BRITISH STANDARD

BS 5803-4: 1985

Thermal insulation for use in pitched roof spaces in dwellings —

Part 4: Methods for determining flammability and resistance to smouldering

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Committees responsible for this British Standard

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Chartered Institution of Building Services

Consumer Standards Advisory Committee of BSI

Department of the Environment (Building Research Establishment, Fire Research Station)

Department of the Environment (Housing and Construction Industries)

Department of the Environment (Property Services Agency)

Eurisol (UK) (Association of Manufacturers of Mineral Fibre Insulation)

Greater London Council

Independent Waste Paper Processors' Association

Institution of Building Control Officers

National Association of Loft Insulation Contractors

National Council of Building Materials Producers

Royal Institute of British Architects

Thermal Insulation Manufacturers' Association

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Contents

Foreword

This Part of BS 5803, having been prepared under the direction of the Elements and Components (of Diverse Materials) for Buildings Standards Committee.

Existing British Standard methods of test for the reaction to fire of building materials cannot be applied to many types of loft insulating material which may consist of loose-fill granules, beads or fibres, laid on a horizontal surface. In the absence of a standard method of test suitable for assessing the susceptibility of the products to the propagation of smouldering from ignition sources either above or within the material, a new procedure has been developed.

This Part of this standard describes two tests:

a) a flammability test in which a small wooden crib is placed on the top surface of a specimen of insulation in a specified tray and ignited;

b) a smouldering resistance test in which a pre-heated metal cylinder is buried within a specimen of insulation in a specified tray.

The results obtained from the tests will apply only to igniting sources of severity similar to those described in the test procedure. Results cannot be directly extrapolated in an attempt to predict the behaviour of loft insulating materials with other ignition sources. These tests reflect the resistance of the sample to flaming or smouldering combustion.

BS 5803 comprises the following Parts.

— Part 1: *Specification for man-made mineral fibre thermal insulation mats;*

— Part 2: *Specification for man-made mineral fibre thermal insulation in pelleted or granular form for application by blowing;*

— Part 3: *Specification for cellulose fibre thermal insulation for application by blowing;*

— Part 4: *Methods for determining flammability and resistance to smouldering;*

— Part 5: *Specification for installation of man-made mineral fibre and cellulose fibre insulation.*

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 8, 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

This Part of BS 5803 describes methods of test for flammability and resistance to smouldering of thermal insulating materials, which may consist of loose-fill granules, beads or fibres, designed to be laid horizontally between joists in lofts of dwellings.

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

2 Flammability test

2.1 Principle

A specimen of conditioned insulation is inserted in a tray having a plasterboard base and wooden sides representing a typical configuration of joists and ceiling forming the base of a loft. A small wooden crib is placed on the surface and ignited, providing an intensity of heating of about 3.5 W/cm^2 under the crib and an average intensity of 0.3 W/cm^2 over an area of 7 500 mm^2.

Observations are made of the occurrence and duration of flaming and smouldering of the insulation outside the area covered by the crib and of the extent of spread of the combustion zone.

2.2 Apparatus

NOTE All dimensions are nominal unless tolerances are specified.

2.2.1 *Specimen holder,* in the form of a tray, constructed as shown in Figure 1 from softwood timber 100 mm × 50 mm and 50 mm × 50 mm in section and from plasterboard 12.5 mm thick. It shall have internal dimensions of 500 mm × 300 mm × 100 mm deep. A movable softwood timber cross-piece 300 mm × 100 mm × 50 mm shall be provided to span between the 500 mm × 100 mm × 50 mm timbers to give a 300 mm square × 100 mm deep tray.

2.2.2 *Crib ignition source,* constructed in accordance with Appendix A.

2.2.3 *Crib support,* consisting of a piece of wire mesh made from heat-resisting steel wire, about 0.5 mm diameter woven to an aperture width of about 1 mm, and cut about 45 mm square.

2.2.4 *Stop watch or clock,* capable of measuring to an accuracy of 1 s in 1 h.

2.3 Test environment

The test shall be carried out at a temperature of 23 ± 5 °C in a suitable draught free enclosure so that the operator is protected from decomposition products.

NOTE Where doubts exist about the harmful effects of such products then a physical separation of the test and operator may be necessary. Fan-assisted exhaustion of the products into the atmosphere is permissible only at the end of each test.

Easily accessible means of extinguishing combustion of the specimens shall be provided, e.g. fire blanket, extinguisher or water.

2.4 Conditioning of sample

Condition a sample of the material, sufficient to make at least five specimens 300 mm × 300 mm × 100 mm at the density described in **2.5.1**, in a ventilated oven controlled at a temperature of 40 ± 2 °C for 12 h. Either carry out the test between 2 h and 4 h after removal of the sample from the oven or transfer the material to polyethylene bags[1)]. Knot each bag and place it inside a second bag and knot the second bag also.

2.5 Procedure

2.5.1 Fill the specimen holder, with the movable cross-piece in position, to form a specimen 300 mm × 300 mm × 100 mm deep. Form each specimen at the density at which the R value (thermal resistance) for that material is determined and tested.

Carry out the test on five specimens.

2.5.2 Place the crib (**2.2.2**) centrally over the top surface of the specimen.

NOTE Where difficulty is experienced in supporting the crib on the surface because of the physical nature of the material, the wire mesh crib support (**2.2.3**) may be inserted between the crib base and the surface of the specimen.

Ignite the crib by applying a match or taper to the lint and start the timing device simultaneously. If any fire from the burning specimen develops rapidly, extinguish it immediately, and report the fact. Otherwise, retain the specimen in the holder until all smouldering and flaming ceases or until the combustion zone extends at any depth to within 25 mm of any part of the timber surround.

NOTE This requirement is included because, in some specimens, the combustion zone is obviously prevented from reaching the timber surround by the edge effects of the apparatus, e.g. shrinkage of the specimen, accumulation of flame-retardant salts at the edges of the specimen or thermal balance.

After combustion has ended, carefully pull away the surfaces of the specimen still in contact with the timber surround to enable any combustion that may have occurred below the surface of the specimen and reached the timber surround to be observed.

[1)] Bin liners are suitable.

Record the following observations for each of the five samples.

a) Information essential for assessment of compliance with the appropriate Parts of BS 5803, i.e. whether or not, after combustion has ceased, any part of the combustion zone has extended to within 25 mm of any part of the timber surround.

b) Additional information (where requested), times being measured from the start of the test to the nearest 5 s and distances to the nearest 5 mm:

1) the time to ignition of any part of the surface of the specimen;

2) if flaming of the specimen occurs and continues after flaming of the crib has ceased:

i) the heights of flames, estimated visually;

ii) the time at which flaming ceases if this is before the combustion zone extends to within 25 mm of any part of the timber surround;

iii) the time at which the flames first extend to within 25 mm of any part of the timber surround;

3) the time at which the combustion zone, either on the surface or at any depth, extends to within 25 mm of any part of the timber surround;

4) if, after combustion has ceased, no part of the combustion zone has reached to within 25 mm of any part of the timber surround, the extent of the spread of the combustion zone either at, or below the surface.

2.6 Test report

The test report shall include the following essential information:

a) name and address of testing laboratory;

b) name and address of sponsor of test;

c) date(s) of test(s);

d) identification and description of the material being tested;

e) details of the process used to condition the sample;

f) rate of application and density of the material in the specimens, based on the mass of the specimen before test;

g) type(s) of ignition source used;

h) ambient temperature at the time of testing;

i) records for each specimen, as stated in **2.5.2** a).

The test report shall also contain any additional information as described in **2.5.2** b) where requested.

3 Smouldering resistance test

3.1 Principle

A specimen of conditioned insulation is inserted in a tray similar to that used in **2.1** and containing a preheated metal cylinder. Observations are made of the duration of any flaming and smouldering of the insulation and of the extent of spread of the combustion zone.

3.2 Apparatus

NOTE All dimensions are nominal unless tolerances are specified.

3.2.1 *Specimen holder,* in the form of a tray, constructed as shown in Figure 1 from softwood timber 100 mm × 50 mm and 50 mm × 50 mm in section and from plasterboard 12.5 mm thick. It shall have internal dimensions of 500 mm × 300 mm × 100 deep. A movable softwood timber cross-piece 300 mm × 100 mm × 50 mm shall be provided to span between the 500 mm × 100 mm × 50 mm timbers to give a 300 mm × 375 mm × 100 mm deep tray.

3.2.2 *Ignition source,* consisting of a stainless steel cylinder, as shown in Figure 2, having a diameter of 50 mm and a height of 50 mm. A 2 mm diameter hole is drilled in the top of the cylinder at a position 15 mm from its centre line and to a depth of 25 mm. The centre of the top of the cylinder is also drilled and tapped to a depth of 15 mm to accommodate an 8 mm diameter stainless steel bolt set so as to leave a clearance of 10 mm between the top of the cylinder and the upper side of the bolt head.

The overall height of the cylinder with its fitted bolt shall be 60 ± 1 mm and the total mass shall be 800 ± 5 g.

Two squares of mineral fibre insulating board 75 mm × 75 mm × 12 mm shall be stacked to provide a 24 mm thick support for the stainless steel cylinder during the test.

3.2.3 *Cylinder heater and temperature indicator.* The heater shall be capable of raising the smouldering ignition cylinder to 500 °C.

NOTE This may be an electrically heated muffle furnace or an open gas-fired burner (boosted, if necessary, by the use of a hand-held gas-fired blow lamp).

A thermo-electric temperature indicating device capable of being read at 445 °C to within 0.5 °C shall be fitted with a metal sheathed thermocouple suitable for use at temperatures up to 500 °C and for insertion in the 2 mm diameter hole in the stainless steel cylinder. The device shall be transportable or so positioned that the cylinder with a thermo-couple inserted may be transferred from the heater to the specimen holder located in its draught-free testing enclosure (see **3.3**).

3.2.4 *Stop watch or clock,* complying with **2.2.4**.

3.3 Test environment

The test shall be carried out in an environment complying with **2.3**.

3.4 Conditioning of sample

Condition a sample of the material, sufficient to make at least five specimens 300 mm × 375 mm × 100 mm at the density described in **3.5.1**, in a ventilated oven controlled at a temperature of 40 ± 2 °C for 12 h. Either carry out the tests between 2 h and 4 h after removal of the sample from the oven or transfer the material to polyethylene bags[2)]. Knot each bag and place it inside a second bag and knot the second bag also.

3.5 Procedure

3.5.1 Weigh out a specimen of the material sufficient to fill the specimen holder, to form a specimen 300 mm × 375 mm × 100 mm deep at the density at which the *R* value (thermal resistance) for that material is determined and tested.

Carry out the test on five specimens.

NOTE If it is necessary to repeat the test a further five specimens will be required.

3.5.2 With the movable cross-piece in position, stack the two squares of mineral fibre insulating board uniformly on the floor of the specimen holder so that their centres are 150 mm away from each of the three fixed sides and 225 mm from the movable cross-piece.

Heat the stainless steel cylinder, fitted with its thermocouple (**3.2.3**) until the temperature is approximately 500 °C. Transfer the cylinder, using tongs and without dislodging the thermocouple, and re-position it centrally on the stacked mineral fibre insulating boards to commence cooling.

When the temperature indicating device shows that the cylinder has cooled to 445 $^{+1}_{-0}$ °C, immediately pour approximately half of the pre-weighed specimen of conditioned test material gently over it. Immediately remove the thermocouple and start the timing device. Pour the remainder of the specimen gently into unfilled areas of the specimen holder and bring the whole to a substantially even surcharge above the timbers by flicking material about, as necessary, with the finger tips. Evenly compress the surcharge using a piece of flat material fully spanning the specimen holder, such that the specimen is finally of uniform density and exactly filling the specimen holder. Then bring the test environment into compliance with **3.3**.

If any fire from the burning specimen develops rapidly, extinguish it immediately and report the fact. Otherwise, allow the test to continue until all smouldering and flaming cease or until the combustion zone on the surface of the specimen is seen to extend on the surface beyond a line 150 mm from the centre line of the cylindrical ignition source, at which time the combustion may be extinguished. After combustion has ended, withdraw the movable cross-piece from the specimen holder and progressively and carefully remove the exposed end of the test material until charred remains are first detected (usually at about mid-depth).

In the event of one only of the set of five specimens giving a char length exceeding 150 mm from the centre line of the cylindrical source, test a further set of five specimens.

Record the following observations for each of the five specimens.

a) Information essential for assessment of compliance with the appropriate Part of BS 5803,

1) whether or not, after combustion has ceased, smouldering (as indicated by black char) or flaming combustion extended to more than 150 mm from the centre line of the cylindrical ignition source.

2) whether one or two sets of specimens were tested.

b) Additional information (where requested), times being measured from the start of the test to the nearest minute and distances to the nearest 5 mm:

1) the times at which any flaming starts and finishes;

[2)] Bin liners are suitable.

2) the time at which the combustion zone is seen to extend on the surface beyond a line 150 mm from the centre of the cylindrical ignition source;

3) the maximum distance, determined when combustion ceases, to which smouldering extended, at any depth, from the centre line of the cylindrical ignition source.

3.6 Test report

The test report shall include the following essential information:

a) name and address of testing laboratory;

b) name and address of sponsor of test;

c) date(s) of tests(s);

d) identification and description of the material being tested;

e) details of the process used to condition the sample;

f) rate of application and density of the material in the specimens, based on the mass of the specimen before test;

g) type(s) of ignition source used;

h) ambient temperature at the time of testing;

i) records for each specimen, as stated in **3.5.2** a) for the first (and if necessary the second) set of specimens.

The test report shall also contain any additional information as described in **3.5.2** b) where requested.

Appendix A Crib ignition source

NOTE This source is identical with crib ignition source 4 described in BS 5852-2.

A.1 Test materials

The following materials shall be used for the construction of the crib:

a) seasoned planks of the softwood *Pinus silvestris,* which have been stored in warm dry conditions for a minimum of one week;

b) BPC grade absorbent surgical lint, mass approximately 200 g/m^2, which is cut into squares 40 mm × 40 mm (each square having a mass of approximately 0.3 g);

c) polyvinyl acetate (PVS) or other suitable wood adhesive for glueing together the sticks and lint;

d) propan-2-ol (1.4 ± 0.1 mL per crib);

e) graduated glass syringe or other suitable measuring instrument capable of measuring 1.4 ± 0.1 mL of propan-2-ol.

A.2 Assembly of the crib

The crib parameters shall be as given in Table 1.

NOTE The crib is illustrated in Figure 3 and a suggested method of construction is as follows.

Glue together eight sticks to form the main crib body. Stick one square of lint across the crib square section and then glue on the remaining two sticks to form the base (see Figure 3).

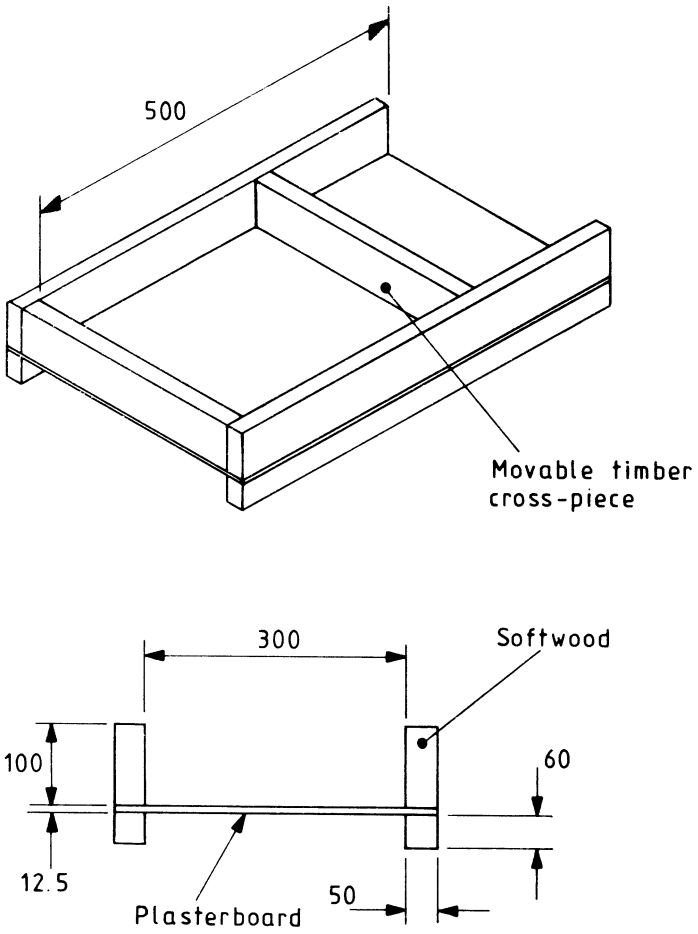
The required number and sizes of sticks, conditioned as specified in **A.3**, having the required total mass, are selected and assembled into cribs with the square of lint incorporated, fluffy side uppermost when the crib is standing on its base. The sticks in each layer are parallel to one another and at right angles to the sticks in the adjacent layer. The sticks in each layer are placed as far away from each other as possible, but without undue overhang at their ends, to form a square-sectioned crib. The sticks are glued together and the lint secured with small amounts of the adhesive.

Table 1 — Parameters of crib ignition source 4

Parameter	
Stick length	40 ± 2 mm
Stick square section	6.5 ± 0.5 mm
No. of sticks	10
Total mass of sticks	8.5 ± 0.5 g
No. of layers each of two sticks	5
Approximate lint dimensions	40 mm × 40 mm

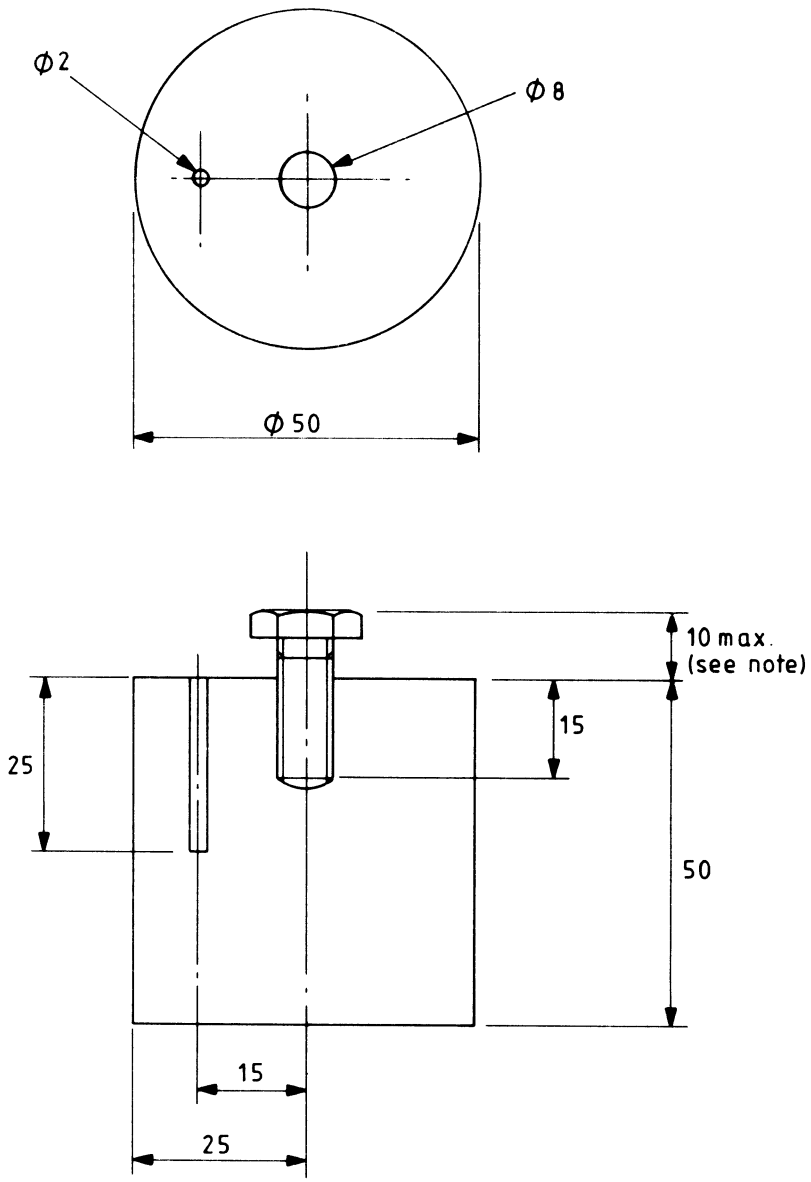
A.3 Conditioning

The sticks and the cribs shall be conditioned before the test for 72 h in indoor ambient conditions and then immediately before the test for at least 16 h in an atmosphere having a temperature of 20 ± 5 °C and a relative humidity of 50 ± 20 %.



All dimensions are in millimetres.

Figure 1 — Sample holder



Material: stainless steel

All dimensions are in millimetres.

NOTE The upper surface of the bolt is to be not more than 10 mm above the cylinder.

Figure 2 — Cylinder

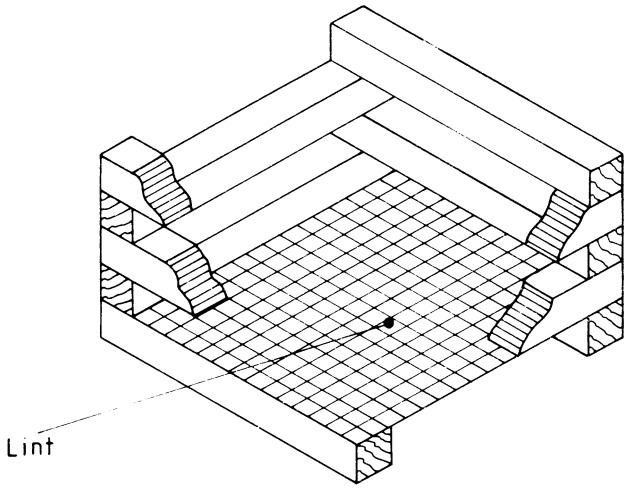


Figure 3 — Crib

Publications referred to

BS 5803, *Thermal insulation for use in pitched roof spaces in dwellings.*

BS 5803-1, *Specification for man-made mineral fibre thermal insulation mats.*

BS 5803-2, *Specification for man-made mineral fibre thermal insulation in pelleted or granular form for application by blowing.*

BS 5803-3, *Specification for cellulose fibre thermal insulation for application by blowing.*

BS 5803-5, *Specification for installation of man-made mineral fibre and cellulose fibre insulation.*

BS 5852, *Fire tests for furniture.*

BS 5852-2, *Methods of test for the ignitability of upholstered composites for seating by flaming sources.*

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