

# Fire tests on building materials and structures —

## Part 12: Method of test for ignitability of products by direct flame impingement

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                       | Department of Transport (Marine Directorate)           |
| Association of Building Component Manufacturers                         | Engineering Equipment and Materials Users' Association |
| Association of Structural Fire Protection Contractors and Manufacturers | Eurisol (UK) Mineral Wool Association                  |
| British Cement Association                                              | Fibre Building Board Organisation (FIDOR)              |
| British Fire Services' Association                                      | Fibre Cement Manufacturers' Association Limited        |
| British Floor Covering Manufacturers' Association                       | Flat Glass Manufacturers' Association                  |
| British Plastics Federation                                             | Flat Roofing Contractors' Advisory Board               |
| British Railways Board                                                  | Gypsum Products Development Association                |
| British Rigid Urethane Foam Manufacturers' Association                  | Home Office                                            |
| British Wood Preserving and Damp-proofing Association                   | Institution of Fire Engineers                          |
| Chemical Industries' Association                                        | London Fire and Civil Defence Authority                |
| 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 Material Producers        |
| Department of the Environment (Building Research Establishment)         | National GRP Construction Federation                   |
| Department of the Environment (Construction Directorate)                | National House-building Council                        |
| Department of the Environment (Property Services Agency)                | RAPRA Technology Ltd.                                  |
| Department of the Environment for Northern Ireland                      | Royal Institute of British Architects                  |
|                                                                         | Steel Construction Institute                           |
|                                                                         | Timber Research and Development Association            |
|                                                                         | United Kingdom Atomic Energy Authority                 |
|                                                                         | Warrington Fire Research Centre                        |
|                                                                         | Wood Wool Slab Manufacturers' Association              |

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

|                                                  |                                                                      |
|--------------------------------------------------|----------------------------------------------------------------------|
| Autoclaved Aerated Concrete Products Association | Polyethylene Foam Insulation Association                             |
| British Carpet Manufacturers' Association Ltd.   | Queen Mary College                                                   |
| British Steel Industry                           | Suspended Ceilings Association                                       |
| GAMBICA (BEAMA Ltd.)                             | Thermal Insulation Manufacturers' and Suppliers' Association (TIMSA) |
| Phenolic Foam Manufacturers' Association         | Yarsley Technical Centre Ltd.                                        |

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## 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 ISO 11925-2, but it has been retained based on legitimate need for the standards within non-EU markets.

This Part of BS 476 has been prepared under the direction of the Fire Standards Policy Committee.

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. Neither should it be used as the sole source on which a valid assessment of hazard pertaining to ignitability can be based. A series of second generation “reaction to fire” tests are under preparation in ISO/TC 92, Fire tests on building materials, components and structures. The United Kingdom is participating in this work, and it is intended to offer this test for consideration.

This Part of BS 476 has been produced in response to the perceived need for tests which will assess the response of building materials and products to any of a range of primary sources. The test regime does not involve the imposition on the test specimen of any irradiation other than that from the ignition source.

Although the sources specified in the test have been chosen to represent the heating characteristics of a number of statistically important real-life ignition sources, such as a match flame or electrical sources, they are all flame sources, some diffusion, some pre-mixed. These flame sources are matched, as far as practicable, in terms of intensity and area of heating and together represent a range of both characteristics. In the long term, specifiers may lay down requirements related to particular levels rather than requiring all tests to be carried out. This may require the provision of rules for re-testing if the results of testing differ for each specimen. An example of such rules is given in appendix B. The method has been subjected to a wide ranging interlaboratory trial involving six laboratories and 26 different materials.

Attention is drawn to the Health and 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 and inhalation of smoke and/or toxic products of combustion.

Appendix A gives a recommended form of result sheet.

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 describes a method of test for the determination of the ignitability of materials, composites and assemblies subjected to direct impingement of flames of different size and intensity but without impressed irradiance.

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 following definitions apply.

### 2.1

#### sustained ignition

after withdrawal of the ignition source, the presence of a flame on the surface of the specimen that persists for at least 10 s

### 2.2

#### transient ignition

after withdrawal of the ignition source, the appearance of flashes, or flames, which are not sustained for a continuous 10 s

### 2.3

#### progressive smouldering

an exothermic oxidation not accompanied by flaming which is self-propagating, i.e. independent of the ignition source, and may be accompanied by incandescence

### 2.4

#### flaming debris

matter flowing or separating from the specimen during the test procedure and falling below the initial lower edge of the specimen and continuing to flame as it falls

### 2.5

#### afterflame

persistence of flaming of a specimen, under specified test conditions, after the ignition source has been removed

### 2.6

#### afterglow

persistence of glowing of a specimen, under specified test conditions, after cessation of flaming or, if no flaming occurs, after removal of the ignition source

### 2.7

#### flame application time

the time (in seconds) for which the burner is in its final testing position

### 2.8

#### constant mass

the state of a test specimen 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

## 3 Principle

Vertically held specimens are exposed to specified flames of different sizes and intensities and their ignition behaviour is observed. The flame is applied to the surface and/or a bottom edge on different specimens.

## 4 Safety considerations

There are hazards with these tests and it is essential that adequate precautions are taken. Particular attention should be paid to: the handling of flammable gases; the evolution of potentially toxic gases; and the fact that extensive flaming of specimens may occur.

Between tests, the atmosphere of the testing room (see 5.1) should be cleared of smoke and toxic gases by an extractor fan or other means of ventilation. The required atmosphere for testing should be restored.

Adequate means of extinguishing the specimen should be provided, bearing in mind that some specimens may produce severe flaming during the test. A hand and/or fixed water spray which can be directed over the burning area should be available with other means, such as fire extinguishers (see BS 5423) and fire blankets (see BS 6575).

NOTE In some cases, smouldering may be difficult to extinguish completely and immersion in water may be necessary.

## 5 Apparatus

**5.1 Testing room.** A room equipped with an extractor fan or other means of ventilation and capable of providing a substantially drought-free environment at between 10 °C and 30 °C and a relative humidity of  $50 \pm 20$  %.

NOTE 1 It is recommended that the testing room be divided into two parts, the inner part for carrying out the tests and easily viewed from the outer part in which control equipment would be situated.

NOTE 2 It has been found that a partially darkened room assists with the perception of small surface flames.

For ignition sources D, E, F and G, either a testing room with a minimum volume of 20 m<sup>3</sup> is required, or alternatively, a smaller enclosure with a through flow of air. If the latter is used it shall be equipped with inlet and extraction systems with air flow rates between 0.02 m/s and 0.2 m/s in the locality of the test specimen.

These limits provide adequate oxygen without disturbing the burning behaviour.

NOTE 3 Testing with ignition sources A, B and C may be carried out in either of these environments, or in a suitably ventilated fume cupboard.

**5.2 Propane supply and regulation.** A supply of commercial propane complying with BS 4250-1 connected to the ignition sources by the following.

- a) A cylinder regulator complying with BS 3016 with an outlet pressure of 1 bar<sup>1)</sup> absolute.
- b) An appropriate length of 5 mm internal diameter high pressure hose to BS 3212.
- c) Two flowmeters with integral needle valves and accuracies of  $\pm 0.25\%$ , with flow ranges covering 25 mL/min to 160 mL/min and 1 L/min to 10 L/min, connected to a common manifold top and bottom to allow measurement with either meter.
- d) A length of 5 mm internal diameter hose not greater than 3.0 m in length to connect the flowmeters to the burner carriage via a gas cock mounted on the carriage.
- e) A burner carriage consisting of a movable column which incorporates a 10 mm OD  $\times$  1 mm wall stainless steel tube terminated by a threaded boss to which the various burners can be fixed (see Figure 1).

NOTE Some difficulties have been reported with the supply and measurement of the propane particularly where the propane cylinder has, of necessity, to be stored in an environment cooler than the defined test conditions and/or some distance from the test rig. In these cases, and other situations where difficulties occur, it is important that there is a sufficient length of tubing inside the controlled environment (10 °C to 30 °C) to ensure that the propane equilibrates to the required temperature before flow measurement. One way to assist this is to pass the propane (before flow measurement) through a metal tube immersed in water maintained at 25 °C.

Great care also needs to be exercised with the measurement and setting of the flow rate of the propane. Direct reading flow meters, even those obtained with a direct propane calibration, need to be checked when initially installed, and also at regular intervals during testing, with a method capable of measuring accurately the absolute propane flow at the burner tube. One way of doing this is to connect the burner tube with a short length of tubing (about 7 mm internal diameter) to a soap bubble flowmeter, such that the upward passage of a soap film meniscus in a glass tube of calibrated volume (e.g. a burette) over a known period of time gives an absolute measurement of the flow. Fine control valves which can each be preset to one of the desired propane flow rates, with simple switching means from one to the other, have also proved helpful.

### 5.3 Ignition sources

**5.3.1 Ignition source A.** A burner consisting of a stainless steel tube with a bore of  $0.5 \pm 0.1$  mm and with a minimum length of 35 mm.

NOTE 1 A hypodermic syringe, with the tapered end cut off square and cleanly, has been found suitable.

The flowmeter shall be calibrated to supply a propane gas flow rate at 25 °C of  $25 \pm 2$  mL/min.

NOTE 2 Under these conditions the flame height is approximately 12 mm. The ignition source is similar to those specified in BS 415 and BS 6458-2.2.

**5.3.2 Ignition source B.** A burner tube consisting of a length of stainless steel tube ( $8.0 \pm 0.1$  mm outside diameter,  $6.5 \pm 0.1$  mm internal diameter and  $200 \pm 5$  mm in length). The flowmeter shall be calibrated to supply a propane gas flow rate at 25 °C of  $45 \pm 2$  mL/min.

NOTE Under these conditions the flame height is approximately 35 mm. This ignition source corresponds approximately to that specified as butane flame ignition source 1 in BS 5852.

**5.3.3 Ignition source C.** A burner tube consisting of a length of stainless steel tube ( $8.0 \pm 0.1$  mm outside diameter,  $6.5 \pm 0.1$  mm internal diameter and  $200 \pm 5$  mm in length). The flowmeter shall be calibrated to supply a propane gas flow rate at 25 °C of  $160 \pm 5$  mL/min.

NOTE Under these conditions the flame height is approximately 120 mm. This ignition source corresponds approximately to that specified as butane flame ignition source 2 in BS 5852.

**5.3.4 Ignition source D.** A gas burner comprising a 185 mm long horizontal stainless steel tube (12.0 mm outside diameter, 9.0 mm inside diameter) 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 issue at an angle of 45° below the horizontal (see Figure 2). The flowmeter shall be calibrated to supply a propane gas flow rate at 25 °C of 2 L/min.

NOTE Under these conditions the flame height is approximately 240 mm. This burner corresponds approximately to the manifold specified in BS 476-6.

**5.3.5 Ignition source E.** A gas burner comprising a 185 mm long horizontal stainless steel tube (12.0 mm outside diameter, 9.0 mm inside diameter) 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 issue at an angle of 45° below the horizontal (see Figure 2). The flowmeter shall be calibrated to supply a propane gas flow rate at 25 °C of 10 L/min.

NOTE Under these conditions the flame height is approximately 780 mm. This burner corresponds approximately to the manifold specified in BS 476-6.

<sup>1)</sup> 1 bar =  $10^5$  N/m<sup>2</sup> =  $10^5$  Pa.