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FIRE TESTS
ON BUILDING MATERIALS AND STRUCTURES

Withdrawn

OBSOLETE

BRITISH STANDARDS INSTITUTION

BRITISH STANDARD SPECIFICATION

FIRE TESTS
ON BUILDING MATERIALS AND STRUCTURES

B.S. 476 : 1953

Price 4/- net

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The Institution desires to call attention to the fact that this British Standard does not purport to include all the necessary provisions of a contract.

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The Committee responsible for the preparation of this British Standard consists of representatives from the following Government departments and scientific and industrial organizations:—

British Constructional Steelwork Association
British Electrical and Allied Industries Research Association
British Fire Services' Association
Building Industries National Council
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National Federation of Building Trades Employers
Reinforced Concrete Association
Royal Institute of British Architects

BRITISH STANDARD SPECIFICATION FOR

FIRE TESTS ON BUILDING MATERIALS AND STRUCTURES

FOREWORD

The purpose of this British Standard is to specify a series of tests for determining those properties of building materials and structures which are relevant when considering the fire protection of buildings in which they are to be used, and by which such materials and structures may be accepted or rejected.

Combustibility. It is desirable that the materials used in building construction should not contribute to the intensity of a fire. Materials for building purposes may be classified as non-combustible or combustible according to how they behave when subjected to the combustibility test specified in Section One.

Surface spread of flame. To require non-combustibility in all circumstances would be unreasonably severe and unnecessarily restrictive. It is often sufficient to require that materials should not be readily ignitable and, if ignited, that their tendency to spread flame be limited. The surface spread of flame test in Section Two may be used to classify combustible wall and ceiling lining materials according to the fire hazard they are likely to present in becoming ignited and spreading flame over their surfaces from one part of a building to another. This test may also be used to show the effectiveness of flame-retardant treatments in reducing the surface spread of flame on lining materials.

Fire-resistance of structures. Where a fire occurs in a compartment of a building, the structure of the compartment should be required to contain the fire by continuing to perform those of its normal functions which contribute to the integrity and insulation of the compartment. The fire-resistance test of Section Three grades elements of building structures in accordance with the time for which they are capable of fulfilling these functions while subjected to heating conditions representative of an actual fire in a compartment. Although the term ' fire-resistance ' has often been used indiscriminately in the past to denote the resistance of materials to ignition or spread of flame, the use of the term in this standard is restricted to the performance of complete elements of building structure without individual regard to the performance of the materials of which they are composed. Materials which perform well in the combustibility or surface spread of flame tests may not necessarily do so when built into an element of structure and subjected to the fire-resistance test.

Consideration is being given to the substitution of the term ' fire endurance ' for the term ' fire resistance ' as used in this British Standard, as it is felt in some quarters that the former term is more appropriate for the purposes of the tests.

Alterations to the standard. In the present revision of the standard some major alterations have been made, as follows:—

The non-inflammability test has been deleted. This test was sometimes found to give anomalous results. It was mostly applied to fabrics and decorative materials, for which purpose it was considered that a test similar to that given in B.S. 1547, ' Flameproof industrial clothing ' would be more satisfactory.

In the combustibility test, the specimen is not introduced into the furnace until the temperature of the latter has been stabilized at 750°C., to ensure that the rate of efflux of any combustible gases given off is sufficiently rapid to give the optimum chance of ignition at the pilot flame.

The method of classification of materials in the surface spread of flame test has been amended. In the last edition of B.S. 476, the classification of a material rested on the mean spread of a certain number of specimens. While mean spread gives a measure of the general standard of performance of a material, it does not take account of the variability which is known to occur in the performance of different samples of most materials. The present method is intended to do this by classifying materials in such a way that not more than 1 per cent of a material is likely to have a performance below the standard of the class in which the material is placed, this proportion being chosen as acceptably small for safety reasons. The calculation of the performance of the material is such that credit is given to materials of uniform standard, since variability is penalized by requiring a correspondingly higher standard of general performance if any particular classification is to be attained. The values of the limits are derived from all available testing experience to date, and show an improved balance between 1½-minute and final or 10-minute values, the former having been made considerably more rigorous. The final limit of Class 2 is the equivalent of that used hitherto, while the 10-minute limit of Class 3 is more rigorous.

In the fire-resistance test it has been considered desirable to standardize the method of control of the furnace temperature for all types of specimen to that of the standard time-temperature curve (Fig. 1a), although the tolerance on the curve has had to be increased for conducting specimens in tests of longer than ½-hour duration.

For load-bearing structures, the loading has been reduced to the design load, as it has long been felt that the reasons advanced for imposing one and a half times the design load were not necessarily valid in every instance. It is also in keeping with American test practice. The water test has been deleted as it could not be applied to all types of structure nor

could it be applied during the heating period as is likely in practice. It was found to destroy much useful evidence of the behaviour of a structure and was rarely a deciding issue. The impact test has been deleted as, in general, it was not a satisfactory measure of the weakening effect of a fire. It has not yet been found possible to devise a satisfactory alternative.

An appendix has been added to the standard giving details of a test which may be used by those wishing to ascertain the probable spread of flame values of a material without the necessity for constructing the full size apparatus required for the surface spread of flame test specified in this British Standard. It is emphasized that this is not intended to be quoted in place of the standard test, and is purely for the purpose of obtaining in an economical manner an approximation of the values that will be obtained from the specified test.

SPECIFICATION

SCOPE

1. This British Standard specifies tests for determining those properties of building materials and structures relevant when considering the protection against fire of the buildings in which they are to be used.

SECTION ONE: COMBUSTIBILITY TEST OF MATERIALS

GENERAL

2. This test shall be applied to materials used in the construction or finishing of a building or structure, in order to determine whether they are combustible within the meaning of the definition.

TEST PROCEDURE

3. *a. Size of specimen.* Materials for subjection to the combustibility test shall be made up into specimens each 2 in. × 1½ in. × 1½ in. (50·8 mm. × 38·1 mm. × 38·1 mm.). Specimens of materials which are normally less than 1½ in. thick shall be made of sufficient layers to achieve a final thickness as near as possible to but not exceeding 1½ in. (38·1 mm.). In no instance shall this thickness be exceeded.

b. Number of specimens. Six specimens shall be tested.

c. Conditioning. Three of the test specimens shall be dried by heating to a temperature of 100°C. (212°F.) for six hours, then allowed to cool to room temperature in a dry atmosphere. If these specimens are not tested immediately after conditioning, they shall be stored in a hermetically-sealed dry container until the time of test. The remaining three specimens shall be kept for a period of one week in a desiccator containing solid calcium chloride, before testing.

d. Method of test. The test for combustibility shall be carried out in the furnace detailed in Fig. 2. This furnace shall be heated by passing an electric current from a suitably regulated source through the nickel chrome resistance wire surrounding the heating tube. The temperature of the furnace shall be determined by a thermocouple situated at the level of the centre of the furnace and ⅜ in. (9·5 mm.) from the internal wall of the heating tube. The wires of this thermocouple shall not be thicker than 0·048 in. (18 S.W.G.) and bared for a length of 1 in. (25·4 mm.) from the junction. Throughout the test, and except while inserting specimens, the two-piece adjustable asbestos wood cover shall be arranged so that there is an aperture 1 sq. in. (6·45 sq. cm.) in area with its centre coinciding with the axis of the furnace heating tube. A pilot gas flame shall be located immediately above this aperture on the axis of the heating tube, and shall be between ⅝ in. (15·9 mm.) and ⅞ in. (22·2 mm.) in height.

In carrying out the test, the furnace temperature shall be raised to and stabilized at 750°C. (1382°F.) before insertion of the specimen. The specimen shall then be placed centrally in the tube, with its long axis vertical, not longer than 30 seconds being taken for this operation. The specimen shall be supported by a stirrup of nickel chrome wire which shall be hung through the aperture in the adjustable cover. If the specimen is likely to disintegrate or melt during the test, it shall be supported in a gauze or thin sheet-metal box respectively, having a base of 1⅝ in. (41·3 mm.) square and a height of 2 in. (50·8 mm.). The specimen shall be heated in this way for a period of 15 minutes.

DEFINITION OF COMBUSTIBILITY

4. For the purposes of this British Standard a material shall be considered combustible if, during the test period, any one of the six specimens of the sample:

a. flames *or*
b. produces vapours which are ignited by the pilot flame *or*
c. causes the temperature of the furnace to be raised 50 Centigrade degrees (90 Fahrenheit degrees) or more above 750°C. (1382°F.).

SECTION TWO: SURFACE SPREAD OF FLAME TEST FOR MATERIALS

GENERAL

5. This test shall be applied to materials used as wall and ceiling linings, so that they may be classified according to the tendency for flame to spread over their surfaces.

TEST PROCEDURE

6. *a. Size and number of specimens.* A test sample of a material shall comprise six representative specimens, each 9 in. × 36 in. (228·6 mm. ×