BRITISH STANDARD

BS 4834:1990

Incorporating Amendment No. 1

Specification for

Inset open fires without convection with or without boilers, burning solid mineral fuels

Committees responsible for this British Standard

The preparation of this British Standard was entrusted by the Solid Mineral Fuels Standards Policy Committee (SFC/-) to Technical Committee SFC/9, upon which the following bodies were represented:

Association of British Solid Fuel Appliances Manufacturers
British Ceramic Tile Council
British Coal Corporation
Consumer Policy Committee of BSI
Department of Energy (Energy Efficiency Office)
Department of the Environment
Domestic Solid Fuel Appliances Approval Scheme
Incorporated Association of Architects and Surveyors
Institute of Building Control
Low Temperature Coal Distillers Association of Great Britain Ltd.
METCOM
National Fireplace Council Manufacturers' Association
National Society for Clean Air
Solid Fuel Advisory Service
Solid Smokeless Fuels Federation
Waterheater Manufacturers' Association
Wood and Solid Fuel Association of Retailers and Manufacturers

This British Standard, having been prepared under the direction of the the Solid Mineral Fuels Standards Policy Committee, was published under the authority of the Board of BSI and comes into effect on 31 August 1990

First published August 1972
Second edition August 1990

The following BSI references relate to the work on this standard:
Committee reference RHE/28 (formerly SFC/9)
Draft for comment 87/52906 DC

ISBN 0 580 17883 8

Amendments issued since publication

Amd. No.	Date	Comments
6729	September 1991	Indicated by a sideline in the margin

Contents

Foreword

This first revision of this British Standard has been prepared under the direction of the Solid Mineral Fuels Standards Policy Committee and supersedes BS 4834:1972 which is withdrawn.

This standard is now the responsibility of Technical Committee RHE/28 which was formerly SFC/9.

The main technical changes from the previous edition are as follows:

a) restriction to solid mineral fuels;

b) inclusion of high output boiler appliances with rectangular bottomgrates, and additional requirements for units designated suitable to burn bituminous coal at enhanced efficiency;

c) extension of nominal widths to 500 mm;

d) change of test fuel and modification of test procedure for appliances with underfloor air supply;

e) reduction of the boiler damper opening under the high boiler output (HBO) test condition;

f) inclusion of requirements for materials for general construction;

g) change in ashpan requirements;

h) change of requirements for front firebars;

i) provision of a gas ignition burner changed from an obligatory to an optional requirement;

j) introduction of a boiler cleaning procedure between tests when burning coal;

k) inclusion of requirements for ashpan ash collection;

l) more stringent requirements for thermal performance.

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.

Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, 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.

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Section 1. General

1.1 Scope

This British Standard specifies constructional, dimensional and performance requirements for inset open fires designed to burn solid mineral fuels (i.e. bituminous coal, Welsh dry steam coal, anthracite or manufactured fuels derived from these coals). It does not apply to inset open fires designed to give space heating by convection (see BS 3376).

This standard covers appliances of nominal widths 350 mm, 400 mm, 450 mm and 500 mm, designed for use either with fireplace components complying with BS 1251 and installed in accordance with BS 8303, or with special fireplace components or boilers supplied with the appliance.

The essential components of appliances covered by this standard are the firefront, bottomgrate, ashpit cover, ashpan and means of primary air control.

Specified optional features comprise a deepening bar, deepening plate, front firebars, undergrate gas igniter and boiler.

Appliances are designated as either intermittent or overnight.

NOTE The titles of the publications referred to in this standard are listed on the inside back cover.

1.2 Definitions

For the purposes of this British Standard, the definitions given in BS 1846-1, BS 6100-1.5.1 and BS 3323 apply together with the following.

1.2.1
effective grate area

the area, *Y*, in the plane of the bottomgrate, enclosed by the back and sides of the firebox and by the firefront, when the appliance is installed in accordance with the manufacturer's instructions (see **A.13**)

1.2.2
ash-shedding area

the area, *Z*, within the frame of the bottomgrate that comprises the projected area of the firebars and the spaces between the firebars

1.2.3
rectangular bottomgrate

a bottomgrate, the sides of which form a rectangle

1.2.4
tapered bottomgrate

a bottomgrate, the sides of which form a trapezium

1.2.5
firefront

the structure that forms the front of the appliance and which may also be decorative

1.2.6
target burning rate

a designated rate of fuel consumption (on a dry basis), depending on the nominal width and category of the appliance, under specified test conditions (see Table 8)

1.2.7
normal output boiler

a boiler designed to give a water heating output level of at least 2.3 kW but less than 3.5 kW at the target burning rate

1.2.8
high output boiler

a boiler designed to give a water heating output level of at least 3.5 kW at the target burning rate

1.3 Classification

For the purposes of this standard appliances are categorized as follows:

a) appliances with tapered bottomgrate [see Figure 1(a)]:

1) without a boiler;

2) with a boiler designed for normal output;

3) with a boiler designed for high output. This category also covers those appliances with rectangular bottomgrate which do not comply with the dimensional requirements given in Table 2 and Table 3.

b) appliances of minimum nominal width 400 mm, with rectangular bottomgrate [see Figure 1(b)] with a boiler designed for high output. This category includes those appliances designated as capable of burning bituminous coal at enhanced efficiency. This category excludes intermittent appliances.

Section 2. Construction

2.1 General

The components of the appliance shall be made from materials indicated in Table 1.

Component parts which require periodic replacement shall be either designed or marked to ensure correct fitting. (see section 5).

NOTE Such parts should be easily replaceable.

2.2 Minimum dimensions for category b) appliances

Category b) appliances shall comply with the minimum dimensional requirements given in Table 2, determined in accordance with **A.12** and **A.13**.

NOTE Those appliances which do not comply with Table 2 are considered to be category a) 3) appliances (see **1.3**).

Table 1 — Materials for construction of appliance components

Component	Cast iron	Low carbon steel	Other
Main body	✓	✓	Stainless steel
Ashpit cover	✓	✓	Cast aluminium
Bottomgrate	✓	—	Chrome iron
Front firebars[a]	✓	—	Chrome iron
Ashpan	—	✓	Stainless steel
Deepening bar[a]	✓	✓	Chrome iron
Deepening plate[a]	✓	✓	Chrome iron
Boiler[a]	As specified in BS 3377		

NOTE 1 Decorative parts of the firefront should be made from any material that does not distort or visibly deterioriate during the performance tests described in Appendix A. Such parts should be capable of being easily cleaned.

[a] If fitted.

Table 2 — Minimum dimensional requirements for category b) appliances

Nominal width, mm	400	450	500
Firebox capacity, dm^3	16	19	22
Effective grate area, Y, dm^2	7.4	8.7	10.2

2.3 Firefront

Means shall be provided for rigidly fixing the firefront either to the back-hearth or to the boiler.

The width of that part of the firefront designed to fit within the tiled surround (dimension D in Figure 1) shall be the nominal width of the appliance + 0, – 3 mm.

2.4 Bottomgrate

2.4.1 General

The bottomgrate shall be designed to fit either a fireback complying with BS 1251 or a purpose-made fireback or boiler. It shall be capable of being removed and shall be either designed or marked to ensure correct fitting. The bottomgrate shall consist of a series of firebars and the width of the space between the bars shall be 13 ± 2 mm wide.

NOTE It is recommended that the bottomgrate be supported in such a way as to offer a minimum of obstruction to the removal of ash.

2.4.2 Appliances without underfloor air supply

If the appliance is supplied with its own fireback or boiler, assemble it in accordance with the manufacturer's instructions. Otherwise assemble and install it in a model fireback (e.g. constructed of wood) complying with the mean dimensions specified in BS 1251 ± 1 mm.

NOTE If adjustable, the bottomgrate may be trimmed to the most appropriate dimensions, in accordance with the manufacturer's instructions.

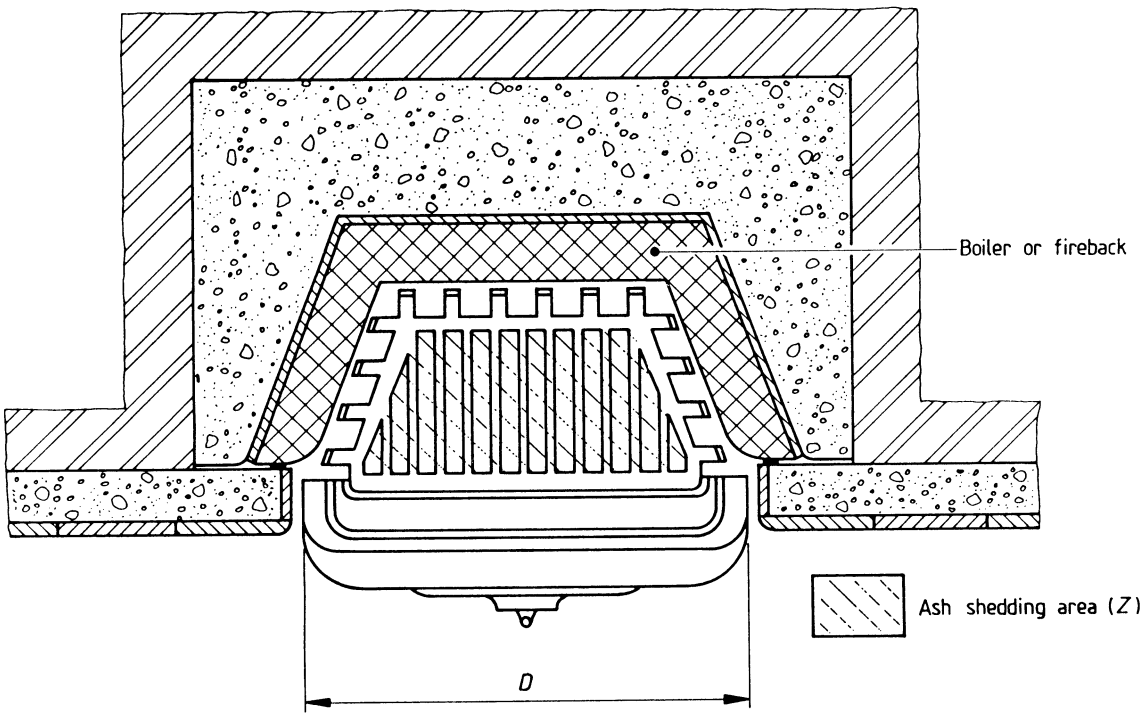
When assembled, the appliance shall comply with the following.

a) The side-to-side movement of the bottomgrate within its support shall not exceed 5 mm.

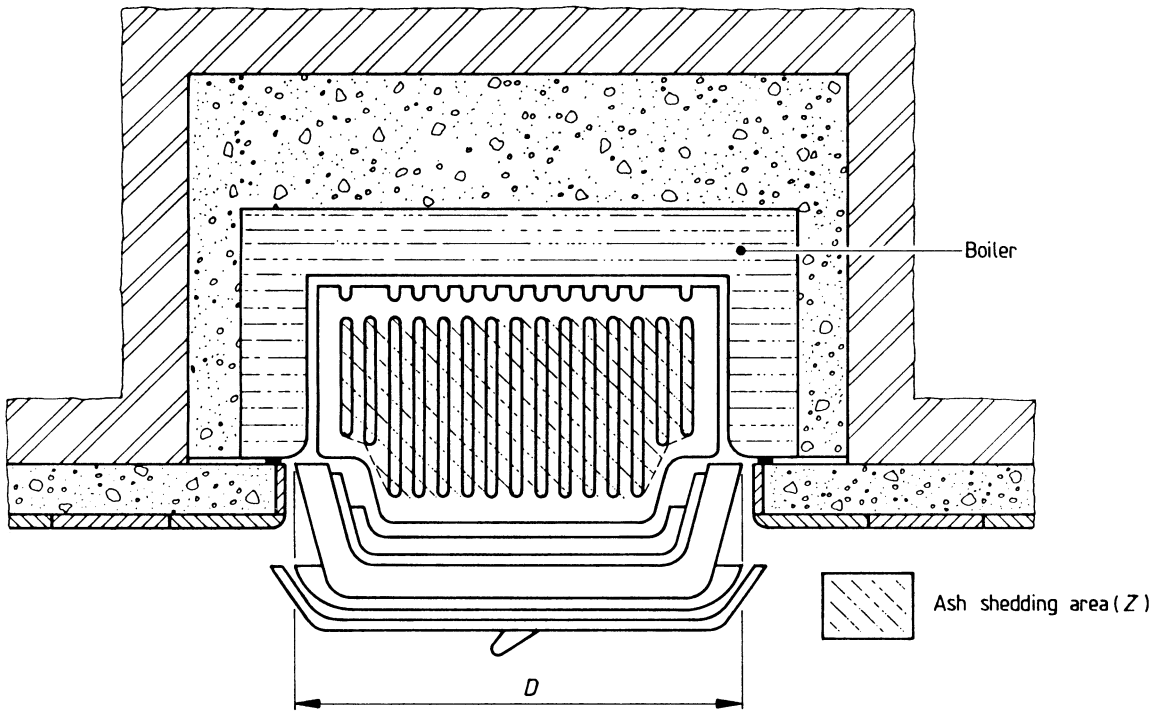
b) It shall not be possible to pass a 20 + 0, – 1 mm diameter sphere from above the bottomgrate into the ashpit at any point other than a corner.

c) It shall not be possible to pass a 30 + 0, – 1 mm diameter sphere from above the bottomgrate into the ashpit at a corner.

d) There shall be a clearance of not less than 6 mm in the plane of the bottomgrate surface at all points between the bottomgrate and adjacent components.



(a) Tapered bottomgrate



(b) Rectangular bottomgrate

Figure 1 — Typical inset open fire

Table 3 — Minimum ashpan capacity

Bottomgrate	Tapered				Rectangular		
Nominal width, mm	350	400	450	500	400	450	500
Minimum capacity, dm^3	1.8	2.1	2.5	2.9	2.5	2.9	3.4

2.4.3 Appliances with underfloor air supply

When assembled as described in **2.4.2**, the appliance shall comply with the following.

a) It shall not be possible to pass a 20 + 0, – 1 mm diameter sphere from above the bottomgrate into the ashpit at any point other than a corner.

b) It shall not be possible to pass a 30 + 0, – 1 mm diameter sphere from above the bottomgrate into the ashpit at a corner.

c) There shall be a clearance of not less than 3 mm in the plane of the bottomgrate surface at all points between the bottomgrate and adjacent components.

2.5 Air control

The appliance shall be designed so that, when it is installed according to the manufacturer's instructions, the primary air shall enter the ashpit only through the designated air inlet(s).

If, for an overnight burning appliance, the hearth forms the base of the ashpit, a means of sealing the firefront to the hearth and either the fireback or boiler shall be provided and be detailed in the manufacturer's instructions.

The air control shall be capable of maintaining any position in which it is intended to be set. It shall be capable of adjustment to at least three intermediate positions between the fully closed and fully open positions. Two of these positions shall be between the fully closed position and 30 % of the fully open position, measured in terms of the area of the primary air opening.

NOTE 1 It is recommended that a further means of fine air control in the nearly closed position be provided.

NOTE 2 The design of the fire should be such that spillage of fuel or ash should not prevent complete closure of the air control.

2.6 Ashpan

An ashpan shall be provided, constructed of low carbon steel or stainless steel (see Table 1) of minimum thickness 0.91 mm.

The minimum ashpan capacity shall be not less than the value given in Table 3. The capacity shall be determined geometrically. If the ashpan is open at the rear, an angle of repose for the ash of 45° shall be assumed at the rear end.

The ashpan shall be so designed that the ash collection area, *X*, shall be not less than the ash-shedding area, *Z*, when calculated in accordance with **A.13**.

NOTE The ashpan should be designed and constructed to ensure the following:

a) that it locates in the ashpit in such a way that it allows the free passage of primary air and does not obstruct any primary air control;

b) that it can be easily and safely withdrawn, carried and emptied, when hot using the tool(s) provided, without undue spillage of ash;

c) that it does not distort in normal use to an extent that makes it unsuitable for its purpose.

2.7 Ashpit and ashpit cover

The height from the bottom of the inside of the ashpan to the underside of the bottomgrate bars shall be not less than 75 mm at any point.

NOTE The design of the ashpit cover should be such that:

a) its closure is not easily prevented by spilled undergrate material;

b) it is difficult to accidentally dislodge from the set position;

c) when hot, it can be handled easily and safely with the tool(s) provided.

2.8 Front firebars and fallplate

2.8.1 General

If front firebars are fitted they shall comply with **2.8.3**.

If a fallplate is fitted then front firebars shall also be fitted. The upper edge of the fallplate shall not project above the upper edge of the topmost firebar.

2.8.2 Fallplate

The design of the fallplate shall be such that, when in the closed position, it is not capable of being opened without deliberately using the tool provided (see **2.14**).

2.8.3 Front firebars

If front firebars are fitted they shall be removable and either horizontal when considered from side to side of the fire, or vertical.

They shall not be capable of being fitted incorrectly.

In the case of horizontal front firebars, the spaces between adjacent bars and between the bottom bar and the firefront shall be such that a 20 + 0, – 1 mm diameter rod cannot be inserted horizontally between them.

In the case of vertical front firebars, the distances between adjacent bars shall not exceed 15 mm.

Horizontal front firebars shall be designed so that when in position they slope downwards towards the back of the fire.

2.9 Deepening bar

If a deepening bar is provided it shall be horizontal when considered from side to side of the fire and slope downwards to the back of the fire. The lower edge of the bar shall be not more than 25 mm above the top of the firefront at any point.

The deepening bar, when in position for use, shall be positively located and shall be capable of manipulation with the tool(s) provided (see **2.14**).

2.10 Deepening plate

If supplied, the deepening plate, when in position for use, shall be positively located and shall be capable of manipulation with the tool(s) provided (see **2.14**).

2.11 Gas ignition burner

2.11.1 General

If supplied, the gas ignition burner shall, in addition to this clause, comply with the detailed requirements of **2.11.2** or **2.11.3** as appropriate.

The burner bar and handle tube shall be made of low carbon steel or alloy steel. The dimensions, tolerances and masses of steel tubes shall comply with those specified for 8 mm bore medium tube in BS 1387.

The burner shall be supplied with an aeration device (see Figure 3) and the relationship between the number of gas ports and the number of air ports shall be as shown in Table 4. The aeration device shall be marked with an arrow showing the direction of flow.

The burner shall be so positioned and located that misalignment during fixing is not possible and that the flames pass between the bars approximately mid-way between front and back of the bottomgrate. With the flame-ports sealed and the burner connected to an air supply at a pressure of 40 mbar[1)], no leakage shall be observed within 10 s, as shown by a bubble leak detector or by immersing the burner in water.

2.11.2 Integral gas ignition burner

The threads of the gas supply connection shall comply with R 1/4 or Rc 1/4 type threads in accordance with BS 21.

Unless the fire is supplied exclusively with its own surround, the distance between the rear edge of the side of the fire surround and the centre line of the burner connection, at the point where the burner or pipe leaves the firefront, shall be not less than 64 mm.

NOTE This is so that a satisfactory fixing is possible within a surround incorporating a 50 mm return at the fireplace opening.

Table 4 — Relationship between gas ports and air ports

Number of gas ports	Number of air ports
11 10	2
9 8	1

2.11.3 Portable gas ignition burner

The threads of the gas supply connection shall comply with Rc 1/8 type threads, in accordance with BS 21.

The handle shall be made of non-combustible material.

NOTE It should afford an adequate grip and be secure so as to prevent slipping or twisting in use.

If the gas connection is in line or at an angle to the handle tube, the diameter of the flange carrying the connection thread shall be not less than 19 mm and the flange shall not project more than 5 mm beyond the face of the handle. The distance between the centre of the gas connection and the superimposed hearth shall be not less than 25 mm.

If the connection is made by means of elbow, this shall be either permanently webbed with a quadrant web as shown in [Figure 4(a)] or provided with a flange as shown in [Figure 4(b)].

In any case, the flange shall be provided with one or more pairs of flats to facilitate assembly and fitting of the gas connection.

2.12 Boiler

If fitted, the boiler shall comply with the requirements of BS 3377.

2.13 Boiler flue

If incorporated, the boiler flue shall be accessible for cleaning with the tool(s) provided (see **2.14**). Any flue access plate shall be capable of being removed and shall be designed or marked to ensure correct location.

[1)] 1 mbar = 100 N/m^2 = 100 Pa.

If the angle to the vertical, α, of the boiler flue mouth is greater than 55° (see Figure 2), the lowest edge, A, of the flue mouth entry shall be at least 25 mm above the uppermost surface of the adjacent bottomgrate, to reduce the risk of blockage of the flue mouth by ash.

If a boiler flue damper is fitted, it shall be designed to ensure correct assembly and shall be capable of maintaining any position in which it is intended to be set.

NOTE 1 Any operations necessary for cleaning the boiler flue should be easy to carry out.

NOTE 2 The design and shape of the flue aperture when fully opened should be such that the risk of blockage is minimized.

2.14 Tools

An operating tool shall be provided if it is necessary to touch any surface having a temperature above 55 °C during normal operation of the appliance.

If a boiler is incorporated, a purpose-made brush or scraper shall be provided for cleaning boiler flueways.

NOTE Any ashpan handling tool should hold the ashpan securely for safe carrying and emptying.

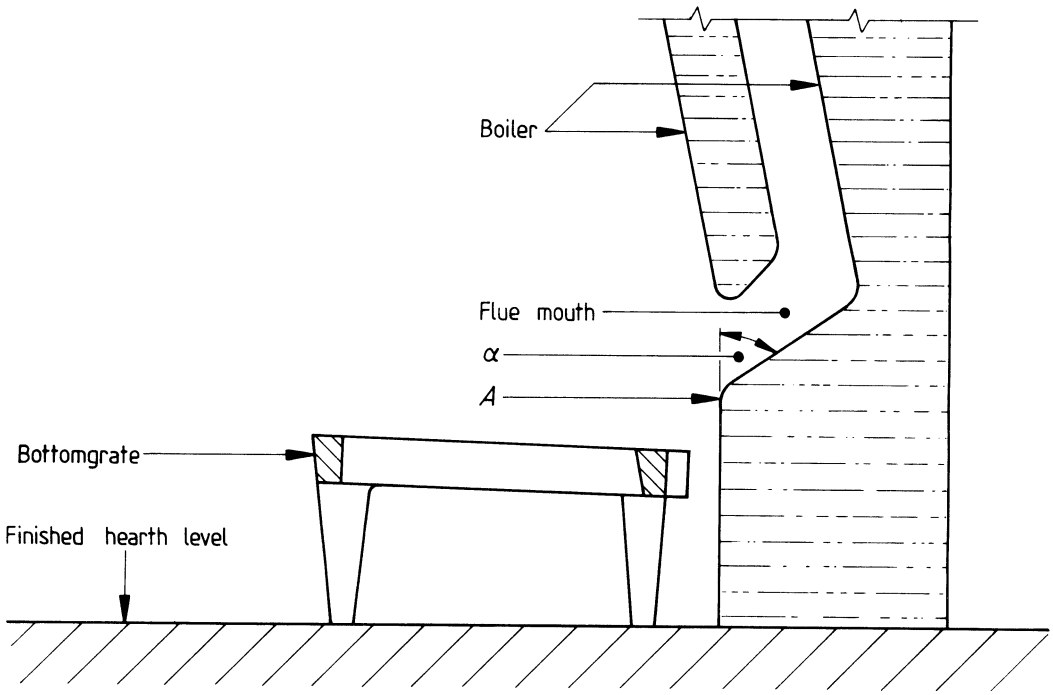


Figure 2 — Boiler flue mouth entry

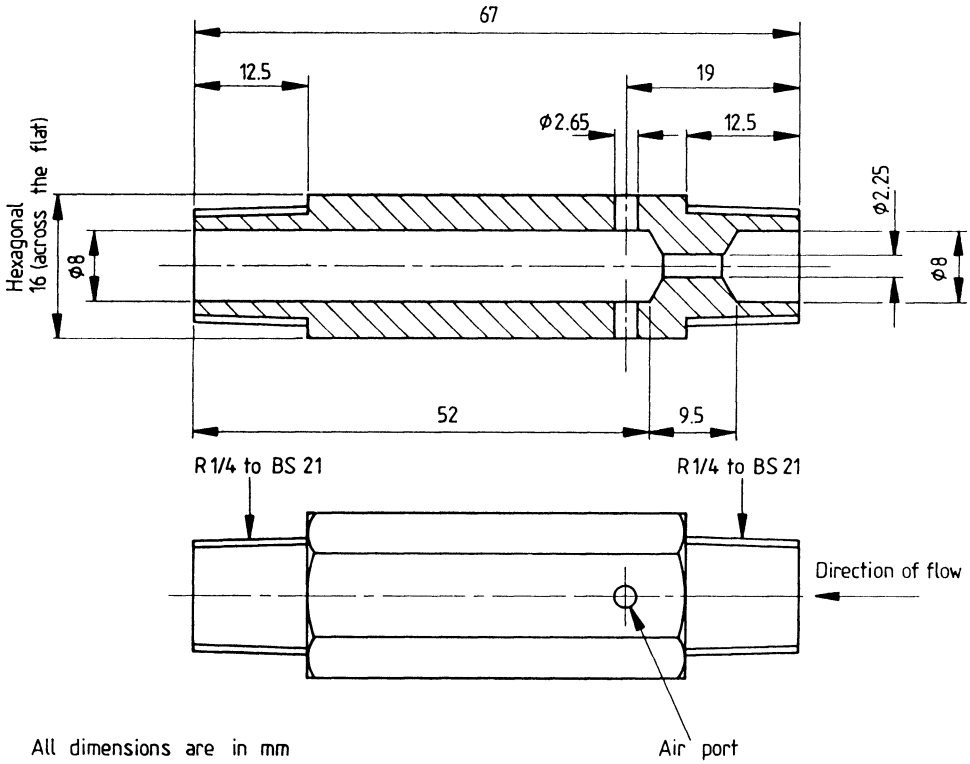
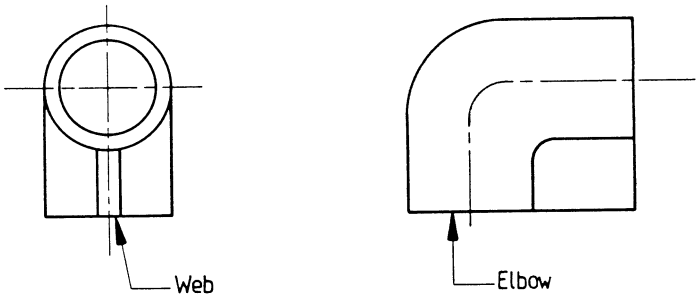
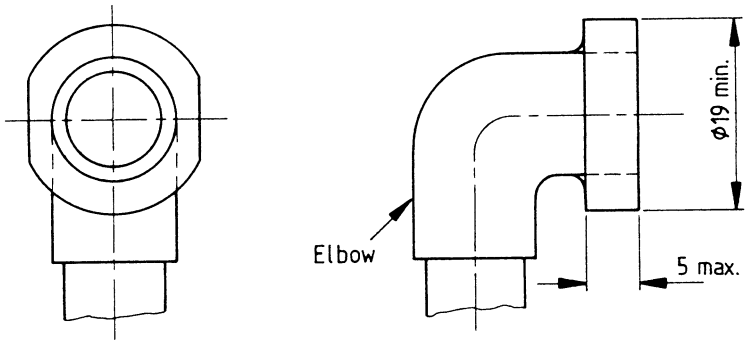


Figure 3 — Example of a suitable aeration device for a natural gas burner



(a) Webbed gas connection



(b) Flanged gas connection

Figure 4 — Gas connection elbows

Section 3. Electrical requirements

3.1 General

Any mains operated electrical control device shall comply with BS 3955.

The assembled appliance shall comply with BS 3456-101.

Section 4. Performance requirements

4.1 Thermal performance requirements

4.1.1 General

The mean of three or more test results shall comply with the thermal performance requirements specified in Table 5 or Table 6 when the appliance is tested in accordance with Appendix A, using the test fuel specified in Appendix B.

All appliances shall comply with either **4.2.1** or **4.2.2**.

4.1.2 Category b) appliances designated as suitable for burning bituminous coal at enhanced efficiency

The mean total efficiency, $\overline{E}_T$, from three or more tests, for category b) appliances so designated shall also comply with Table 7.

4.2 Banking performance requirements

4.2.1 Overnight appliances

Appliances designated as overnight [see **5.2** 2)], shall revive and comply with fuel consumption requirements specified in Table 5 or Table 6, when tested in accordance with **A.8**.

4.2.2 Intermittent appliances

Appliances designated as intermittent [see **5.2** 2)] shall revive and comply with the fuel consumption requirements specified in Table 5, when tested in accordance with **A.9**.

4.3 Condition of appliance after test

Following the completion of the tests specified in **4.1** and **4.2** the finish of the appliance shall show no visible evidence of discoloration, crazing or melting.

Section 5. Instructions and marking

5.1 Instructions

The manufacturer shall provide instructions for the assembly, installation, operation and maintenance of the appliance and recommendations for the fuel to be used. Except in the case of a complete appliance requiring no assembly of parts on site, drawings illustrating the method of assembly shall be provided.

5.2 Marking

The appliance shall carry the following markings:

a) the manufacturer's name or registered trade mark.

b) an identification mark for each replaceable component or sub-assembly.

In addition, the following markings shall be carried on a label attached to the fire and/or its container and/or the instruction card supplied.

1) the number and date of this British Standard, i.e. BS 4834:1990[2)];

2) the nominal width and the word "Intermittent" or "Overnight", as appropriate (see **4.2**);

3) the instruction "Use only the manufacturer's recommended fuels";

4) electrical data, e.g. working voltage of component (in volts), etc.

Table 5 — Performance requirements for category a) appliances burning test fuel A or B

Test schedule	Requirement		
Category (see **1.3**)	a) 1)	a) 2)	a) 3)
High radiation output (HRO) test (see **A.6**)			
Mean total efficiency, $\bar{E}_T$ (minimum), %	37	45	55
Rated radiation heat output, R_r, (minimum)			
Nominal width			
350 mm, kW	2.6	—	—
400 mm, kW	3.2	1.5	1.5
450 mm, kW	3.9	1.8	1.8
500 mm, kW	4.6	2.1	2.1
High boiler output (HBO) test (see **A.7**)			
Mean total efficiency, $\bar{E}_T$, (minimum), %	—	50	63
Mean water heating efficiency, $\bar{E}_b$, (minimum), %	—	25	35
Rated water heating output, R_b, (minimum), kW	—	2.3	3.5
Banking test for overnight appliances (see **A.8**)			
Fuel consumed, dry basis, W, (maximum)[a]			
500 mm appliances, kg	4.5	5.5	5.5
Others, kg	4.0	5.0	5.0
Banking test for intermittent appliances (see **A.9**)			
Fuel consumed, dry basis, W, (maximum)[a]			
500 mm appliances, kg	4.4	4.4	5.5
Others, kg	4.0	4.0	5.0

[a] Fuel consumption at point of revival

[2)] Marking BS 4834:1990 on or in relation to a product represents a manufacturer's declaration of conformity, i.e. a claim by or on behalf of the manufacturer that the product meets the requirements of the standard. The accuracy of the claim is therefore solely the responsibility of the person making the claim. Such a declaration is not to be confused with third party certification of conformity, which may also be desirable.

Table 6 — Performance requirements for category b) appliances burning test fuel A or B

Test schedule	Requirement
High radiation output (HRO) test (see **A.6**)	
Mean total efficiency, $\overline{E}_T$ (minimum), %	55
Rated radiation heat output, R_r, (minimum)	
Nominal width	
400 mm, kW	1.8
450 mm, kW	2.1
500 mm, kW	2.5
High boiler output (HBO) test (see **A.7**)	
Mean total efficiency, $\overline{E}_T$ (minimum), %	65
Mean water heating efficiency, $\overline{E}_b$ (minimum), %	35
Rated water heating output, R_b, (minimum), kW	3.5
Banking test for intermittent appliances (see **A.9**)	
Fuel consumed, dry basis, W, (maximum)[a]	
Nominal width	
400 mm, kW	5.0
450 mm, kW	5.5
500 mm, kW	5.9

[a] Fuel consumption at point of revival

Table 7 — Performance requirements for category b) appliances burning test fuel C and designated as suitable for burning bituminous coal at enhanced efficiency

Test schedule	Minimum mean total efficiency, $\overline{E}_T$
High radiation output (HRO) test (see **A.6**)	40
High boiler output (HBO) test (see **A.7**)	54

Appendix A Test methods and conditions

A.1 Test setting

Install the appliance for test in a chimney setting constructed in accordance with Figure 5. The chimney shall terminate inside the test room and shall be provided with a hood vented either naturally or by mechanical means and constructed in accordance with Figure 6. For natural draughts the minimum area, A, of the hood flue shall be 64.5×10^3 mm^2. The design of the extraction system shall not increase the chimney draught by more than 0.01 mbar[3)], measured at room temperature and at 1 ± 0.1 m above the fireplace opening.

A.2 Installation

A.2.1 *General*

A.2.1.1 Within the limitations given in **A.2.1.2** to **A.2.1.6**, follow the manufacturer's written installation instructions.

A.2.1.2 Install appliances without boiler that are not supplied with their own fireback in a fireback complying with the dimensions specified in BS 1251 except that the dimensional tolerances shall be half the values specified. If appliances are supplied with a fireback it shall be used for the purposes of the test.

A.2.1.3 Install the appliance in the setting in such a position that the surface against which the rear edges of the firefront are located is in the plane of the front surface of the chimney. If the appliance has a boiler, connect the flue outlet to the test chimney with a smooth gather which shall be sealed to the top of the boiler (a metal gather is illustrated in Figure 7). No gather shall be fitted to an appliance without a boiler.

A.2.1.4 For 400 mm, 450 mm and 500 mm appliances, the dimensions of the builder's opening shall be as shown in Figure 5. For 350 mm appliances, the width of the builder's opening shall be reduced to 460 mm by lining each side of the recess, from the hearth up to the lintel, with temporary brickwork.

A.2.1.5 Cover the front of the builder's opening surrounding the appliance with a panel of non-asbestos insulating board 1 ± 0.01 m high, 750 ± 10 mm wide and $6 + 1, -0$ mm thick, attached firmly to the front surface of the chimney. The opening in this panel shall be 560 mm high and either 360 mm, 410 mm, 460 mm or 510 mm wide according to the nominal size of the appliance with a tolerance of ± 5 mm. In the case of special appliances for which the manufacturer's installation instructions specify other dimensions for the opening, such instructions shall be followed. In the case of appliances having an integrally attached frame or surround, this frame or surround shall be used and set into the insulating board where it would otherwise overlap.

A.2.1.6 Fill any void in the builder's opening, behind the back and sides of the fireback or boiler between hearth level and the level of the top of the fireback or boiler, with loose-fill exfoliated vermiculite.

A.2.2 *Appliances with boiler*

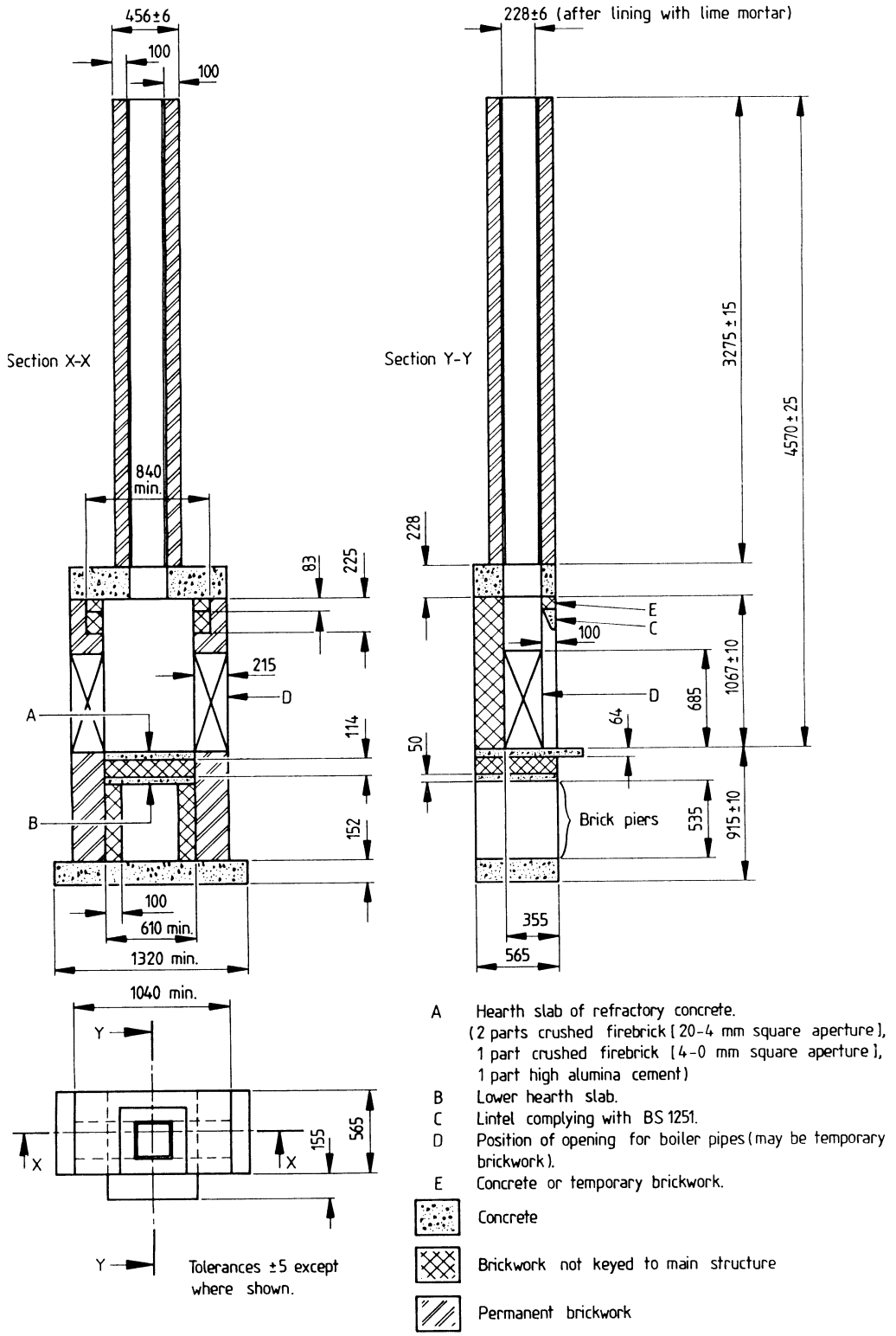
Connect the boiler to a constant water flow apparatus (see Figure 8). Fit the inlet and outlet pipes with thermometers, thermocouples or other temperature-measuring devices with their sensitive elements between 150 mm and 300 mm from the side of the setting. Cover the outlet pipe with pre-formed polyurethane foam of thickness 9 ± 1 mm or equivalent non-asbestos insulation to a distance of at least 150 mm beyond the point at which the temperature is measured. Insert the temperature-measuring device vertically and coaxially to the flow to a depth of either not less than 150 mm or to the depth for which it is calibrated.

A.3 Datum level of fuel bed

During tests, fuel or refuel the appliance (see **A.6.3**) to the datum level, which is the plane of the fuel bed surface sloping upwards from a specified site on the firefront, to the fireback or boiler.

The angle, β (see Figure 9), of the plane of the datum level to the horizontal, determined geometrically, shall be 35° except for testing with test fuel C when it shall be 30°. If necessary, reduce the angle of the datum level by a minimum value to prevent the plane intersecting the fireback above the knee.

[3)] 1 mbar = 100 N m^2 = 100 Pa.



NOTE The chimney shown is purely for test purposes and does not relate to modern practice of chimney construction.
All dimensions are in millimetres

Figure 5 — Test setting

If, for the banking tests (see **A.8** and **A.9**), the appliance is fitted with a deepening plate, the datum level shall originate from the inner edge of the topmost part of the deepening plate [see Figure 9(a)]. In all other cases, the datum level shall originate from the top edge of the foremost part the firefront, front firebars or deepening bar [see Figure 9(b)].

NOTE It is recommended that a reference line should be drawn in chalk or similar marking where the plane intersects the back and sides of the fireback or boiler.

A.4 Determination of total radiation heat output

A.4.1 *General*

Determine the radiation heat output with a BCURA cage radiometer[4)], consisting of a hemispherical cage fitted with a matched set of radiometer elements.

A.4.2 *Procedure*

Place the radiometer cage in position, with the front tubular structure vertical and its outer surfaces 40 ± 5 mm in front of the plane of the builder's opening. Locate the cage symetrically in relation to the vertical centre line of the fireplace opening. Adjust the height of the cage so that its horizontal centre line is in line with the top of the firefront, deepening bar or front firebars.

NOTE As the radiometer is sensitive to heat radiation falling on the back of the elements when in use, take care that this is minimized. Also, take care to ensure that the radiometer is protected from draughts.

Record the output of the radiometer (in millivolts) by either a potentiometric recorder or a data logger.

A.4.3 *Calculation and results*

Calculate the total radiation heat output O_r, in kJ, over each test period, from the equation:

$$O_r = 60tLF$$

where

t is the duration of the test period (in min);

L is the mean radiometer output over the test period (in mV) (see **A.6** or **A.7**);

F is the calibration factor[a] for the radiometer (in kW/mV).

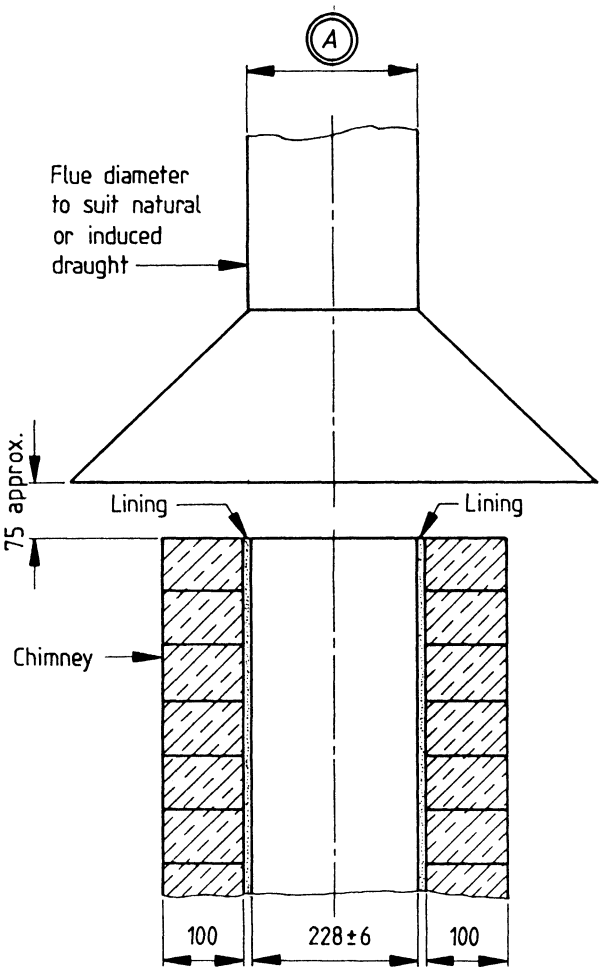
[a] The calibration factor, as determined by an approved laboratory within 2 years.

A.5 Determination of total water heating output

A.5.1 *Procedure*

Determine the heat given to the water by the constant water flow method, using the constant water flow apparatus described in **A.2.2**. Set the water flow rate using a water flow meter so that the average rise in temperature during the test period is between 33 K and 55 K. During the test, maintain a constant flow rate either by reference to a water flow meter or by weighing and record the water flow rate at least twice per hour. Maintain the cold water supply at constant pressure and control its temperature within the range 5 °C to 25 °C during the test. Do not allow the temperature of the cold water supply to change by more than 1 K in any hour. Do not allow the total fluctuation in temperature to exceed 3 K.

[4)] For information on the supply of BCURA cage radiometers and calibrated radiometer elements apply to Enquiry Section, British Standards Institution, Linford Wood, Milton Keynes, MK14 6LE, enclosing a stamped addressed envelope for reply.



All dimensions are in millimetres

Figure 6 — Hood for test chimney

Do not reduce the water flow rate to compensate for short period reductions in the temperature rise which occur after refuelling.

A.5.2 *Calculation and results*

Calculate the total water heating output, O_b, in kJ, over each test period from the equation:

$$O_b = \left[\frac{t}{60}\right] C_p \, MN$$

where

t is the duration of the test period (in min);

C_p is the mean specific heat of water = 4.187 kJ/kg·K;

M is the mean water flow rate through the boiler (in kg/h);

N is the mean water temperature rise (in K).

A.6 High radiation output (HRO) test

A.6.1 *Test setting and installation of the appliance*

Follow the procedures described in **A.1** and **A.2**.

A.6.2 *Appliance ancillaries and controls*

Throughout the test keep the boiler control, if any, completely closed. Remove any deepening plate from the firefront. Locate any fall plate in the position which least obstructs the radiation from the fire. If recommended and provided by the manufacturer, a deepening bar shall be fitted appropriate to the type of test fuel to be used (see **A.6.3**).

Set the primary air control as necessary to obtain the burning rate within the required tolerance (see **A.6.4.5**).

NOTE Removal of the ashpit cover or opening of the ashpit door does not constitute an operation of the control unless provision is made for the definite location of the cover or door in a partially opened position.

Test appliances with fan-assisted primary air with the fan running continuously throughout the test. Achieve any necessary adjustment of the combustion rate by using the primary air control.

A.6.3 *Fuelling, de-ashing and poking the fire*

A.6.3.1 Select and prepare the test fuel in accordance with **B.1** and **B.3**. When fuelling the fire, shovel the test fuel from a heap on the floor or from a tray. Do not artificially pack the fuel down, such as by beating down, although final shaping of the surface by hand may be carried out.

A.6.3.2 De-ash open fires which have an underfloor air supply, from above the fuel bed by inserting a 6 mm diameter steel rod (poker), about 600 mm long, into the rear end of each firebar space in turn and gently drawing it towards the front of the fire to clear any ash from the back spaces of the grate.

A.6.3.3 De-ash open fires, which do not have an underfloor air supply, by removing the ashpit cover and by gently drawing a thin hooked tool along each firebar space from below the grate until live fuel begins to be discharged. Fabricate the tool from a 6 mm diameter steel red, 600 mm long, bent to a right angle 60 mm from one end. Bring the short limb to a chisel end with the blade across the long axis of the tool.

A.6.3.4 De-ash appliances at the beginning of the pre-test period and at the beginning and end of the test period.

A.6.3.5 De-ash open fires with fan-assisted primary air in accordance with **A.6.3.3** and **A.6.3.4** but, in addition, de-ash before the three refuels during the test period.

A.6.3.6 De-ash open fires, when burning test fuel C, in accordance with **A.6.3.3** and **A.6.3.4** but, in addition, poke the fuel bed lightly from above at the three refuels during the test period, to separate the lumps of fuel and to form an even level on the surface of the bed. Use the straight poker (see **A.6.3.2**).

A.6.3.7 If open fires, when burning test fuel A, cannot otherwise achieve the target burning rate during the test period (see **A.6.4.5**), poke the fuel bed, if necessary, at the three refuels in the manner described in **A.6.3.6**.

A.6.3.8 After de-ashing, replace the ashpit cover and set the air control according to the stage reached in the firing procedure.

A.6.3.9 In all cases, at each refuel of the test period, clear the top surface of the firefront and any front firebars or deepening bar of ash, by drawing the straight poker along the top of the firefront and each bar in turn, to deposit the ash into the fire.

A.6.4 ***Firing procedure***

A.6.4.1 *General*

The test shall consist of three periods as follows:

a) an initial period typically of 90 min;

b) a pre-test period typically of 90 min;

c) a test period of 360 ± 2 min.

A.6.4.2 *Initial period*

Start this period either by lighting a fresh fire or de-ashing and refuelling an existing fire. During the remainder of this period manipulate the primary air control so that, at the end of about 90 min, the fuel bed is in approximately the same condition as is expected to be obtained at the end of the test period before the final refuelling.

Take a sample of the test fuel for the determination of its total moisture content as charged, m, (see **B.3**).

A.6.4.3 *Pre-test period*

At the end of the initial period, de-ash and refuel the fire to the appropriate datum level (see **A.3**). Adjust the primary air control to the estimated setting for the required burning rate (see **A.6.4.5**) and allow the fire to burn unattended for approximately 90 min.

A.6.4.4 *Test period*

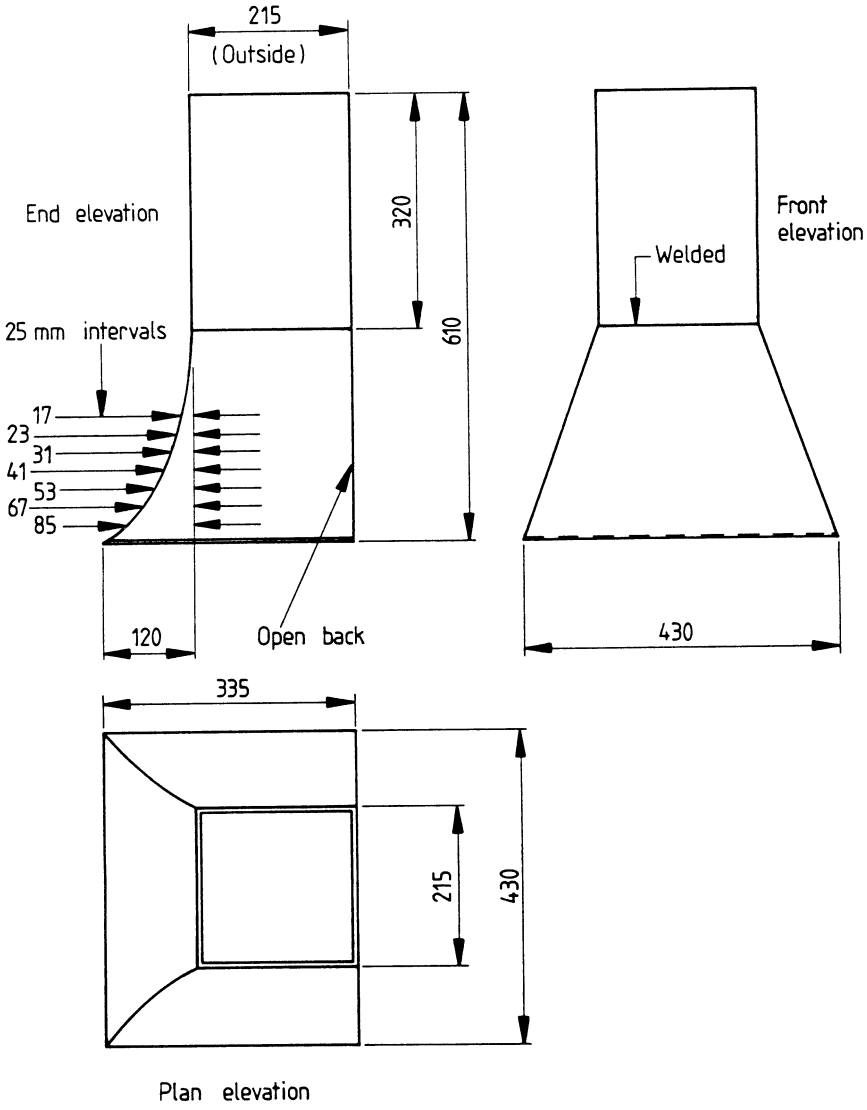
At the end of the pre-test period, de-ash the fire, empty the ashpan and refuel to datum level. Record the mass of fuel added when burning test fuel C, W_0. The test period starts after refuelling to the datum level.

Carry out four further refuels to the appropriate datum level (see **A.3**) at intervals of 90 ± 1 min from the start of the test period. Record the masses added for all test fuels. As described in **A.6.3**, de-ash fires fuelled with test fuel B before each refuel. Likewise, de-ash fires fuelled with test fuel C before the final refuel only and lightly poke them before the intermediate refuels. De-ash fires fuelled with test fuel A before the final refuel only and, if the target burning rate cannot otherwise be attained, lightly poke them before the intermediate refuels.

Measure the parameters of the radiation heat output and water heating output during the test period as described in **A.4** and **A.5** respectively, either continuously or at regular intervals of not more than 10 min, using recording or data logging equipment. If measurements are taken at regular intervals, arrange the timing such that each refuel is carried out at the middle of an interval.

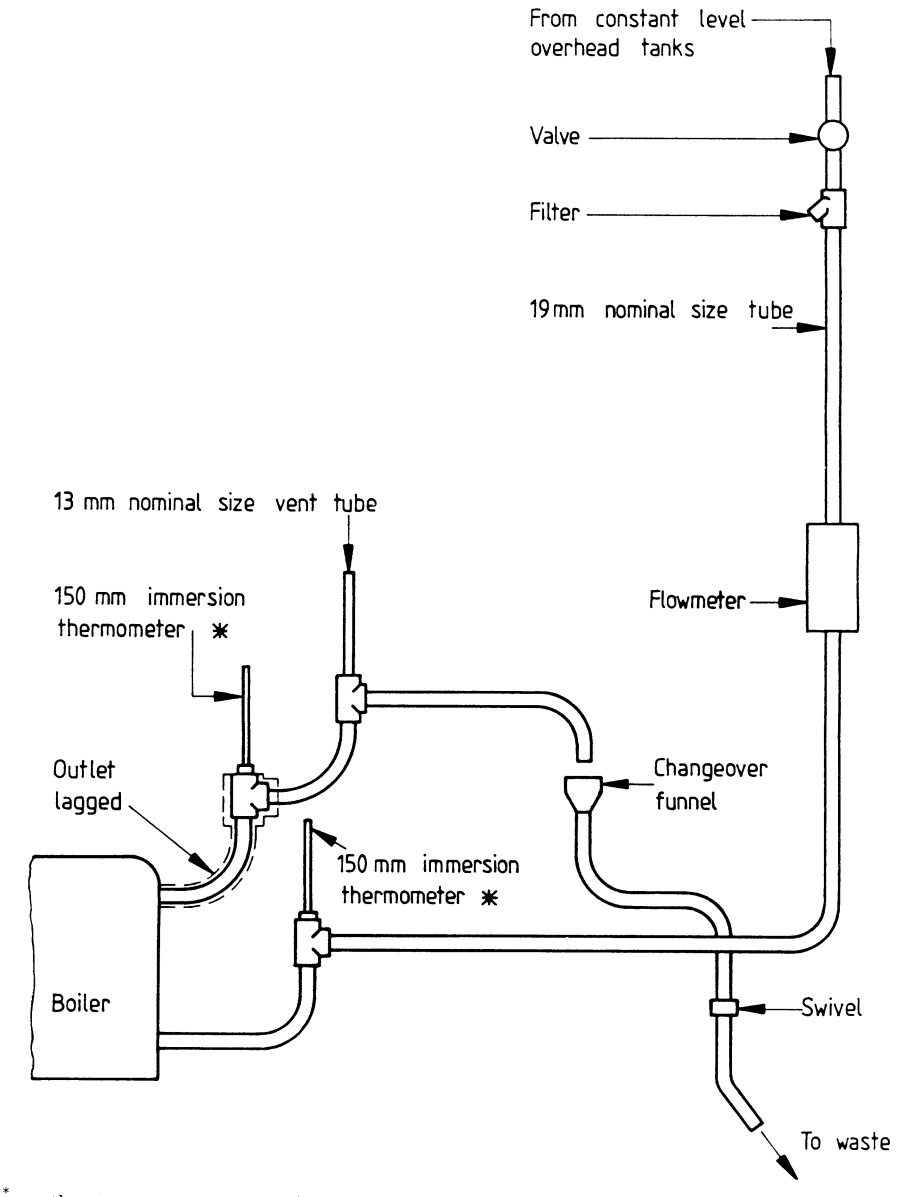
The test period shall expire immediately after the final refuel to the datum level.

At the end of the test period determine the mass, u, in kg, of combustible material recovered from the ashpan that remains on a 6.7 mm square aperture perforated plate test sieve complying with BS 410.



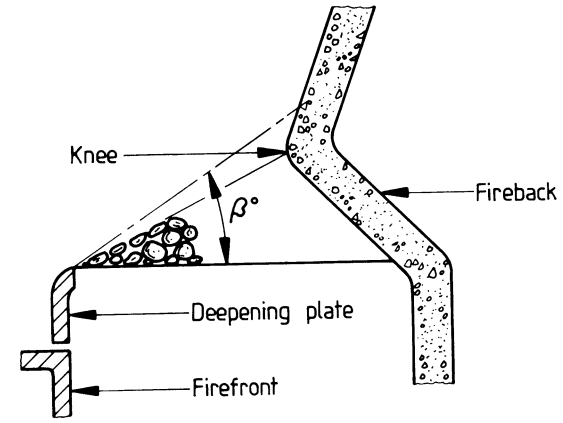
All dimensions are in millimetres
NOTE The material should be of low carbon steel 0.9 mm to 1.6 mm thick

Figure 7 — Typical gather for 400 mm open fire with back boiler

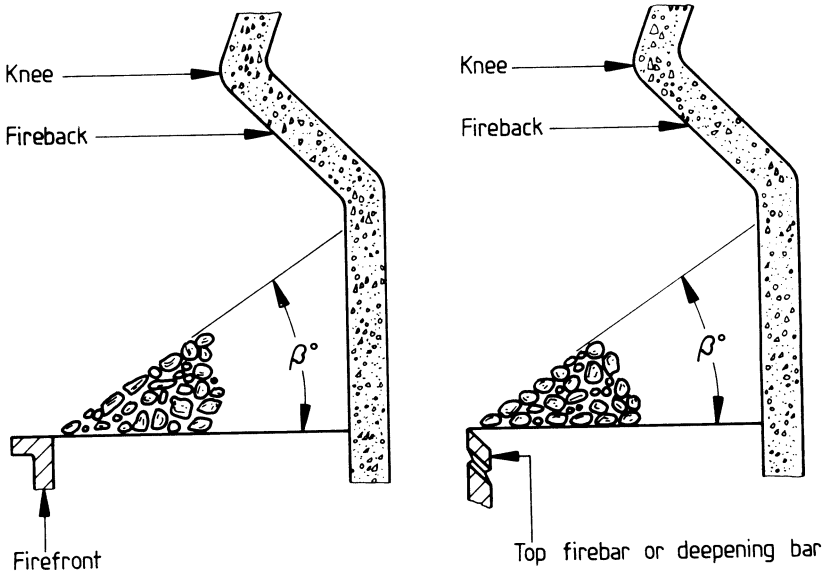


*or other temperature measuring device

Figure 8 — Typical constant water flow apparatus



(a)



(b)

Figure 9 — Datum level for various types of open fire

A.6.4.5 *Burning rate*

The average burning rate during each test period, calculated on a dry basis, shall be within 10 % of the target burning rate given in Table 8. At least one of the tests conducted shall give a burning rate equal to or greater than the target burning rate. The mean value of burning rates for all tests shall be within 5 % of the target burning rate. However, for category a)1) appliances, lower values may be used in order to comply with the thermal performance requirements specified in Table 5.

A.6.5 ***Calculation of parameters***

Calculate the mass of fuel consumed in the test period, W, in kg (dry basis), from the following equations:

For test fuels A and B:

$$W = \left[(W_1 + W_2 + W_3 + W_4) \frac{(100 - m)}{100} \right] - u$$

For test, fuel C:

$$W = \{ [W_1 + W_2 + W_3 + W_4 + 0.3 (W_0 - W_4)] \frac{(100 - m)}{100} \} - u$$

Table 8 — Target burning rates

Category	a)2),3)[a]				b)					
Test fuel	A or B				A or B			C		
Nominal width, mm	350	400	450	500	400	450	500	400	450	500
Target burning rate, kg/h	0.91	1.13	1.36	1.59	1.36	1.59	1.86	1.81	2.12	2.48

[a] These values for target burning rate should be used for category a)1) appliances, if possible.

where

W_0..., W_4 are the masses of test fuel charged at the beginning of the test period and at the first, second, third and final refuels respectively (in kg, as charged);

m is the total moisture content of the fuel as charged (see **A.6.4.2**) (in %);

n is the mass of the combustible undergrate material (see **A.6.4.4**) [in kg (dry basis)];

NOTE The expression 0.3 ($W_0 - W_4$) is an empirical correction for volatile matter content of test fuel C in the different masses of refuel charge at the beginning and end of the test.

Calculate the total radiation heat output, O_r, in kJ, and total water heating output, O_b, in kJ, during the 6 h test period in accordance with **A.4.3** and **A.5.2** respectively.

Calculate the total efficiency of the appliance, E_T, in %, during the test period in accordance with **A.10**.

Calculate the rated radiation heat output of the appliance, R_r, in kW, in accordance with **A.11.1**.

NOTE Although not a performance requirement, a rated water heating output, R_b, in kW, may be calculated in accordance with **A.11.2**.

A.7 High boiler output (HBO) test

Follow the method described in **A.6**, except for the following conditions.

If fitted, position the fall plate as recommended by the manufacturer for HBO conditions.

Adjust the primary air control to achieve the target burning rate, but do not fully close it.

At the end of the initial period, set the boiler damper by means of a pre-set stop either to 10 mm open or to the manufacturer's recommended setting, whichever is the greater, and maintain that setting throughout the test.

When burning test fuel A, do not poke the fuel bed during the test period (but see **A.6.3.7**). When burning test fuel C, brush the boiler flue-ways with the tool provided (see **2.14**) before the start of the test.

Calculate the rated water heating output of the appliance, R_b, in kW, in accordance with **A.11.2**.

NOTE Although not a performance requirement, a rated radiation heat output, R_r, in kW, may be calculated in accordance with **A.11.1**.

A.8 Banking test for overnight appliances

A.8.1 *General*

This test shall consist of two periods as follows:

a) a pre-test period;

b) a banking test period of 600 ± 4 min.

A.8.2 *Test setting and installation of the appliance*

Follow the procedures described in **A.1** and **A.2**

If the appliance incorporates a boiler damper, set this closed.

A.8.3 *Initial and pre-test period*

Follow the procedures for the initial and pro-test periods described in **A.6.4.2** and **A.6.4.3** but complete these periods by allowing the fire to burn for a total of about 3 h at approximately the target burning rate.

Allow the fire to attain a suitable condition for banking in accordance with the manufacturer's instructions. Fit the deepening plate if it is recommended by the manufacturer for banking.

If a boiler is fitted, pass a sufficient flow of water through it to ensure a mean temperature rise not greater than 55 K during the ensuing test period.

A.8.4 *Test period*

De-ash the fire in accordance with **A.6.3** and refuel to datum level (see **A.3**) and set the controls for overnight burning in accordance with the manufacturer's instructions. Allow the fire to burn unattended for 600 ± 4 min and then attempt to revive it by opening the air controls and de-ashing as necessary. Add a small weighed quantity of fresh fuel. The fire shall revive by visibly igniting fresh fuel in less than 20 min. On revival, de-ash the fire in accordance with **A.6.3** and refuel to datum.

The total mass of fuel, on a dry basis, added to revive the fire at the end of the test period shall be taken as the fuel consumed during this banking test (see Table 5 and Table 6).

NOTE Determination of heating output is not required during this test.

A.9 Banking test for intermittent burning appliances

A.9.1 *General*

This test shall consist of the following two periods:

a) a pre-test period; and

b) a test period of 360 ± 2 min.

A.9.2 *Test setting and installation of the appliance*

Follow the procedure described in **A.8.2**

A.9.3 *Initial and pre-test period*

Follow the procedure described in **A.8.3**.

A.9.4 *Test period*

De-ash the fire in accordance with **A.6.3** and refuel the fire to datum level (see **A.3**). Set the controls for intermittent burning according to the manufacturer's instructions. Follow the method described in **A.8.4** but allow the fire to burn unattended for 360 ± 2 min.

A.10 Calculation of total efficiency and mean total efficiency

Calculate the radiation and water heating efficiencies to two decimal places from the results of single HRO and HBO tests described in **A.6** and **A.7** respectively, as follows.

Calculate the radiation efficiency, E_r, in %, from the equation:

$$E_r = \left[\frac{O_r}{WQ}\right] 100$$

where

O_r is the total radiation heat output over each test period (see **A.4** and **A.6** or **A.7**) (in kJ);

W is the mass of fuel consumed over each test period (see **A.6** or **A.7**) [in kg (dry basis)];

Q is the gross calorific value of the batch of the test fuel charged (see **B.3**) [in kJ/kg (dry basis)].

Calculate the water heating efficiency, E_b, in %, from the equation:

$$E_b = \left[\frac{O_b}{WQ}\right] 100$$

where

O_b is the total water heating output over each test period (see **A.5** and **A.6** or **A.7**) (in kJ).

Calculate the total efficiency of the appliance, E_T, in %, for both the HRO (see **A.6**) and HBO (see **A.7**) tests, by adding the value of the radiation efficiency, E_r, to that of the water heating efficiency, E_b, in each case as follows.

$$E_T = E_r + E_b$$

For the same tests, calculate arithmetic mean values of E_T, E_r and E_b expressed by the symbols $\bar{E}_T$, $\bar{E}_r$ and $\bar{E}_b$ respectively.

A.11 Calculation of rated output of the appliance

A.11.1 *Rated radiation heat output*

Calculate the rated radiation heat output, R_r in kW, from the following equation.

$$R_r = \frac{TC_v\bar{E}_r}{36 \times 10^4}$$

where

T is the target burning rate (see Table 8) [in kg/h (dry basis)];

C_v is the nominal calorific value of the test fuel (see Table 9) (in kJ/kg);

$\bar{E}_r$ is the mean radiation efficiency from three or more values of E_r (see **A.10**) (in %).

Table 9 — Nominal calorific values for test fuels (see **B.1**)

Test fuel	Calorific value, C_v (kJ/kg)
A	31 600
B	30 240
C	32 560

A.11.2 *Rated water heating output*

Calculate the rated water heating output R_b, in kW, for both the HRO (see **A.6**) and HBO (see **A.7**) tests from the following equation:

$$R_b = \frac{TC_v\bar{E}_b}{36 \times 10^4}$$

where

$\bar{E}_b$ is the mean water heating efficiency from three or more values of E_b (see **A.10**) (in %).

A.11.3 *Expression of results*

Express the results to the nearest 0.1 kW and round values of 0.05 to 0.1.

A.12 Determination of firebox capacity

Determine the firebox capacity using test fuel B (see **B.1**). Measure the bulk density of test fuel B on the day of the test, as described in BS 1016-13, but using a cubical box of capacity 57 dm^3 and sides 384 mm in length.

Fill the firebox to the 35° datum level defined in **A.3**.

When filling the appliance do not pack the fuel artificially, for example by beating down. Final shaping of the surface by hand placing may be carried out.

Weigh the quantity of fuel added to within 50 g. From the bulk density determined, calculate the volume of the fuel added, expressed in dm^3. Record the result to the nearest 0.02 dm^3.

Calculate the firebox capacity as the mean of two results, provided that the difference between them does not exceed 0.6 dm^3. If the difference between the two results exceeds this figure, carry out a third determination. If the range of the three results does not exceed 0.72 dm^3, take the mean of these results as the firebox capacity.

If the range of results exceeds 0.72 dm^3, carry out further determinations until three lie within the range of 0.72 dm^3, accept these three for the calculation of the mean value and reject the remainder.

A.13 Determination of ash collection area, effective grate area and ash-shedding area

A.13.1 Determine geometrically, to within 0.05 dm^2, the maximum area, *X*, of the ashpan capable of collecting ash. However, if ash deflectors or similar design features which direct ash into the ashpan are fitted, the value for *X* shall include the projected area of those parts of the deflectors, etc. that do not overlap that area of the ashpan already determined.

A.13.2 Assemble the appliance and determine geometrically, to within 0.05 dm^2, the effective grate area, *Y*.

A.13.3 Determine geometrically to within 0.05dm^2, the ash-shedding area *Z*.

Appendix B Test fuels

B.1 General

The test fuels[5)] shall be as follows.

a) *Test fuel A* for testing all appliances except those operating with fan-assisted primary air.

b) *Test fuel B* for testing appliances operating with fan-assisted primary air.

c) *Test fuel C* for additional testing of category b) appliances designated as suitable for burning bituminous coal at enhanced efficiency. (see **4.1.2**).

NOTE For the purpose of appliance testing, it is essential that the test fuels are of consistent quality as the performance requirements specified in this standard are based on the use of these test fuels.

B.2 Requirements

When sampled and analysed in accordance with the appropriate Part of BS 1017 and BS 1016 respectively, each batch of test fuel shall comply with the following requirements.

a) *Test fuel A*:

ash on a dry basis complying with BS 1016-4: 4.0 % to 7.0 %.

bulk density on a dry basis, complying with BS 1016-13: 0.30 kg/dm^3 to 0.35 kg/dm^3.

b) *Test fuel B*:

ash on a dry basis complying with BS 1016-4: 8.5 % to 10.0 %.

bulk density on a dry basis complying with BS 1016-13: 0.42 kg/dm^3 to 0.47 kg/dm^3.

c) *Test fuel C*:

ash on a dry basis complying with BS 1016-3: 4.0 % to 7.0 %.

NOTE The designation of test fuel C is British Coal Corporation, coal rank code number 802.

B.3 Storage, preparation and analysis

Each batch of test fuel shall be stored under cover and sieved before use, using square aperture perforated plate test sieves complying with BS 410, to give material within the following size ranges:

a) *Test fuel A*: 63 mm to 26.5 mm. For banking tests, 20 ± 2 %, by mass, of test fuel A shall be within the size range 63 mm to 37.5 mm.

b) *Test fuel B*: 37.5 mm to 19 mm.

c) *Test fuel C*: 53 mm to 19 mm.

Determine the gross calorific value, *Q*, (in kJ/kg), on a dry basis, for each batch of test fuel, in accordance with BS 1016-5.

Before use, dry each selected test fuel, at a temperature not exceeding 110 °C for test fuels A and B, or 30 °C for test fuel C, to a total moisture content, *m*, not exceeding 2.0 % for test fuels A and B, when analysed in accordance with BS 1016-2, and not exceeding 11.0 % for test fuel C, when analysed in accordance with BS 1016-1.

[5)] For information on the availability of test fuels, apply to Enquiries Section, British Standards Institution, Linford Wood Milton Keynes MK14 6LE, enclosing a stamped addressed envelope for reply.

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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 410, *Specification for test sieves.*

BS 1016, *Methods for analysis and testing of coal and coke.*

BS 1016-1, *Total moisture of coal.*

BS 1016-2, *Total moisture of coke.*

BS 1016-3, *Proximate analysis of coal.*

BS 1016-4, *Moisture, volatile matter and ash in the analysis sample of coke.*

BS 1016-5, *Gross calorific value of coal and coke.*

BS 1016-13, *Tests special to coke.*

BS 1017, *Methods for sampling of coal and coke.*

BS 1017-1, *Sampling of coal.*

BS 1017-2, *Sampling of coke.*

BS 1251, *Specification for open fireplace components.*

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 1846, *Glossary of terms relating to solid fuel burning equipment.*

BS 1846-1, *Domestic appliances.*

BS 3323, *Glossary of coal terms.*

BS 3376, *Specification for solid mineral fuel open fires with convection, with or without boilers.*

BS 3377, *Specification of boilers for use with domestic solid mineral fuel appliances.*

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

BS 3456-101, *General requirements.*

BS 3955, *Specification for electrical controls for household and similar general purposes.*

BS 6100, *Glossary of building and civil engineering terms.*

BS 6100-1.5.1, *Coordination of dimensions; tolerances and accuracy.*

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

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

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