

Installation of chimneys and flues for domestic appliances burning solid fuel (including wood and peat) —

Part 1: Code of practice for masonry chimneys and flue pipes

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Committees responsible for this British Standard

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- British Board of Agrément
- British Flue and Chimney Manufacturers' Association
- British Precast Concrete Federation Ltd.
- Clay Pipe Development Association Ltd.
- Department of the Environment
- Department of the Environment (Building Research Establishment)
- Department of the Environment (Housing and Construction)
- Domestic Solid Fuel Appliances Approval Scheme
- Greater London Council
- Institute of Building Control Officers
- Institution of Municipal Engineers
- Institution of Public Health Engineers
- National Association of Plumbing, Heating and Mechanical Services Contractors
- National Clayware Federation
- National Coal Board
- National Federation of Building Trades Employers
- National Federation of Clay Industries
- National Fireplace Council Manufacturers' Association
- Royal Institute of British Architects
- Scottish Development Department
- Solid Fuel Advisory Service
- Woodburning Association of Retailers and Manufacturers

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Foreword

This British Standard has been prepared under the direction of the Building Services Standards Committee and is a revision in two Parts of CP 131:1974, which is withdrawn. It takes account of current experiences on design, construction and erection of all forms of in situ built and factory-made and flue block domestic chimneys. It should be read in conjunction with CP 403, the scope of which has a considerable bearing on the recommendations given in this standard, particularly in relation to size and height of chimneys and the formation of a fireplace recess at the base of a chimney flue.

This Part of this standard covers masonry chimneys and flue pipes; factory-made chimneys are covered in Part 2 of this standard.

The changing energy availability and cost position, now and in the coming years, suggests that new houses should incorporate a chimney suitable for a variety of different forms of heating appliances and fuels that might need to be used during the lifetime of a house. Chimneys may also be required in houses built without a flue. This code gives advice on what to provide.

Because misunderstanding may arise on the distinction between a chimney and a flue, definitions of chimney and flue are given in clause 2.

The construction of a chimney is presently controlled by the following regulations and amendments to them.

- a) The Building Regulations 1976, applicable in England and Wales.
- b) London Building (Constructional) By-laws, 1972-1979, applicable to Inner London.
- c) The Building Standards (Scotland) Regulations 1981 and 1982.
- d) The Building Regulations (Northern Ireland) 1977.

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 and ii, pages 1 to 24, an inside back cover and a back cover.

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

1 Scope

1.1 This Part of BS 6461 gives recommendations for the construction of new flues, whether in chimneys or flue pipes, the operation of which depends on natural draught. It includes recommendations for chimneys built of brick, stone, concrete and flue blocks and also on the materials, components and installation of flue pipes. Warm air ducts forming an integral part of an installation are not included. Appendix A gives guidance on remedial action for defective chimneys.

The chimneys and flues are specifically suitable for use with all types of domestic solid fuel appliances, including wood burning appliances, but see Appendix B regarding cleaning and maintenance. They are also suitable for use with gas and oil fired appliances.

1.2 This Part of this standard is confined to chimneys and flue pipes serving appliances with a maximum heat output of 45 kW and the temperature of the flue gases leaving the appliance has been assumed not to exceed 500 °C under normal operating conditions. The chimneys and flue pipes will normally withstand much higher temperatures that can arise during overrun conditions and chimney fires for short periods, but may need some repair.

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

2 Definitions

For the purposes of this Part of BS 6461, the following definitions apply.

2.1

chimney

a structure (including any part of the structure of a building) enclosing or forming part of a flue or flues other than a flue pipe, including any opening therein for the accommodation of an appliance but excluding the flue terminal

2.2

chimney breast

a projection beyond the thickness of a wall containing the fireplace and flue(s)

2.3

chimney connector

an accessory that connects an appliance or flue pipe to a chimney

2.4

chimney jamb

the walling at the side of a fireplace recess

2.5

chimney stack

part of a chimney enclosing one or more flues that rises above the roof of a building of which it forms a part and which includes the chimney terminal but not the flue terminal

2.6

chimney terminal

the uppermost part of a chimney stack

2.7

corbel

projection of masonry having a bearing in a wall to support a load

2.8

core

a sack filled with soft material to fit snugly in the flue, drawn up as the work proceeds

2.9

coring

freeing, by the use of a core, the inside of a flue from obstructions and mortar droppings

2.10

drip throating

a projection, throated on the underside, to facilitate the fall of rainwater clear of the wall or structure

2.11

fireplace recess

a space formed in a wall or chimney breast into which an appliance may be placed and from which a flue leads

NOTE This is sometimes referred to as builder's opening.

2.12

flaunching

the weathering formed in mortar at the top of a chimney or base of a terminal

2.13

flue

a passage that conveys the products of combustion from an appliance to the open air

2.14

flue adaptor

a fitting between the appliance flue outlet and the inlet to a flue pipe or to the chimney flue

2.15

flue block

a factory-made masonry unit that can be erected on site to form a chimney. It may contain voids for either insulation or for combustion air

2.16**flue lining**

a lining forming the wall of a flue for the purpose of protecting the chimney fabric

2.17**flue pipe**

a pipe used for connecting the appliance flue outlet to the chimney flue or to outside atmosphere but not including a pipe used as a lining to a chimney

2.18**flue terminal** (chimney pot)

A prefabricated or built up unit forming the outlet end of a flue

2.19**fly ash**

fine particles of ash entrained in flue gases

2.20**gather** (oncome)

the contraction over a fireplace recess to reduce it to the size of the flue

2.21**lintel**

a loadbearing and/or throat forming beam above the fireplace recess

2.22**offset**

a double bend introduced into a flue so that its direction remains parallel to its original direction

NOTE The effect is to give the path of the flue a lateral displacement.

2.23**oversailing**

courses of stone or brickwork (masonry) arranged to project from the face of a wall or chimney stack largely for decorative effect

2.24**rendering**

one or more coats of mortar or plaster on brick, concrete or stonework, or the act of laying such a coat or coats

2.25**throat**

that part of the flue, if contracted, which is located between the fireplace and the chimney flue

2.26**withe** (midfeather, bridge, brig)

a partition between adjacent flues in a chimney

3 Exchange of information

3.1 The designer should acquire sufficient information to enable him effectively to detail the whole of the work. This should include particulars of the locality and exposure of the site, the proximity of trees and tall buildings, the direction of the prevailing winds, and the disposition of windows and other openings, in relation to the position of the fireplaces. Consideration should also be given to the possible subsequent installation of a different type of appliance in place of that originally intended. Full details should be obtained whenever possible from the manufacturers regarding any special requirements of appliances affecting flue size, insulation and chimney height. All relevant drawings, specifications and information should be provided to those responsible for carrying out the construction and erection of the chimneys and to others whose work may be affected.

3.2 The construction of brick, stone or concrete chimneys will normally be undertaken with the main constructional work of the building.

3.3 In the preparation of a time schedule for the main contract or one applicable to chimneys only, it should be noted that:

- a) chimney stacks are usually completed before the roof covering is laid, when final coring of the flues can be carried out before the removal of the scaffolding and fixing of the appliances;
- b) rendering of chimney walls adjacent to floors and roof members should be undertaken in the course of construction;
- c) precast concrete blocks and units should be adequately cured before transportation to the site and before building-in.

4 General**4.1 Materials, appliances and components****4.1.1 British Standards**

4.1.1.1 All materials, appliances and components used should comply with the relevant British Standard where applicable. Where materials are used that are not covered by a British Standard, the manufacturer's recommendation should be obtained as to their suitability.

4.1.1.2 In addition to the British Standards referred to in the text, the following British Standards are relevant to the recommendations contained in this code.

BS 12, *Specification for ordinary and rapid-hardening Portland cement*.

BS 146, *Portland-blastfurnace cement*.

BS 890, *Building limes*.

BS 915, *High alumina cement*.

BS 1014, *Pigments for Portland cement and Portland cement products*.

BS 1198, BS 1199 and BS 1200, *Building sands from natural sources*.

BS 3892, *Pulverized-fuel ash — Part 1 Specification for pulverized-fuel ash for use as a cementitious component in structural concrete*.

BS 4027, *Specification for sulphate-resisting Portland cement*.

BS 4729, *Shapes and dimensions of special bricks*.

BS 5224, *Specification for masonry cement*.

BS 6073, *Precast concrete masonry units*.

4.1.2 Mortars. Mortar mixes should be selected to suit the conditions in the particular part of the chimney or flue in which they are to be used and specific recommendations are given in **5.2** and **5.3**.

Consideration should be given to:

- a) the location of the building and chimney and the degree of exposure;
- b) any local mixes that may have been used to deal satisfactorily with special conditions;
- c) the recommendations given in CP 121.

Mortars should consist of one of the following mixes:

- a) Portland cement and sand; or
- b) Portland-blastfurnace cement and sand; or
- c) high alumina cement and sand; or
- d) lime and sand with Portland cement or Portland-blastfurnace cement; or
- e) masonry cement and sand;

and the mix should be in proportions compatible with the masonry units that it is jointing.

A more impervious, high cement content mortar or the use of sulphate-resisting cement will provide greater resistance to sulphate attack.

NOTE See **5.1.1.2** regarding drying out of the mortar.

4.2 Design

4.2.1 General. The most important general considerations of chimney design can be summarized as follows.

- a) The materials used in the construction should be such that the construction is non-combustible, durable, resistant to high temperature and rapid changes in temperature and resistant to internal and external corrosion.
- b) Masonry chimneys should be lined except when constructed in accordance with **5.6**.
- c) The cross-sectional area of the flue and the vertical height should be considered in relation to the type of appliance it has to serve.

d) Excessive heat losses should be prevented and undesigned leakage of air into the flue avoided.

e) Rough internal surfaces, too flat gradients, abrupt changes of direction and sudden enlargements or contractions of the flue should be avoided.

f) The number of bends, where these are unavoidable, should be kept to a minimum and in no case should a bend be used with an angle of more than 45° (but see **4.5**).

g) In relation to the roof, terminals should be located to avoid as far as possible zones of wind pressure that are likely to cause downdraught. In addition, it is essential to avoid flue gases discharging in a position where they can enter a window or skylight capable of being opened or an air inlet to a ventilating system.

h) A chimney stack, and especially a chimney terminal, is particularly exposed to the weather and precautions are necessary, such as the proper selection of masonry units (particularly bricks and mortar) and protective detailing, as protection against the weather (see **5.2**).

i) Chimneys on internal walls are to be preferred in order to minimize loss of heat from the flue and also to retain useful heat within the dwelling.

4.2.2 Relationship to heating appliance. The design of the chimney should be suitable for the variety of heating appliances that might be installed during the lifetime of the dwelling. The most critical design feature is the flue size. The requirements for a chimney serving an open fire differ from those for a chimney with a closed appliance in that considerably more excess air has to be carried up the flue and the total amount of flue gases (including excess air) is not necessarily directly related to the rate of combustion in the appliance. Open fireplaces function primarily as air collecting hoods in which small amounts of combustion products are diluted with relatively large amounts of air. Providing that a chimney is constructed in accordance with **4.2.1**, the most important factors influencing the size and height of a flue for an open fire are the configuration and dimensions of the throat, lintel and entry to the chimney flue, and the air flow velocity into the fireplace opening. Recommendations for the construction and design of fireplace recesses and the installation of open fires are given in CP 403.

4.2.3 Size and height of chimneys

NOTE Where flue liner sizes are given, these refer to *internal* dimensions.

4.2.3.1 Chimneys serving an appliance recess. For a chimney built with a fireplace recess in which an open fire, a room heater or stove may be fitted, a flue size of 185 mm nominal square or 225 mm nominal diameter is recommended with an absolute minimum size for circular flues of 200 mm diameter. These flue sizes are suitable for virtually all closed appliances and for open fires with an opening up to 500 mm by 550 mm. For larger sizes of open fire, or closed appliance that can be used as an open fire, the cross-sectional area of flue should be between 14.0 % and 16.0 % of the free, unobstructed area of the fire opening.

In cases where a closed appliance, such as a room heater, boiler or cooker, is installed with a chimney intended for an open fire and built in accordance with this code, it should not normally be necessary to make any alterations to the chimney or flue. If, however, the type and rating of the appliance to be installed is known before the chimney is built and it is unlikely that the chimney will be used for some form of open fire inset or free-standing, then the optimum size of the chimney can be determined for the particular installation.

4.2.3.2 Chimneys not serving an appliance recess. For a boiler chimney, such as one situated in a kitchen or separate boiler house, a flue of 150 mm nominal square or diameter is recommended as being suitable for virtually any closed domestic heating appliance up to 30 kW.

A flue of a minimum of 175 mm nominal square or diameter is recommended as suitable for closed domestic heating appliances above 30 kW up to 45 kW output.

4.2.3.3 Chimney height. For chimneys in brickwork, stonemasonry, concrete and hollow blocks built in accordance with this code, a height of about 4.5 m (the height being measured above the top of the fireplace opening) is normally sufficient for flue draught. The recommendations for the height of the chimney outlet above the roof of a building are given in 4.7.

4.3 Fireplace recess and throat

4.3.1 Mention has been made in 4.2.2 of the importance of good design in the construction of a fireplace recess for open fire installation. However, the design of the recess may be modified in order to be more suitable to the installation of other types of appliance, e.g. free-standing appliances or inset room heaters. It should also be noted that to facilitate the use of precast block chimneys, there are available compatible proprietary makes of prefabricated recess that normally comply with the requirements of a conventional brick-built recess. Different forms of recess construction are illustrated in Figure 1 and Figure 2. Recommendations for good design of the recess and the throat are also given in CP 403.

4.3.2 In designing fireplace recesses, account may have to be taken of any need for providing access to boiler connections and the incorporation of ducts for some fan-assisted appliances. Details of the dimensions of recesses for stand-in and free-standing appliances are given in CP 403.

4.4 Condensation. Condensation may occur when the appliance is lit and the flue surfaces are relatively cold and also where the temperature and volume of the flue gases are low, such as when a closed appliance is operating at a low burning rate. The condensate forms acids from water vapour condensing on the flue surfaces and combining with flue gas deposits.

Burning wood on a closed appliance produces special problems of condensation due to the high concentrations of water vapour. The tar-like materials in the flue gases may pass out through the mortar joints and stain the brickwork externally (see Appendix A).

The use of flue linings assists in minimizing the effect of condensation within the flue.

4.5 Bends and changes of section. Flues should be vertical wherever possible. A bend above the flue mouth may help to reduce splashes of rain and soot that may fall on the hearth but the angle of the bend should be no greater than 45° and preferably less than 30°. The inside surface of the bend should be smooth and there should be no reduction in the area of the flue at the bend (see 5.1.5.4).

There should be no more than two bends in the length of the flue.

NOTE The angles of bends have been redesignated using the method agreed in the International Organization for Standardization (ISO), i.e. the angle quoted is the angle through which the flow is diverted. Angles previously designated 135° and 150° are therefore now designated 45° and 30° (see Figure 3).

4.6 Openings into flues and communicating flues

4.6.1 No opening should be made into any flue in a masonry chimney except for:

- a) inspection or cleaning, where the opening is fitted with a non-combustible cover of double door construction; or
- b) a draught stabilizer, made from durable non-combustible material, fitted in the same room as the appliance.

4.6.2 No flue should communicate with more than one room or internal space except in the case of an opening as in **4.6.1** a).

4.6.3 A flue should serve only one appliance; therefore, where it is anticipated that more than one appliance will be used in a room, additional flues should be constructed.

4.7 Height and position of chimney outlets above roofs

4.7.1 General. The height and position of a chimney outlet above a roof should be designed to ensure dispersal of combustion products and minimize the risks of fire. The height and position of a chimney in its relation to the roof has a very important bearing on the proper functioning of the flue. Wind may affect the action of a flue in several ways. Wind pressure and suction are dependent not only upon the slope of the roof but also upon external influences, such as the shape of the building, land contours and the proximity of adjacent buildings and trees. A complete set of rules to cover every case, however, cannot be laid down for the correct positioning and height of chimneys. It should be recognized that, in general, chimney terminals should not be placed in high pressure regions. Ignoring external influences, Figure 4 shows typical pressure and suction zones or belts caused by wind around a building.

It will be seen from Figure 4(a) that the pressure on the windward slope of a roof of appreciably steeper pitch than 30° is greatest in the region marked Z. A flue outlet in this position is liable to cause smoke/fume emission at the appliance unless it is high enough to escape the high pressure region. It will be observed also that there is a suction or low pressure zone on the leeward side of the building. If an appliance connected to a flue is sited in a room that has windows or other openings into this zone, the possibility of smoke/fume emission at the appliance is increased. Figure 4 also shows the desirability with a steeply pitched roof, for a chimney outlet on the prevailing windward slope to be as near the ridge as possible to avoid the pressure zone. With a shallow pitched roof as shown in Figure 4(b), the position of the chimney is not of such great importance. Generally, as far as pressure on the windward side of a roof of approximately 30° pitch or less is concerned, the action of the wind on the flue performance may be ignored. A very shallow pitch will approximate to the conditions for flat roofs.

Figure 4(c) shows a flat-roofed building and illustrates that a suction zone is created on the roof. From this it will appear that a chimney through a flat roof will be immune from smoke/fume emission at the appliance. However, the suction created on the leeward side of any building may be greater than that on parts of the roof, and if a window or door is opened in a room on the leeward side, the suction through the room may cause smoke/fume emission. Figure 4(c) shows that the nearer the flue is to the leeward side as at position X, the greater is the risk of smoke/fume emission from this cause.

4.7.2 Fire precautions. It is important that the chimney terminates in a position where the vented products of combustion are neither a fire nor a health hazard.

4.7.3 Chimney terminal heights (excluding any flue terminal) (see Figure 5). For pitched roofs with no other influences from high trees or buildings or from land contours, etc. the optimum terminal point for a chimney is outside the pressure zones, which means above the ridge level [see Figure 4(a) and Figure 4(b)]. This will give the flue the best opportunity to function properly. If a chimney passes through, or within, a horizontal distance of 0.6 m from the ridge, it should terminate a minimum of 0.6 m above the ridge level.

A chimney with any part passing through the roof greater than 0.6 m from the ridge but no further than the 2.3 m, should terminate at a minimum height level with the ridge.