

Fire tests on building materials and structures –

Part 6: Method of test for fire propagation for products

ICS 13.220.50

Committees responsible for this British Standard

The preparation of this British Standard was entrusted by the Fire Standards Policy Committee (FSM/-) to Technical Committee FSM/1, upon which the following bodies were represented:

Association of British Roofing Felt Manufacturers	Electricity Supply Industry in England and Wales
Association of Building Component Manufacturers Ltd.	Engineering Equipment and Materials Users' Association
Association of Structural Fire Protection Contractors and Manufacturers	Eurisol (UK) Association of Manufacturers of Mineral Insulation Fibres
British Cement Association	Fibre Building Board Organisation (FIDOR)
British Fire Services Association	Fibre Cement Manufacturers' Association Limited
British Floor Covering Manufacturers' Association	Fire Protection Association
British Plastics Federation	Flat Glass Manufacturers' Association
British Railways Board	Flat Roofing Contractors Advisory Board
British Rigid Urethane Foam Manufacturers' Association	Gypsum Products Development Association
British Wood Preserving Association	Home Office
Chemical Industries Association	Institution of Fire Engineers
Chief and Assistant Chief Fire Officers Association	Loss Prevention Council
Concrete Society	Mastic Asphalt Council and Employers' Federation
Department of Education and Science	National Council of Building Materials Producers
Department of the Environment (Building Research Establishment)	RAPRA Technology Ltd.
Department of the Environment (Construction Industries Directorate)	Royal Institute of British Architects
Department of the Environment (Property Services Agency)	Steel Construction Institute
Department of the Environment for Northern Ireland	Timber Research and Development Association
Department of Transport (Marine Directorate)	United Kingdom Atomic Energy Authority
	Warrington Fire Research Centre
	Wood Wool Slab Manufacturers' Association
	Yarsley Technical Centre Ltd.

The following bodies were also represented in the drafting of the standard, through subcommittees and panels:

Autoclaved Aerated Concrete Products Association	Phenolic Foam Manufacturers' Association
London Scientific Services	Queen Mary College Industrial Research
National GRP Construction Federation	Thermal Insulation Manufacturers and Suppliers Association (TIMSA)

This British Standard, having been prepared under the direction of the Fire Standards Policy Committee, was published under the authority of the Board of BSI

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Contents

	Page
Committees responsible	Inside front cover
Foreword	ii
1 Scope	1
2 Definitions	1
3 Suitability of a product for testing	1
4 Test specimens	1
5 Test apparatus	2
6 Ancillary equipment	3
7 Setting up procedure	3
8 Calibration	4
9 Test procedure	5
10 Calculation of results	6
11 Test report	6
Appendix A Guidance for operators	13
Appendix B Effect of thermal characteristics on the performance of assemblies	14
Appendix C Determination of dry density of calibration sheet	14
Figure 1 — Diagrammatic representation of the apparatus: front	8
Figure 2 — Diagrammatic representation of the apparatus: rear	9
Figure 3 — Thermocouple locating device	10
Figure 4 — Layout of apparatus and ancillary equipment	11
Figure 5 — Typical calibration curve	12
Table 1 — Allowable limits for calibration	5
Publications referred to	Inside back cover

Foreword

This part of BS 476 is published by BSI Standards Limited, under licence from The British Standards Institution.

This standard has been superseded by the current BS EN 13823, but it has been retained based on legitimate need for the standards within non-EU markets.

This Part of BS 476 has been revised under the direction of the Fire Standards Policy Committee primarily to specify a replacement calibration sheet because of problems of availability of the sheet currently specified. Experience with a wide range of materials has indicated that the non-combustible material now specified should not produce test results which are more onerous.

Text deleted

Consideration was also given to the fuel gas and, in order to improve a difficult supply situation, a standard test gas has been specified. Generally, the derived indices will not vary as a result of using this gas. Engineering drawings for the apparatus are published as PD 6498.

The summary test report formerly included in BS 476-6 has been deleted.

In this method of test, a specimen of the product (material, composite or assembly) is subjected to a specific heating regime. The test takes account of the combined effect of factors such as the ignition characteristics, the amount and the rate of heat release, and the thermal properties of the product in relation to their ability to accelerate the rate of fire growth. The test result is expressed in terms of a fire propagation index that is the summation of three time-based subindices. The higher the fire propagation index, the greater is the influence of the product on accelerating the growth of a fire. The method of computation of the subindices ensures that greater significance is placed on those factors affecting the early stages of the test compared with those affecting the later stages.

Whilst this test has been designed to give information on the performance of a product in the early stages of a fire, it should not be considered or used by itself for describing or appraising the fire hazard of a material, composite or assembly under actual fire conditions or as the sole source on which a valid assessment of hazard pertaining to fire propagation can be based.

Text deleted

Attention is drawn to the Health & Safety at Work etc. Act 1974, and the need to ensure that the method of test specified in this standard is carried out under suitable environmental conditions to provide adequate protection to personnel against the risk of fire, inhalation of smoke and/or toxic products of combustion.

Text deleted

The start and finish of text introduced or altered by Amendment No. 1 is indicated in the text by tags **Text added** **Text deleted**. Minor editorial changes are not tagged. BS 476-6:1989+A1:2009 supersedes BS 476-6:1989 which is withdrawn. However, the 1981 edition, which has also been withdrawn, will still be made available on request since it is referred to in building regulations.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a British Standard cannot 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 14, 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 476 specifies a method of test, the result being expressed as a fire propagation index, that provides a comparative measure of the contribution to the growth of fire made by an essentially flat material, composite or assembly. It is primarily intended for the assessment of the performance of internal wall and ceiling linings.

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

2 Definitions

For the purposes of this Part of BS 476, the definitions given in BS 4422-1, BS 4422-2 and BS 4422-5 and BS 476-10 apply, together with the following.

2.1

assembly

a fabrication of materials and/or composites that can contain air gaps

2.2

composite

a combination of materials which are generally recognized in building construction as discrete entities, e.g. coated or laminated materials

2.3

exposed surface(s)

the surface(s) of the product subjected to the heating conditions of the test

2.4

essentially flat surface

a surface from which can be obtained specimens that have an irregularity from a flat plane which is less than ± 3 mm

3 Suitability of a product for testing

3.1 Surface characteristics

3.1.1 A product having one of the following is suitable for evaluation by this method:

- a) an essentially flat exposed surface;
- b) a surface irregularity that is evenly distributed over the exposed surface (see A.1) provided that:
 - 1) at least 50 % of the surface of a representative square area of $225 \text{ mm} \times 225 \text{ mm}$ lies within a depth of 6 mm from a plane taken across the highest points on the exposed surface;
 - 2) any cracks, fissures or holes do not exceed 6.5 mm in width nor 10 mm in depth, and the total area of such cracks fissures or holes at the surface does not exceed 30 % of a representative square area of $225 \text{ mm} \times 225 \text{ mm}$ of the exposed surface.

3.1.2 When an exposed surface does not comply with the requirements of either 3.1.1 a) or 3.1.1 b) it is permissible for the product to be tested in a modified form with a flat exposed surface; this shall be stated in the test report.

3.2 Asymmetrical products

A product submitted for this test could have faces that differ or could contain laminations of different materials arranged in a different order in relation to the two faces. If either of these faces can be exposed in use within a room, cavity or void, then both faces shall be tested.

3.3 Products with particular burning characteristics

This method of test could be inadequate for assessing products that react in particular ways under exposure to the specified heating conditions (see 9.2). In this case provision is either made to apply a suffix to the result [see 10.4.2 and clause 11 g)], or prohibit an assessment being made because the product is unsuitable for testing by this method (see 10.4.3).

NOTE Products showing these characteristics should be assessed by other test methods.

4 Test specimens

4.1 Number of specimens

The test sample shall comprise a minimum of three and a maximum of five specimens for each face to be tested.

4.2 Size of specimens

NOTE Specific advice on the testing of assemblies is given in A.2 and appendix B.

4.2.1 The specimens shall be square, with sides 225 ± 1.5 mm long.

4.2.2 Products of normal thickness 50 mm or less shall be used to full thickness.

4.2.3 For products of normal thickness greater than 50 mm, the specimens shall be obtained by cutting away the unexposed face of the product to reduce the thickness to 50^{+0}_{-3} mm.

4.3 Edge effects

Where the specimen is backed by an air gap (see appendix B), ensure that the perimeter of the specimen will not permit flame to penetrate into the cavity. Similarly, where a flame-retardant coating is applied to a surface, the edge detail shall be such as to prevent ignition of the underlying layers.

4.4 Conditioning of specimens

All specimens shall be conditioned to constant mass (see A.3) at a temperature of 23 ± 2 °C and a relative humidity of 50 ± 5 %, and maintained in this condition until required for testing.

NOTE Constant mass is considered to be attained when two successive weighing operations, carried out at an interval of 24 h, do not differ by more than 0.1 % of the mass of the specimen, or 0.1 g, whichever is the greater.

5 Test apparatus

5.1 General

5.1.1 All dimensions given in the following description of the test apparatus are nominal unless tolerances are specified.

5.1.2 The test apparatus (see Figure 1 to Figure 3) shall consist of a combustion chamber with a specimen holder fixed to one face. The combustion chamber shall contain a horizontal gas burner tube and two electrical heating elements and shall be surmounted by a removable steel chimney and cowl.

5.2 Combustion chamber

Ⓐ The walls of the chamber shall be made from 12 mm thick calcium silicate board having a nominal dry density of 1 400 kg/m³. The calcium silicate shall also have the following properties:

Properties	Value
Flexural strength	23 MPa
Hardness	80 Shore D
Maximum service temperature	1 000 °C
Thermal conductivity	0.49 W/(m·K)
Shrinkage (750 °C for 12 h)	0.14 % – 1.1 %
Coefficient thermal expansion	6.6×10^{-6}

The internal dimensions of the chamber shall be 190 mm × 190 mm × 90 mm. Ⓐ

An air inlet slot measuring 96 mm × 25 mm and a mica observation window measuring 50 mm × 50 mm shall be provided together with a hole for the discharge of combustion gases and a suitable fixing for the chimney and cowl. A steel baffle plate 200 mm × 40 mm shall be fixed horizontally to the top of the combustion chamber above the window. Four steel rods shall be fitted to the combustion chamber to enable the specimen holder to be located and fixed firmly in position during each test.

5.3 Specimen holder

Ⓐ The specimen holder shall be made from calcium silicate board having the same dry density and properties as that of the walls of the combustion chamber (see 5.2). The holder shall be recessed to take a specimen of area 225 mm × 225 mm and a recess depth of 12.5 mm, 25 mm or 50 mm,

depending upon the thickness of the specimen to be tested. Ⓐ

5.4 Gasket

A non-combustible compressible gasket, 1 mm thick, shall be provided for interposing between the specimen holder and the combustion chamber to assist in obtaining an adequate seal (see A.2).

5.5 Chimney and cowl

The chimney shall be 190 mm long and 38 mm internal diameter and made of 1.0 mm thick steel. It shall be provided with a removable steel cowl also made of 1.0 mm thick steel 152 mm high and 76 mm internal diameter having two diametrically opposite bushed circular holes to take the thermocouples and their locating devices as specified in Figure 3. The chimney and cowl shall have a surface of low reflectivity and shall have an overall mass in the range of 530 g to 550 g (see A.4.3).

5.6 Gas burner

The gas burner shall comprise a horizontal stainless steel tube of wall thickness 1.5 mm and 9 mm bore closed at each end and fitted with a central gas supply pipe. The burner tube shall have a row of 14 holes of 1.5 mm diameter at 12.5 mm centres arranged so that the gas jets impinge horizontally on the specimen 25 mm above the floor of the combustion chamber. When the calibration sheet (see 8.1) is in position, the holes in the tube shall

be ${}^{+1}_{-0}$ mm from the face of the calibration sheet.

5.7 Electric heating elements

The two heating elements shall be pencil type electric elements¹⁾, each of 1 000 W rating and of 16 mm maximum diameter, and the heating coil shall be 190 mm in length with a pitch of approximately 1 turn per millimetre. The elements shall be supported horizontally with their centres at a distance of 45 mm from the face of the specimen and arranged at 64 mm vertical centres symmetrically in the combustion chamber.

Each heating element shall be enclosed in a transparent silica tube 17 ± 1 mm internal diameter, having a wall thickness of 1.1 ± 0.25 mm and a length of 210 ± 2 mm.

The heating elements shall be connected in parallel with copper busbars and the end terminals shall be protected with suitable guards that, if made of metal, shall be effectively earthed. The framework of the apparatus, including the chimney and the cowl, shall be earthed.

¹⁾ A commercial electric fire element with a 229 mm fixing centre is generally suitable.