maintenance of ventilation for gas appliances*.

BS 5482, *Code of practice for domestic butane- and propane-gas-burning installation.*

BS 5615, *Specification for insulating jackets for domestic hot water storage cylinders.*

BS 5955-8, *Plastics pipework (thermoplastics materials) — Part 8: Specification for the installation of thermoplastic pipes and associated fittings for use in domestic hot and cold services and heating systems in buildings*.

BS 6282, *Devices with moving parts for the prevention of contamination of water by backflow*.

BS 6332, *Thermal performance of domestic gas appliances*.

BS 6332-1, *Specification for thermal performance of central heating boilers and circulators*.

BS 6332-3, *Specification for thermal performance of combined appliances: gas fire/back boiler*.

BS 6400, *Specification for installation of domestic gas meters (2nd family gases).*

BS 6461, *Installation of chimneys and flues for domestic appliances burning solid fuels (including wood and peat).*

BS 6461-1, *Code of practice for masonry chimneys and flue pipes*.

BS 6461-2, *Code of practice for factory-made insulated chimneys for internal applications*.

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

BS 6798, *Specification for installation of gas-fired hot water boilers of rated input not exceeding* 60 kW.

BS 6891, *Specification for installation of low pressure gas pipework of up to* 28 mm *(R1) in domestic premises (2nd family gas).*

BS 7074, *Application, selection and installation of expansion vessels and ancillary equipment for sealed water systems*.

BS 7074-1, *Code of practice for domestic heating and hot water supply*.

BS 7291, *Thermoplastic pipes and associated fittings for hot and cold water for domestic purposes and heating installations in buildings*.

BS 7291-1, *General requirements*.

BS 7291-2, *Specification for polybutylene (PB) pipes and associated fittings*.

BS 7291-3, *Specification for cross-linked polyethylene (PE-X) pipes and associated fittings*.

BS 7671, *Requirements for electrical installations — IEE Wiring Regulations — Sixteenth edition*.

BS 8303, *Code of practice for installation of domestic heating and cooking appliances burning solid mineral fuels*.

IGE/UP/7, *Guide for gas installations in timber framed housing*.

PD 6501, *The preparation of British Standards for building and civil engineering*[2)].

PD 6501-1, *Guide to the types of British Standard, their aims, relationship, content and application*.

Approved domestic solid fuel appliances[3)].

[2)] Referred to in the foreword only.
[3)] Obtainable from DSFAAS Ltd., P.O. Box 37, Gloucester GL 52 4TB.

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