

Fire tests on building materials and structures —

Part 22: Methods for determination of the fire resistance of non-loadbearing elements of construction

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	Electric Cable Makers' Confederation	Suspended Ceilings Association
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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This standard has been superseded by the current BS EN 1634-1 and will be withdrawn on 2 September 2029.

This Part of BS 476 has been prepared under the direction of the Fire Standards Committee, and describes the procedures for determining the fire resistance of non-loadbearing elements of building construction. This Part should be read in conjunction with BS 476-20 which describes the general principles for these methods.

This Part has been prepared in such a way as to allow reference to be made to the appropriate method of determining the fire resistance of the designated element by clause number only. Therefore clauses 5 to 7 are selfcontained and cross refer to BS 476-20 where necessary.

Methods for determining the fire resistance of loadbearing elements that have a finite fire resistance and of components that make a contribution to the fire resistance of a structure are described in BS 476-21 and 23 respectively.

The general changes made to the methods described in this Part compared with BS 476-8 are described in the foreword to BS 476-20. Appendix A gives guidance and background information which will assist the designer and the testing laboratory to select and evaluate specimens that are representative of “in use” situations.

The methods described are not relevant to the assessment of the penetration of smoke under cold and/or medium temperature conditions, and for such information on doorsets and shutter assemblies, the methods described in BS 476-31.1 and in other Sections of Part 31 (in preparation) are applicable.

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

CAUTION. The mechanical sawing of asbestos cement components attracts the provisions of the Asbestos Regulations 1969. Adequate methods exist to control levels of dust during such operation and these are detailed in the Control and Safety Guides¹⁾ issued by the Asbestos Research Council.

This Part, together with BS 476-20, 21, 23 and 24, supersedes BS 476-8:1972 which is withdrawn. However, the latter will still be made available on request since it is referred to in building regulations and other legislative documents.

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Compliance with a British Standard cannot confer immunity from legal obligations.

¹⁾ Available from the Asbestos Information Centre, Sackville House, 40 Piccadilly, London W1V 9PA.

Summary of pages

This document comprises a front cover, an inside front cover, pages i to iii pages 1 to 22, 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 procedures for determining the fire resistance of non-loadbearing elements of building construction when subjected to the heating and pressure conditions specified in BS 476-20. This Part is applicable to vertical partitions, to fully insulated, partially insulated and uninsulated vertical doorsets and shutter assemblies (except fire dampers incorporated in ducts), to ceiling membranes, and to glazed elements.

The methods described are appropriate to normal combinations of these elements.

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 476-20 and BS 4422 apply, together with the following:

2.1

ceiling membrane

a non-loadbearing element of a building construction designed to provide horizontal fire separation as distinct from protection to any floor or roof above

2.2

doorset

an assembly (including any frame or guide) for the closing of permanent openings in separating elements. For the purposes of this standard, the term doorset includes shutter assemblies but excludes fire dampers for incorporation into ducts

2.3

partition

a non-loadbearing element of a building construction designed to provide vertical fire separation when exposed to fire from one side

NOTE The partition may incorporate either glazing or doors.

3 Test conditions

The test conditions shall be as specified in BS 476-20.

4 Apparatus

The apparatus for the test shall be as specified in BS 476-20 except that the apparatus for the provision of loading and fixity specified in 6.2 and 6.3.2 of BS 476-20:1987 is not required.

5 Determination of the fire resistance of partitions

5.1 General

This clause describes a method for the determination of the fire resistance of partitions and non-loadbearing walls providing vertical separation which are required to withstand exposure from fire from one or either side (see A.1.1).

NOTE Loadbearing partitions or walls should be tested in accordance with BS 476-21.

5.2 Test specimen

5.2.1 General. Partitions shall be tested from both sides, i.e. two specimens, unless the partition is entirely symmetrical or unless the weakest direction can be clearly identified or unless the partition is known to be exposed to a fully developed fire from one side only. If testing is carried out from one side only, i.e. one specimen, the reason for this shall be clearly stated in the report.

5.2.2 Dimensions. The test specimen shall be of such dimensions that at least 3 m × 3 m is exposed to the furnace or full size if the element is smaller.

5.2.3 Design of specimen

5.2.3.1 When partitions include mechanical joints in the element for either erection, construction, or as a result of dimensional co-ordination, the specimen shall incorporate at least one joint of each type, even though these may occur at greater than 3 m centres.

Different jointing systems in a single specimen shall be avoided if they are likely to give substantially different performances and affect the evaluation of the performance of the whole system. In such cases it is preferable to conduct tests on different specimens for each jointing system.

5.2.3.2 Partitions frequently incorporate a head section that is capable of accommodating deflections from floor slabs above. When such a detail is included in the specimen, the specimen shall be tested with the deflection head in the mid-position of its adjustment.

5.2.3.3 Partitions often incorporate services; where these form an integral part of the element, the test construction shall incorporate them in a representative manner. When the services and associated fittings are not an integral part of the element but may be fitted subsequently in a manner that may have an adverse effect on the fire resistance of the element, these shall be subject to a separate test.

5.2.4 Test construction and condition. The construction and condition of the specimen shall be in accordance with BS 476-20 except for the requirements for fixity and loading (see A.1.4).

5.3 Specimen installation

5.3.1 Where the test specimen is smaller than the element in practice, three edges shall be installed as in practice (see **A.1.3**) and one vertical edge shall have freedom of movement. When testing a partition where lateral thermal expansion is likely to occur during heating, which would be resisted in practice, no allowance should be made for expansion in the mounting of the test specimen.

5.3.2 When the test specimen is full size, it shall be subjected to similar edge and end conditions as would be applied in practice.

5.3.3 A partition that is to be tested with freedom of movement along its vertical edge shall be mounted in such a manner that the gap between the specimen support frame of the furnace surround is sealed with a resilient mineral fibre gasket such that it shall not restrict the freedom of movement due to frictional forces, but will resist the penetration of hot gases.

5.4 Examination of specimen

5.4.1 Establish the dimensions and properties of the materials used in the construction of the specimen in accordance with BS 476-20 (see **A.1.4**).

5.4.2 Mount the test construction vertically in front of the furnace.

5.4.3 Position the furnace control thermocouples at not less than one to every 1.5 m², or part thereof, of the exposed surface area, with a minimum of four for specimens of less than 6 m² with the exposed surface area being the nominal area measured in the plane of the specimen. Distribute the thermocouples uniformly ensuring that no thermocouple is closer than 500 mm from the furnace walls, and with the thermocouple hot junctions at 100 ± 10 mm from the surface of the specimen at the start of the heating period. Where the surface is irregular, measure the 100 ± 10 mm from the median depth provided the junction is not nearer than 50 mm from any part of the exposed surface.

For partitions that incorporate glazing, place one thermocouple directly in front of a glazed area for every 20 % of the specimen area taken up by glazing.

NOTE When the area of glass is less than 20 % of the specimen area, no special requirements apply.

5.4.4 Position at least one pressure sensing head in the furnace such that the pressure conditions in the furnace are measured and controlled in accordance with BS 476-20, and so that the sensing heads do not interfere with the deflection of the specimen.

5.4.5 Position five surface temperature measuring thermocouples with one placed approximately in the centre of the specimen and one at the centre of each quarter section. Do not fix these thermocouples to any glazing unless the glass is designed to provide insulation (but see note to **5.4.6**).

Where the unexposed face of an element comprises more than one material, e.g. glazing designed to provide insulation in a timber panel, place at least one thermocouple on each component material.

Where the partition incorporates doors or doorsets, test these in accordance with clause **6**. Where the partition incorporates more than 50 % of glazed screen, test the partition and glazed screen as glazing in accordance with clause **10** unless the glazing is designed to provide insulation when the partition is tested as a partition in accordance with this clause.

5.4.6 Attach additional surface temperature measuring thermocouples at positions other than those specified to determine the temperature at other points on the surface where the temperature rise is likely to be higher than elsewhere due to lower levels of insulation, and which may be required for evaluation of the maximum temperature rise.

Do not fix thermocouples to the free edges of partitions (see **5.3.2**).

NOTE When partitions incorporate glazing, it may be necessary to fix additional thermocouples to the glazing in order to determine the time at which the use of the cotton pad should be discontinued.

5.4.7 When additional information is required with respect to internal temperatures, e.g. cavities or temperatures of individual components, fix any additional thermocouples that have not been incorporated during construction in accordance with BS 476-20.

5.4.8 Locate in position, and attach if necessary, the deflection measuring equipment at the anticipated point of maximum deflection. Where this position cannot be predetermined, take more than one deflection measurement and report the maximum deflection measured.

5.4.9 When a partition is to be examined for the amount of heat being radiated from the surface, position the radiometer in front of the partition before the start of the test, at such a distance that the field of view of its sensing unit circumscribes the specimen area.

5.5 Test procedure

5.5.1 General. Carry out the test in accordance with BS 476-20 and make any observations on the behaviour of the specimen.

5.5.2 Integrity. Monitor the unexposed face of the specimen for evaluation of the integrity in accordance with clause 9 of BS 476-20:1987.

5.5.3 Insulation

5.5.3.1 Measure the temperature rise of the unexposed face for evaluation of the insulation in accordance with clause 9 of BS 476-20:1987 for both the mean temperature rise and the maximum temperature rise, using the thermocouples specified in 5.4.5 and 5.4.6. Use the measurements from the roving thermocouple, when employed, and from the additional fixed thermocouples only for determining maximum temperature rise.

5.5.3.2 If during the test a thermocouple is known to be heated directly by gases passing through the specimen from the furnace, for example owing to the occurrence of shrinkage, cracking or distortion, do not use the readings obtained from it for the purpose of determining compliance with the criterion of either mean or maximum unexposed face temperature rise and report this fact. If more than two of the thermocouples that are intended to be used in determining the mean temperature rise are affected, do not assess the specimen for compliance with the criterion for mean temperature rise and report this occurrence.

5.5.4 Irradiance. Monitor the irradiance of the unexposed face of any construction that is not designed to satisfy the insulation criterion by means of the radiometer described in BS 476-20.

5.5.5 Deflection. Monitor the maximum deflection of the specimen.

5.6 Criteria of failure, expression of results and test report

5.6.1 Criteria of failure. The fire resistance of a partition shall be determined with respect to integrity and insulation. The criteria of failure shall be as given in 10.3 and 10.4 of BS 476-20:1987 respectively.

5.6.2 Expression of results. The results shall be stated in terms of elapsed time to the nearest minute, between the commencement of heating and the time of failure in accordance with BS 476-20 with respect to the two criteria given in 5.6.1.

When the irradiance from the unexposed face of the specimen has been monitored the mean irradiance shall be reported in a graph or table with respect to time.

The distance from the surface at which these values were obtained shall be given together with the angle of view of the radiometer.

NOTE An example of the method of expressing the results is given in A.11 of BS 476-20:1987.

5.6.3 Test report. The test report shall include the results (see 5.6.2) and any observations, together with the other requirements given in clause 12 of BS 476-20:1987. In addition, the report shall state the maximum lateral deflection and the position at which this occurred, together with the reasons for testing from one side only and the mode of failure, if applicable.

6 Determination of the fire resistance of fully insulated doorsets and shutter assemblies

6.1 General

This clause describes a method for the determination of the fire resistance of fully insulated doorsets, shutter assemblies, lift landing doors and other essentially vertical separating elements designed in such a manner as to allow the ingress of personnel or goods during normal operation, but also designed to withstand exposure to fire from one or either side when closed (see A.2.1).

NOTE Fully insulated doorsets and shutter assemblies are those designed to provide insulation for the expected duration of the test.

6.2 Test specimen

6.2.1 Number of specimens. Doorsets and shutter assemblies shall be tested from both sides, i.e. two specimens, unless the doorset or shutter assembly, including the hardware, is entirely symmetrical or unless the weakest direction can be clearly identified, or unless the doorset or shutter assembly is known to be exposed to fully developed fire from one side only, e.g. certain lift landing doors. If testing is carried out from one side only, i.e. one specimen, the reason for this shall be clearly stated in the report.

6.2.2 Size of specimen

6.2.2.1 The test specimen shall be full size and shall be mounted within an appropriate section of associated construction, i.e. of the type to be used in practice or satisfying the requirements of 6.3.1, to provide a representative size of test construction which complies with 4.5 of BS 476-20:1987.

6.2.2.2 If the size of the door assembly in practice is larger than can be accommodated in the furnace, it shall be tested at a dimension to enable the door and associated construction to be accommodated in a furnace having minimum dimensions of 3 m × 3 m.

NOTE Application of the results to an element of larger dimensions than that tested should be based on knowledgeable extrapolation of the test results (see A.2.2).

6.2.3 Design of specimen

6.2.3.1 The specimen shall be designed and constructed as used in practice. The final decorative treatments, e.g. painting or veneering, may be excluded unless these are likely to significantly increase or decrease the fire resistance of the assembly. If the doorset does not incorporate a sill, the specimen shall have either a non-combustible sill or a sill covered with non-combustible material.

6.2.3.2 The test construction shall incorporate all hardware essential for the provision of the fire resistance of the element in practice. It is not necessary to test floor springs and devices fixed only to the test construction, where, once closing has been achieved, other components are responsible for providing the maintenance of the closed condition, e.g. the latch on a hinged door leaf (see **A.2.3**).

6.2.3.3 In the case of pre-hung doorsets, steel sliding or folding doors or roller shutters which are manufactured in such a manner that the gaps between the edge of the opening element and the fixed frame cannot be modified during installation, the specimen shall be constructed with gaps that are representative of normal practice. Where this cannot be established, no gap shall be less than 3 mm.

6.2.4 Specimen construction and condition. The construction and condition of the specimen shall be in accordance with BS 476-20.

6.3 Specimen installation

6.3.1 The specimens shall be mounted in an associated construction of a wall or partition of the type to be used in practice or, if not known, in a construction which has a known fire resistance greater than that anticipated for the specimen being tested. The construction shall be of sufficient strength to resist any thermally induced stresses that may develop during the test and shall be capable of providing adequate fixing.

6.3.2 The method of fixing the specimen to the associated construction shall be representative of that to be used in practice. The doorsets shall be in the closed position with any latching or bolting hardware engaged but not locked (see **A.2.4**).

6.4 Examination of specimen

6.4.1 Establish the dimensions and properties of the materials used in the construction of the specimen (see **A.2.5**) in accordance with BS 476-20.

6.4.2 Mount the specimen in its associated construction (see **6.3**) vertically in front of the furnace.

6.4.3 Position the furnace control thermocouples at not less than one to every 1.5 m², or part thereof, of the exposed surface area of the test construction (ignoring the area of any furnace closure) with a minimum of four for test constructions of less than 6 m², with the exposed surface being the nominal area measured in the plane of the test construction. Distribute the thermocouples uniformly ensuring no thermocouple is closer than 500 mm from the furnace walls, and with the thermocouple hot junction at 100 ± 10 mm from the surface at the start of the heating period. Ignore any irregularities such as architraves and hardware and position the thermocouples so that the position does not vary during the heating period by more than 50 mm. For doors and shutters that incorporate glazing, place one thermocouple directly in front of the glazed area for every 20 % of the specimen area taken up by glazing.

NOTE When the area of glass is less than 20 % of the specimen area, no special positioning is required.

6.4.4 Position at least one pressure sensing head in the furnace such that the pressure conditions in the furnace are measured and controlled in accordance with BS 476-20, and so that the sensing heads do not interfere with the deflection of the specimen.

6.4.5 Fix surface temperature monitoring thermocouples, in order to measure the unexposed face temperature rise of the specimen in accordance with BS 476-20, positioning them as follows.

- a) At the centre of the specimen and one in the centre of each quarter section. Do not locate thermocouples within 50 mm of a stiffener or a through member or within 50 mm of a joint between one moving element and another or any moving element and the fixed frame. Where head and/or side panels are incorporated, fix two additional thermocouples to each panel.
- b) On stiffeners or other locations on the door leaf (or leaves) which may be hotter than the average on the face. Do not locate any thermocouple within 50 mm of the edge of the door leaf (or leaves) or the door handle/lock, or closer than 50 mm to any joint between one moving element and another, or any moving element and the adjacent fixed frame.
- c) On the frame of the door assembly, one at midheight on each vertical side member and one at the mid-point of each door leaf on the horizontal top member.