

A comparison between the technical requirements of BS 476 : Part 8 : 1972 with other relevant international standards and documents

Une comparaison entre les exigences techniques de la BS 476 : Partie 8 : 1972 et d'autres normes et documents internationaux pertinents

Ein Vergleich der technischen Anforderungen von BS 476 : Teil 8 : 1972 mit anderen einschlägigen internationalen Normen und Dokumenten

Correction

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Change of title

On the front cover and on page 3 delete the existing title and substitute the following in each case:

'A comparison between the technical requirements of BS 476 : Part 8 : 1972 and other relevant international standards and documents on fire-resistance tests'.

On the front cover delete the existing French and German translations of the title and substitute the following:

'Une comparaison entre les exigences techniques de la BS 476 : Partie 8 : 1972 et d'autres normes et documents internationaux pertinents relatifs aux essais de résistance au feu

Ein Vergleich der technischen Anforderungen von BS 476 : Teil 8 : 1972 und anderen einschlägigen internationalen Normen und Dokumenten im Bereich Feuerwiderstandsprüfungen'.

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Foreword

The Technical Committee responsible for BS 476 'Fire tests on building materials and structures' Part 8 : 1972 'Test methods and criteria for the fire resistance of elements of building construction' is undertaking the revision of these methods of test. Before doing so, it was decided to analyse the technical requirements of these tests with those requirements given in similar international and draft international test standards. This analysis is given in this Published Document which is being issued to encourage wide consultation and aid future work on the preparation and revision of all the tests described.

To assist readers, the relevant clauses of the test methods, are summarized from their original texts. This, it is hoped, will avoid the necessity for readers to refer to the original documents. Those documents which have been published are listed. However a number of tests included in the analysis are still in draft form and, although the analysis covers the latest position, it is inevitable that certain requirements will be amended before the methods of test are finalized. In all cases, the draft methods of test will be issued for public comment before completion.

This document represents the first full consultation on the technical requirements of a draft EEC Commission DG III Directive, referred to throughout the text by its EEC Commission document number 1202 dated September 1977, for the classification by testing of the fire resistance of structural building components. The purpose of this 'optional' directive, when completed is to eliminate barriers to trade between member states of the Community. Being an 'optional' directive, member states are not required to change existing regulatory requirements, except that they must allow free access and use of components which meet the requirements of the Directive when approved.

The Department of the Environment represents the United Kingdom on all aspects of this Draft Directive, and

it has invited the BSI Technical Committee responsible for BS 476 : Part 8 to make recommendations on the fire resistance tests to be included in the Directive as annex 1. It is these test provisions which are included in this Published Document.

At the time of the preparation of this document, the EEC Commission is undertaking a survey of all approved testing laboratories in the Community with a view to clarifying the procedures and equipment specified in the preliminary Draft Directive.

The requirements of the Draft Directive method of test are based on those in ISO 834, published by the International Organization for Standardization (ISO). However because of different testing provisions throughout the Community, and the need to more closely specify certain aspects of the tests, the requirements given in ISO 834 are no longer identical to those in the Directive. Although the Directive does not include the testing of doors, glazed elements or suspended ceilings, it is open to the EEC Commission to include these at a later stage, and so the requirements of the relevant tests; ISO 3008, ISO 3009 and the draft test ISO/TR 6167 are included in the analysis.

Readers will be aware that the changes proposed to the international test methods could have a significant effect on the performance classification of some components when compared with those obtained by BS 476 : Part 8. During the revision of BS 476 : Part 8, these factors will be taken into account, but on economic and technical grounds it may not be possible to achieve full harmonization between the tests. Readers with information which will be helpful to the BSI Technical Committee in its future work on the fire resistance test, are invited to send it to the Secretary of the Committee FSB/1 for study.

A comparison between the technical requirements of BS 476 : Part 8 : 1972 with other relevant international standards and documents

1. Scope

1.1 This Published Document compares the technical requirements given in BS 476 'Fire tests on building materials and structures' Part 8 : 1972 'Test methods and criteria for the fire resistance of elements of building construction' with the technical requirements given in the following published and draft international standards, together with those given in the preliminary draft EEC Commission DG III Directive for the fire resistance of building components:

- (a) ISO 834-1975* Fire-resistance tests — Elements of building construction;
- (b) ISO 3008-1976 Fire-resistance tests — Door and shutter assemblies;
- (c) ISO 3009-1976 Fire-resistance tests — Glazed elements;
- (d) ISO/DP 6167-1978† Fire-resistance tests — Suspended ceilings;

(e) Annex 1 of the preliminary draft of an EEC Commission Directive, DG III (document 1202, September 1977) on the approximation of the provisions laid down by law, regulation or administrative action in the Member States relating to the classification, by testing, of the resistance to fire of structural building components.

1.2 The comparison of the above test methods is presented in tabular form, according to the subject and clause number as given in BS 476 : Part 8 : 1972. The clause numbers given in the ISO and EEC columns refer to the texts of the original documents.

Where appropriate to the clause, an analysis is given which highlights the main differences between the compared texts.

2. References

The titles of the standards publications referred to in this Published Document are listed on the inside back cover.

* Also see ISO/TR 3956-1975 'Principles of structural fire-engineering design with special regard to the connection between real fire exposure and the heating conditions of the standard fire-resistance test (ISO 834)'.

† This is the draft proposal for ISO/TR 6167.

3. Basic test method

Relevant BS 476 : Part 8 clause reference	BS 476 : Part 8 requirement	ISO 834 reference and requirement	EEC 1202 reference and requirement	Analysis
1.1 Scope	Test applies to walls and partitions (loadbearing and non-loadbearing) floors, flat roofs, columns, beams, suspended ceilings protecting steel beams, door and shutter assemblies, glazing.	2 Test applies to walls and partitions (loadbearing and non-loadbearing) floors (with or without ceilings), roofs (with or without ceilings), columns, beams. Refer to ISO 3008 for doors and shutters, ISO 3009 for glazed elements.	No specific reference Test applies to walls and partitions (loadbearing and non-loadbearing), floors, columns, beams.	BS 476 is the only standard covering suspended ceilings. EEC 1202 has yet to be expanded to cover doors, shutters and glazing.
1.2 Details of specimen				
1.2.1 Size	Specimens shall be full size where possible.	5.1.1 Specimens should be full size where possible.	Chap.B.I.1 Specimens must be full size or a representative portion.	Whilst furnace size is different the basic statement is identical in all three standards.
1.2.2 Construction	The test shall be on a specimen representative of the element, e.g. a partition which includes at least one of each type of joint. Method of fixing and support, finishes and workmanship shall be as intended in service. Materials and standard of workmanship shall be representative of those applying in practice as defined in British Standards or Codes of Practice. The laboratory can request test to be carried out to establish properties necessary for interpretation of resistance test results.	5.2.1 The test shall be on a specimen representative of the element. An attempt shall be made to reproduce boundary conditions and the method of fixing or support to be representative of that used in practice. The specimen shall include at least one of each type of joint. 5.2.2 The materials and standard of workmanship shall be representative of those in national codes and standards.	Chap.B.II (Walls only) With regard to its periphery, the test component must include at least one of each type of joint. Must have two vertical joints and same number of horizontal joints as in practice.	Very similar recommendations in all three standards, although ISO 834 gives greater emphasis to the boundary conditions.
1.2.3 Conditioning	The specimen shall be conditioned to approximate to the state of strength and moisture content expected in service. Tests not to be carried out until specimen is at equilibrium with laboratory atmosphere, as determined by weight or relative humidity measurement within specimen or representative sample.	5.3 The specimen shall be conditioned to correspond as closely as possible in temperature, moisture and mechanical strength to the expected state in service. 5.3.1 Test shall not be carried out until specimen in dynamic equilibrium with atmosphere expected in service. Equilibrium may be determined on specimen or representative sample.	Chap.B.III Moisture content must be measured prior to test. Test not to be performed until specimen in balance with an atmosphere similar to the average internal atmosphere of a building. Dynamic balance can be determined on actual specimen or representative sample. Natural drying to be constant at 27 ± 15 °C and 40 % r.h. to 65 % r.h. If artificial	Introductory statement similar in BS 476 : Part 8 and ISO 834 tests. No such introduction in EEC 1202. (a) EEC 1202 gives greater information on conditioning procedure, e.g. recommends times for concrete.

	Laboratory humidity not to exceed 70 % r.h. Drying temperature not to exceed 60 °C, if this will affect properties of specimen. Drying to be under natural or controlled conditions.	Drying may be by natural or artificial means but not at a temperature high enough to impair fire resisting properties of material. Maximum recommended temperature 60 °C. Where possible moisture content to be measured at time of test and included in report.	drying must not be at a high enough temperature to affect fire resisting properties of components. Maximum recommended temperature 67 °C. Natural drying for 200 days for concrete $\leq 2000 \text{ kg/m}^3$ 100 days for concrete $> 2000 \text{ kg/m}^3$ 50 days for wet claddings Manufacturer to be consulted for synthetic materials or resins.	(b) Only BS 476 : Part 8 allows test to be performed in equilibrium with laboratory, the other standards make reference to service conditions. (c) ISO 834 and EEC 1202 specify that moisture content is measured and reported but BS 476 : Part 8 does not. (d) Maximum drying temperature of 67 °C is 7 °C higher in EEC 1202 than in the other two standards, but does recommend consultation with manufacturer.
1.3 Loading and restraint 1.3.1 Loading	Before heating, a loadbearing specimen shall be subjected to a loading to produce stresses of the same nature and magnitude produced at normal temperatures in the full size element by the maximum permissible loads which the element is capable of carrying when designed in accordance with appropriate British Standards or Codes of Practice. Loads other than these by agreement between laboratory and sponsor. Load shall be maintained constant during test period.	6.1.1.3 At least 30 min before heating the loadbearing specimen shall be subjected to a loading which in the critical regions of the element, produces stresses of the same magnitude as would be produced normally in the full size element when subjected to the design load. Preloading may be required to stabilize the element and load equipment. 6.1.1.4 The level and distribution of loading shall be maintained during the test.	Chap.B.IV.2 The loadbearing components in a test must be subjected to the design load. The calculation of the design load and data must be included in the report. Characteristics of elements to be measured prior to test to ensure compliance with those used in calculation. The load must be applied not less than 30 min before test. System must be stable before test. A uniformly distributed load can be simulated by a number of equal, statistically equivalent spot loads. The level and distribution of the load must be kept within $\pm 1 \%$ throughout test.	(a) Unlike BS 476 : Part 8 both EEC 1202 and ISO 834 specify that load to be applied at least 30 min before heating. (b) EEC 1202 is the only standard to specify a tolerance of $\pm 1 \%$ on the applied load. (c) Basic loading considerations similar in all three procedures (i.e. maximum service load). (d) ISO 834 is more specific with respect to specifying and recording the restraint conditions. (e) All three standards relate restraint to service conditions.

3. Basic test method (continued)

Relevant BS 476 : Part 8 clause reference	BS 476 : Part 8 requirement	ISO 834 reference and requirement	EEC 1202 reference and requirement	Analysis
1.3.2 Restraint	The methods adopted for supporting or restraining the ends or sides of a specimen during a test shall be as far as possible similar to those applied to the element in service.	6.1.1.1 Methods for supporting or restraining the specimen to be similar to that in practice. If restraint is applied, restraint conditions shall be specified with regard to free movements of the element and external forces and moments transmitted to the element by restraint.	Chap.B.IV.1 In cases where the behaviour of the component in service can be determined exactly, the corresponding clamping and support conditions must be reproduced.	
1.4 Test procedure 1.4.1 Furnace	The specimen shall be heated as specified in 1.4.2 in a furnace which can produce a positive pressure in accordance with requirements of 1.4.4 .	3.1 Furnace capable of subjecting a specimen element to the standard heating and pressure conditions specified in clause 4 (equivalent to 1.4.2 and 1.4.4 of BS 476 : Part 8 : 1972).	Chap.A.I Furnace for conducting thermal attack on a test component in accordance with the temperature and pressure conditions specified in section III. Furnaces must have comparable heat transfer characteristics. Range of four possible fuels specified.	EEC 1202 is the only standard to specify more than heating and pressure. This standard states that all furnaces must have comparable heat transfer characteristics but does not specify them. The fuels are also limited.
1.4.2 Standard heating conditions	To be as close as possible to $T - T_0 = 345 \log_{10} (8t + 1)^*$. T_0 to be between 10 °C and 40 °C. Accuracy of furnace control shall be such that: (1) During first 10 min area under curve not to vary by more than ± 15 % of area under standard curve. (2) During first 30 min area under curve not to vary by more than ± 10 % of area under standard curve. (3) For any period after first 30 min area under curve not to vary by more than ± 5 % of the area under standard curve.	4.1.1 $T - T_0 = 345 \log_{10} (8t + 1)^*$ (no limits on T_0). The tolerances on the mean deviations shall be within: (a) ± 15 % during first 10 min; (b) ± 10 % during first 30 min; (c) ± 5 % after the first 30 min. 4.1.3.2 Temperature after the first 10 min to be within ± 100 °C of standard time versus temperature curve or ± 200 °C for specimens with significant amount of combustible materials.	Chap.A.II.1 $T - T_0 = 345 \log_{10} (8t + 1)^*$ (no limits on T_0). Chap.A.II.3 The tolerances on the deviations to be within: ± 15 % during first 10 min; ± 10 % during first 30 min; ± 5 % for periods of more than 30 min. Temperature after the first 10 min to be within ± 100 °C of the standard curve or ± 200 °C for specimens with combustible materials which flame on the exposed face.	(a) The basic T versus t relationship is identical in all three standards although BS 476 : Part 8 is the only standard to specify a tolerance on T_0 . (b) Tolerances on mean furnace temperature virtually identical. (c) The mean furnace temperature has a tolerance of ± 100 °C in all three standards but both ISO 834 and EEC 1202 allow this to extend to ± 200 °C for combustible elements.

	Mean furnace temperature to be within ± 100 °C of standard curve after first 10 min. Tolerance in item (2) applies in glazed or uninsulated doors for any duration of test.			(d) Only BS 476 : Part 8 specifies a greater tolerance on uninsulated constructions.
1.4.3 Measurement of furnace temperature	Temperature shall be measured by bare wire thermocouples, not less than 0.75 mm and not more than 1.50 mm diameter, symmetrically arranged within the furnace (see relevant clauses for particular elements). Accuracy shall be within ± 1.5 %. The wires shall be located in heat resisting material (e.g. porcelain tubes) with hot junction projecting approximately 25 mm from the open end, with the hot junction 100 mm from the nearest point of the specimen. This distance shall be kept constant. The furnace temperature shall be the average of the temperatures recorded.	4.1.2.3 Bare wire thermocouples of diameter not less than 0.75 mm and not more than 1.5 mm shall be arranged such that the hot junction is 100 mm from the test specimen. This distance to be kept constant. Sheathed thermocouples may be used providing that sensitivity not less than and time-constant not greater than those of bare wire thermocouples. Wires of thermocouples shall be placed in tubes of heat resistant (e.g. porcelain) material with the junction 25 mm from the open end. The furnace temperature is the average of the temperatures recorded.	Chap.A.I.2 Bare wire thermocouples of diameter not less than 0.75 mm and not more than 1.5 mm. The wires must be in open, fire resisting insulating tubes at least 25 mm from the hot junction. Chap.A.II.2 Thermocouple junction to be 100 mm from the nearest point of the specimen. This distance to be kept constant.	Thermocouple specification and position identical in all three standards although ISO 834 does recognize sheathed thermocouples.
1.4.4 Determination of integrity	When testing for integrity the upper part of the furnace shall be maintained at a positive pressure of 15 ± 5 N/m ² (1.5 ± 0.5 mm water gauge). Method of test is to hold a cotton wool pad not more than 30 mm from the aperture, but not in contact with the specimen, located centrally over it in a plane parallel to the surface of the specimen. The pad shall be applied at frequent intervals for not less than 10 s at a time. The pad shall not be reused.	4.2 An overpressure (not mandatory for the first 10 min) of 10 ± 0.2 mmH ₂ O shall exist in the furnace during the whole period of test on separating elements. For vertical elements this shall be over at least upper two-thirds of height of specimen and be measured 100 mm from underside surface of horizontal elements and at three-quarters of height of vertical elements. NOTE. This may also be achieved by lowering unexposed face pressure.	Chap.A.III After first 5 min there must be a furnace overpressure of 10 ± 2 Pa when testing components performing a separating function. This must be measured 100 mm from lower surface of horizontal element and at three-quarters height of vertical elements. There must be an overpressure (on at least upper three-quarters of the height of the component).	(a) Both ISO 834 and EEC 1202 specify 10 ± 2 Pa whilst BS 476 : Part 8 specifies 15 ± 5 Pa. (b) (1) ISO 834 : applied continuously after first 10 min. (2) EEC 1202 : pressure applied continuously after first 5 min.

* The following definitions apply:

t is the test time, in min;

T is the furnace temperature, in °C, at time t ;

T_0 is the initial temperature, in °C.

3. Basic test method (continued)

Relevant BS 476 : Part 8 clause reference	BS 476 : Part 8 requirement	ISO 834 reference and requirement	EEC 1202 reference and requirement	Analysis
	The cotton pad shall be new undyed soft fibres with no artificial fibres. Pad to be 20 mm thick and 100 mm square and between 3 g to 4 g. Pad to be conditioned for at least 30 min. Pad to be held in frame of 1 mm diameter wire with wire handle approximately 750 mm long (other methods permitted for doors and glazing).	6.2.3.1 Above conditions shall apply when testing for integrity. Observations shall be made of sustained flaming and of ignition of cotton pad held for between 10 s to 30 s at 20 mm to 30 mm from any opening on unexposed face. Pad shall not be reused if charred or has absorbed moisture. Specification of pad and frame as in BS 476 : Part 8. Pad shall be conditioned for 30 min at 100 °C prior to use.	Chap.C.II.3 Observations to be made of sustained flaming and of the ignition of a cotton pad held for 30 s to 32 s at 20 mm to 22 mm from any opening on the unexposed face. The pad not to be reused. Specification of pad and frame as in BS 476 : Part 8. Pad to be dried at 100 ± 5 °C for at least 30 min.	(3) BS 476 : Part 8 : only specifies pressure application when testing for integrity. (c) (1) ISO 834 : pressure applied over 100 mm below horizontal elements and three-quarters height of vertical elements. (2) EEC 1202 : as ISO 834. (3) BS 476 : Part 8 : states pressure applied over 'upper part' for both tests. (d) (1) ISO 834 : cotton pad applied for 10 s to 30 s. (2) EEC 1202 : cotton pad applied for 30 s to 32 s. (3) BS 476 : Part 8 : cotton pad applied for not less than 10 s. (e) Size, conditioning and position of pad similar in all three standards.
1.4.5 Measurement of insulation	Temperatures on the unexposed face (apart from glazing) shall be measured by means of thermocouples each with its junction attached to the face of a 12 mm diameter copper disc 0.2 mm thick secured to the surface of the specimen. The disc shall be covered with an oven dry asbestos pad 30 mm square by 2 mm and the thermocouple wires not to exceed 0.5 mm.	4.1.4 Surface temperatures shall be measured by means of thermocouples with wire dia. not more than 0.7 mm. Each junction shall be attached to the centre of the face of a 12 mm diameter copper disc 0.2 mm thick secured to the surface of the specimen. The disc shall be covered with an oven dry asbestos pad 30 mm square by 2 mm thick of density 1000 kg/m ³ .	Chap.A.I.2(b) Description of thermocouple as for ISO 834. Tolerance on asbestos pad density must be ± 100 kg/m ³ . Any moveable thermocouple must be of the same type and mounted appropriately. Chap.A.II.4 The temperatures on the unexposed surface of the specimen can be measured by applying thermocouples to the surface of the specimen.	(a) The basic thermocouple for unexposed face similar in all three standards. (b) Asbestos covering pad identical except EEC 1202 and ISO 834 specify a density and EEC 1202 a tolerance on the density. (c) EEC 1202 gives a specification of the roving thermocouple.

	The disc and pad shall make intimate contact e.g. by pins, tape, adhesive. Temperatures shall be accurate within $\pm 1.5\%$.	The disc and pad may be fixed to the surface by pins, tape or adhesive. The wires from thermocouples within the specimen shall if possible follow the isotherm through the hot junction extending to 30 mm from the junction.	The maximum temperature can be measured by a moveable thermocouple. The disc and pad can be fixed to the element with pins, pegs or adhesive. Chap.A.II.5 Specification of wires within the specimen as for ISO 834.	(d) EEC 1202 and ISO 834 give guidance on measuring internal temperatures.
1.4.6.1 Stability	Note shall be made of the deformation of the specimen, occurrence of collapse, or any other factor which could affect its stability.	6.2.3.2 The full or partial collapse of non-loadbearing separating elements shall be noted as this will constitute ultimate integrity failure. 6.2.1.1 For a loadbearing test specimen, the time at which the specimen can no longer support the test load shall be measured and used to assess the performance.	Chap.C.I.1 In the case of structural components, the component must not weaken in such a way that it can no longer perform the function assigned to it in the structure.	(a) All three standards are similar in concept but wording varies. (b) ISO 834 uses the term 'ultimate integrity' for stability and recognises partial collapse.
1.4.6.2 Integrity	In elements which have a separating function the presence of cracks or other openings which result in any flaming of the cotton wool pad described in 1.4.4 shall be noted.	6.2.3.1 and 6.2.3.2 Note shall be made of the time when the first ignition of the cotton pad occurs and the position where this takes place. To obtain the time of ultimate integrity failure the test shall be continued beyond initial integrity failure and observations and measurements made of enlargements of cracks, holes or other openings through which flames or gases could pass.	Chap.C.II.3 The time and position at which the cotton wool first ignites must be recorded.	All three standards use the ignition of the pad for (initial) integrity failure.
1.4.6.3 Insulation	In elements which have a separating function the temperature conditions of the unexposed face of the specimen shall be recorded, preferably continuously, but at least at intervals not exceeding 5 min.	6.2.2.1 In the case of elements with an unheated surface, the temperature of the unexposed face shall be measured. 6.2.2.2 The temperature shall be measured at the point that appears to be the hottest at any time during the test.	Chap.C.II.2a When one face of the test component is not exposed to fire the temperature attained by the unexposed face must be measured. Chap.C.II.2b The temperature must be measured at the point which seems to attain the highest temperature at any given time during the test.	All three standards measure average and maximum unexposed face temperature.

3. Basic test method

Relevant BS 476 : Part 8 clause reference	BS 476 : Part 8 requirement	ISO 834 reference and requirement	EEC 1202 reference and requirement	Analysis
1.1 Scope	Test applies to walls and partitions (loadbearing and non-loadbearing) floors, flat roofs, columns, beams, suspended ceilings protecting steel beams, door and shutter assemblies, glazing.	2 Test applies to walls and partitions (loadbearing and non-loadbearing) floors (with or without ceilings), roofs (with or without ceilings), columns, beams. Refer to ISO 3008 for doors and shutters, ISO 3009 for glazed elements.	No specific reference Test applies to walls and partitions (loadbearing and non-loadbearing), floors, columns, beams.	BS 476 is the only standard covering suspended ceilings. EEC 1202 has yet to be expanded to cover doors, shutters and glazing.
1.2 Details of specimen				
1.2.1 Size	Specimens shall be full size where possible.	5.1.1 Specimens should be full size where possible.	Chap.B.I.1 Specimens must be full size or a representative portion.	Whilst furnace size is different the basic statement is identical in all three standards.
1.2.2 Construction	The test shall be on a specimen representative of the element, e.g. a partition which includes at least one of each type of joint. Method of fixing and support, finishes and workmanship shall be as intended in service. Materials and standard of workmanship shall be representative of those applying in practice as defined in British Standards or Codes of Practice. The laboratory can request test to be carried out to establish properties necessary for interpretation of resistance test results.	5.2.1 The test shall be on a specimen representative of the element. An attempt shall be made to reproduce boundary conditions and the method of fixing or support to be representative of that used in practice. The specimen shall include at least one of each type of joint. 5.2.2 The materials and standard of workmanship shall be representative of those in national codes and standards.	Chap.B.II (Walls only) With regard to its periphery, the test component must include at least one of each type of joint. Must have two vertical joints and same number of horizontal joints as in practice.	Very similar recommendations in all three standards, although ISO 834 gives greater emphasis to the boundary conditions.
1.2.3 Conditioning	The specimen shall be conditioned to approximate to the state of strength and moisture content expected in service. Tests not to be carried out until specimen is at equilibrium with laboratory atmosphere, as determined by weight or relative humidity measurement within specimen or representative sample.	5.3 The specimen shall be conditioned to correspond as closely as possible in temperature, moisture and mechanical strength to the expected state in service. 5.3.1 Test shall not be carried out until specimen in dynamic equilibrium with atmosphere expected in service. Equilibrium may be determined on specimen or representative sample.	Chap.B.III Moisture content must be measured prior to test. Test not to be performed until specimen in balance with an atmosphere similar to the average internal atmosphere of a building. Dynamic balance can be determined on actual specimen or representative sample. Natural drying to be constant at 27 ± 15 °C and 40 % r.h. to 65 % r.h. If artificial	Introductory statement similar in BS 476 : Part 8 and ISO 834 tests. No such introduction in EEC 1202. (a) EEC 1202 gives greater information on conditioning procedure, e.g. recommends times for concrete.

	Laboratory humidity not to exceed 70 % r.h. Drying temperature not to exceed 60 °C, if this will affect properties of specimen. Drying to be under natural or controlled conditions.	Drying may be by natural or artificial means but not at a temperature high enough to impair fire resisting properties of material. Maximum recommended temperature 60 °C. Where possible moisture content to be measured at time of test and included in report.	drying must not be at a high enough temperature to affect fire resisting properties of components. Maximum recommended temperature 67 °C. Natural drying for 200 days for concrete $\leq 2000 \text{ kg/m}^3$ 100 days for concrete $> 2000 \text{ kg/m}^3$ 50 days for wet claddings Manufacturer to be consulted for synthetic materials or resins.	(b) Only BS 476 : Part 8 allows test to be performed in equilibrium with laboratory, the other standards make reference to service conditions. (c) ISO 834 and EEC 1202 specify that moisture content is measured and reported but BS 476 : Part 8 does not. (d) Maximum drying temperature of 67 °C is 7 °C higher in EEC 1202 than in the other two standards, but does recommend consultation with manufacturer.
1.3 Loading and restraint 1.3.1 Loading	Before heating, a loadbearing specimen shall be subjected to a loading to produce stresses of the same nature and magnitude produced at normal temperatures in the full size element by the maximum permissible loads which the element is capable of carrying when designed in accordance with appropriate British Standards or Codes of Practice. Loads other than these by agreement between laboratory and sponsor. Load shall be maintained constant during test period.	6.1.1.3 At least 30 min before heating the loadbearing specimen shall be subjected to a loading which in the critical regions of the element, produces stresses of the same magnitude as would be produced normally in the full size element when subjected to the design load. Preloading may be required to stabilize the element and load equipment. 6.1.1.4 The level and distribution of loading shall be maintained during the test.	Chap.B.IV.2 The loadbearing components in a test must be subjected to the design load. The calculation of the design load and data must be included in the report. Characteristics of elements to be measured prior to test to ensure compliance with those used in calculation. The load must be applied not less than 30 min before test. System must be stable before test. A uniformly distributed load can be simulated by a number of equal, statistically equivalent spot loads. The level and distribution of the load must be kept within $\pm 1 \%$ throughout test.	(a) Unlike BS 476 : Part 8 both EEC 1202 and ISO 834 specify that load to be applied at least 30 min before heating. (b) EEC 1202 is the only standard to specify a tolerance of $\pm 1 \%$ on the applied load. (c) Basic loading considerations similar in all three procedures (i.e. maximum service load). (d) ISO 834 is more specific with respect to specifying and recording the restraint conditions. (e) All three standards relate restraint to service conditions.

3. Basic test method (continued)

Relevant BS 476 : Part 8 clause reference	BS 476 : Part 8 requirement	ISO 834 reference and requirement	EEC 1202 reference and requirement	Analysis
1.3.2 Restraint	The methods adopted for supporting or restraining the ends or sides of a specimen during a test shall be as far as possible similar to those applied to the element in service.	6.1.1.1 Methods for supporting or restraining the specimen to be similar to that in practice. If restraint is applied, restraint conditions shall be specified with regard to free movements of the element and external forces and moments transmitted to the element by restraint.	Chap.B.IV.1 In cases where the behaviour of the component in service can be determined exactly, the corresponding clamping and support conditions must be reproduced.	
1.4 Test procedure 1.4.1 Furnace	The specimen shall be heated as specified in 1.4.2 in a furnace which can produce a positive pressure in accordance with requirements of 1.4.4 .	3.1 Furnace capable of subjecting a specimen element to the standard heating and pressure conditions specified in clause 4 (equivalent to 1.4.2 and 1.4.4 of BS 476 : Part 8 : 1972).	Chap.A.I Furnace for conducting thermal attack on a test component in accordance with the temperature and pressure conditions specified in section III. Furnaces must have comparable heat transfer characteristics. Range of four possible fuels specified.	EEC 1202 is the only standard to specify more than heating and pressure. This standard states that all furnaces must have comparable heat transfer characteristics but does not specify them. The fuels are also limited.
1.4.2 Standard heating conditions	To be as close as possible to $T - T_0 = 345 \log_{10} (8t + 1)^*$. T_0 to be between 10 °C and 40 °C. Accuracy of furnace control shall be such that: (1) During first 10 min area under curve not to vary by more than ± 15 % of area under standard curve. (2) During first 30 min area under curve not to vary by more than ± 10 % of area under standard curve. (3) For any period after first 30 min area under curve not to vary by more than ± 5 % of the area under standard curve.	4.1.1 $T - T_0 = 345 \log_{10} (8t + 1)^*$ (no limits on T_0). The tolerances on the mean deviations shall be within: (a) ± 15 % during first 10 min; (b) ± 10 % during first 30 min; (c) ± 5 % after the first 30 min. 4.1.3.2 Temperature after the first 10 min to be within ± 100 °C of standard time versus temperature curve or ± 200 °C for specimens with significant amount of combustible materials.	Chap.A.II.1 $T - T_0 = 345 \log_{10} (8t + 1)^*$ (no limits on T_0). Chap.A.II.3 The tolerances on the deviations to be within: ± 15 % during first 10 min; ± 10 % during first 30 min; ± 5 % for periods of more than 30 min. Temperature after the first 10 min to be within ± 100 °C of the standard curve or ± 200 °C for specimens with combustible materials which flame on the exposed face.	(a) The basic T versus t relationship is identical in all three standards although BS 476 : Part 8 is the only standard to specify a tolerance on T_0 . (b) Tolerances on mean furnace temperature virtually identical. (c) The mean furnace temperature has a tolerance of ± 100 °C in all three standards but both ISO 834 and EEC 1202 allow this to extend to ± 200 °C for combustible elements.

	Mean furnace temperature to be within ± 100 °C of standard curve after first 10 min. Tolerance in item (2) applies in glazed or uninsulated doors for any duration of test.			(d) Only BS 476 : Part 8 specifies a greater tolerance on uninsulated constructions.
1.4.3 Measurement of furnace temperature	Temperature shall be measured by bare wire thermocouples, not less than 0.75 mm and not more than 1.50 mm diameter, symmetrically arranged within the furnace (see relevant clauses for particular elements). Accuracy shall be within ± 1.5 %. The wires shall be located in heat resisting material (e.g. porcelain tubes) with hot junction projecting approximately 25 mm from the open end, with the hot junction 100 mm from the nearest point of the specimen. This distance shall be kept constant. The furnace temperature shall be the average of the temperatures recorded.	4.1.2.3 Bare wire thermocouples of diameter not less than 0.75 mm and not more than 1.5 mm shall be arranged such that the hot junction is 100 mm from the test specimen. This distance to be kept constant. Sheathed thermocouples may be used providing that sensitivity not less than and time-constant not greater than those of bare wire thermocouples. Wires of thermocouples shall be placed in tubes of heat resistant (e.g. porcelain) material with the junction 25 mm from the open end. The furnace temperature is the average of the temperatures recorded.	Chap.A.I.2 Bare wire thermocouples of diameter not less than 0.75 mm and not more than 1.5 mm. The wires must be in open, fire resisting insulating tubes at least 25 mm from the hot junction. Chap.A.II.2 Thermocouple junction to be 100 mm from the nearest point of the specimen. This distance to be kept constant.	Thermocouple specification and position identical in all three standards although ISO 834 does recognize sheathed thermocouples.
1.4.4 Determination of integrity	When testing for integrity the upper part of the furnace shall be maintained at a positive pressure of 15 ± 5 N/m ² (1.5 ± 0.5 mm water gauge). Method of test is to hold a cotton wool pad not more than 30 mm from the aperture, but not in contact with the specimen, located centrally over it in a plane parallel to the surface of the specimen. The pad shall be applied at frequent intervals for not less than 10 s at a time. The pad shall not be reused.	4.2 An overpressure (not mandatory for the first 10 min) of 10 ± 0.2 mmH ₂ O shall exist in the furnace during the whole period of test on separating elements. For vertical elements this shall be over at least upper two-thirds of height of specimen and be measured 100 mm from underside surface of horizontal elements and at three-quarters of height of vertical elements. NOTE. This may also be achieved by lowering unexposed face pressure.	Chap.A.III After first 5 min there must be a furnace overpressure of 10 ± 2 Pa when testing components performing a separating function. This must be measured 100 mm from lower surface of horizontal element and at three-quarters height of vertical elements. There must be an overpressure (on at least upper three-quarters of the height of the component).	(a) Both ISO 834 and EEC 1202 specify 10 ± 2 Pa whilst BS 476 : Part 8 specifies 15 ± 5 Pa. (b) (1) ISO 834 : applied continuously after first 10 min. (2) EEC 1202 : pressure applied continuously after first 5 min.

* The following definitions apply:

t is the test time, in min;

T is the furnace temperature, in °C, at time t ;

T_0 is the initial temperature, in °C.

3. Basic test method (continued)

Relevant BS 476 : Part 8 clause reference	BS 476 : Part 8 requirement	ISO 834 reference and requirement	EEC 1202 reference and requirement	Analysis
	The cotton pad shall be new undyed soft fibres with no artificial fibres. Pad to be 20 mm thick and 100 mm square and between 3 g to 4 g. Pad to be conditioned for at least 30 min. Pad to be held in frame of 1 mm diameter wire with wire handle approximately 750 mm long (other methods permitted for doors and glazing).	6.2.3.1 Above conditions shall apply when testing for integrity. Observations shall be made of sustained flaming and of ignition of cotton pad held for between 10 s to 30 s at 20 mm to 30 mm from any opening on unexposed face. Pad shall not be reused if charred or has absorbed moisture. Specification of pad and frame as in BS 476 : Part 8. Pad shall be conditioned for 30 min at 100 °C prior to use.	Chap.C.II.3 Observations to be made of sustained flaming and of the ignition of a cotton pad held for 30 s to 32 s at 20 mm to 22 mm from any opening on the unexposed face. The pad not to be reused. Specification of pad and frame as in BS 476 : Part 8. Pad to be dried at 100 ± 5 °C for at least 30 min.	(3) BS 476 : Part 8 : only specifies pressure application when testing for integrity. (c) (1) ISO 834 : pressure applied over 100 mm below horizontal elements and three-quarters height of vertical elements. (2) EEC 1202 : as ISO 834. (3) BS 476 : Part 8 : states pressure applied over 'upper part' for both tests. (d) (1) ISO 834 : cotton pad applied for 10 s to 30 s. (2) EEC 1202 : cotton pad applied for 30 s to 32 s. (3) BS 476 : Part 8 : cotton pad applied for not less than 10 s. (e) Size, conditioning and position of pad similar in all three standards.
1.4.5 Measurement of insulation	Temperatures on the unexposed face (apart from glazing) shall be measured by means of thermocouples each with its junction attached to the face of a 12 mm diameter copper disc 0.2 mm thick secured to the surface of the specimen. The disc shall be covered with an oven dry asbestos pad 30 mm square by 2 mm and the thermocouple wires not to exceed 0.5 mm.	4.1.4 Surface temperatures shall be measured by means of thermocouples with wire dia. not more than 0.7 mm. Each junction shall be attached to the centre of the face of a 12 mm diameter copper disc 0.2 mm thick secured to the surface of the specimen. The disc shall be covered with an oven dry asbestos pad 30 mm square by 2 mm thick of density 1000 kg/m ³ .	Chap.A.I.2(b) Description of thermocouple as for ISO 834. Tolerance on asbestos pad density must be ± 100 kg/m ³ . Any moveable thermocouple must be of the same type and mounted appropriately. Chap.A.II.4 The temperatures on the unexposed surface of the specimen can be measured by applying thermocouples to the surface of the specimen.	(a) The basic thermocouple for unexposed face similar in all three standards. (b) Asbestos covering pad identical except EEC 1202 and ISO 834 specify a density and EEC 1202 a tolerance on the density. (c) EEC 1202 gives a specification of the roving thermocouple.

	The disc and pad shall make intimate contact e.g. by pins, tape, adhesive. Temperatures shall be accurate within $\pm 1.5\%$.	The disc and pad may be fixed to the surface by pins, tape or adhesive. The wires from thermocouples within the specimen shall if possible follow the isotherm through the hot junction extending to 30 mm from the junction.	The maximum temperature can be measured by a moveable thermocouple. The disc and pad can be fixed to the element with pins, pegs or adhesive. Chap.A.II.5 Specification of wires within the specimen as for ISO 834.	(d) EEC 1202 and ISO 834 give guidance on measuring internal temperatures.
1.4.6.1 Stability	Note shall be made of the deformation of the specimen, occurrence of collapse, or any other factor which could affect its stability.	6.2.3.2 The full or partial collapse of non-loadbearing separating elements shall be noted as this will constitute ultimate integrity failure. 6.2.1.1 For a loadbearing test specimen, the time at which the specimen can no longer support the test load shall be measured and used to assess the performance.	Chap.C.I.1 In the case of structural components, the component must not weaken in such a way that it can no longer perform the function assigned to it in the structure.	(a) All three standards are similar in concept but wording varies. (b) ISO 834 uses the term 'ultimate integrity' for stability and recognises partial collapse.
1.4.6.2 Integrity	In elements which have a separating function the presence of cracks or other openings which result in any flaming of the cotton wool pad described in 1.4.4 shall be noted.	6.2.3.1 and 6.2.3.2 Note shall be made of the time when the first ignition of the cotton pad occurs and the position where this takes place. To obtain the time of ultimate integrity failure the test shall be continued beyond initial integrity failure and observations and measurements made of enlargements of cracks, holes or other openings through which flames or gases could pass.	Chap.C.II.3 The time and position at which the cotton wool first ignites must be recorded.	All three standards use the ignition of the pad for (initial) integrity failure.
1.4.6.3 Insulation	In elements which have a separating function the temperature conditions of the unexposed face of the specimen shall be recorded, preferably continuously, but at least at intervals not exceeding 5 min.	6.2.2.1 In the case of elements with an unheated surface, the temperature of the unexposed face shall be measured. 6.2.2.2 The temperature shall be measured at the point that appears to be the hottest at any time during the test.	Chap.C.II.2a When one face of the test component is not exposed to fire the temperature attained by the unexposed face must be measured. Chap.C.II.2b The temperature must be measured at the point which seems to attain the highest temperature at any given time during the test.	All three standards measure average and maximum unexposed face temperature.