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Fire resistance tests —

Part 3:
Door and shutter assemblies horizontally oriented

Essais de résistance au feu —

Partie 3: Assemblages de portes et volets orientés horizontalement

Reference number
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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT), see the following URL: Foreword — Supplementary information.

The committee responsible for this document is ISO/TC 92, *Fire safety*, Subcommittee SC 2, *Fire containment*.

ISO 3008 consists of the following parts, under the general title, *Fire resistance tests*:

— *Part 2: Lift landing door assemblies*

— *Part 3: Door and shutter assemblies horizontally oriented*

Introduction

This part of ISO 3008 specifies requirements for fire resistance testing which are unique to the elements of building construction described as horizontally oriented doors and shutters. The requirements for these doors and shutters are intended to be applied in conjunction with the appropriate detailed and general requirements contained in ISO 834-1 and ISO 3008.

Fire resistance tests —

Part 3:
Door and shutter assemblies horizontally oriented

CAUTION — The attention of all persons concerned with managing and carrying out this fire-resistance test is drawn to the fact that fire testing may be hazardous and that there is a possibility that toxic and/or harmful smoke and gases may be evolved during the test. Mechanical and operational hazards may also arise during the construction of test elements or structures, their testing and disposal of test residues.

An assessment of all potential hazards and health risks shall be made by the laboratory and safety precautions shall be identified and provided. Written safety instructions shall be issued. Appropriate training shall be given to relevant personnel. Laboratory personnel shall ensure that they follow written safety instructions at all times.

1 Scope

This part of ISO 3008 specifies the test method for determining the fire resistance of horizontally oriented door and shutter assemblies which may be exposed to a fire from the underside. It is applicable to all types of door and shutter assemblies installed in a horizontal orientation within floor or roof assemblies requiring fire-resistance ratings in buildings.

The test method allows for the measurement of integrity and, if required, the measurement of radiation and thermal insulation. In addition, this test method includes measurement of the load-carrying ability of the test specimens subjected to a standard fire-resistance test.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 834-1:1999, *Fire-resistance tests — Elements of building construction — Part 1: General requirements*

ISO 834-5, *Fire-resistance tests — Elements of building construction — Part 5: Specific requirements for loadbearing horizontal separating elements*

ISO 3008, *Fire-resistance tests — Door and shutter assemblies*

ISO 3009, *Fire-resistance tests — Elements of building construction — Glazed elements*

ISO 13943, *Fire safety — Vocabulary*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 834-1, ISO 3008, ISO 13943 and the following apply.

3.1
associated supporting construction
specific construction in which the door or shutter assembly is installed as intended for use in practice and which is used to close off the furnace and provide the levels of restraint and thermal heat transfer to be experienced in normal use

3.2
door assembly
combination of a door, a frame, hardware, closers, sealing materials and other accessories installed in a horizontal plane, which together provide a specific degree of fire-resistance to a through opening in a fire-resistance rated floor or roof

3.3
shutter assembly
complete assembly consisting of rolling, folded or sliding panels or slats including guides, rollers, tracks, other accessories, operating mechanism and housings intended for installation in a horizontal plane

3.4
standard supporting construction
form of construction used to close off the furnace and to support the door assembly being evaluated and has a quantifiable influence on both the thermal heat transfer between the construction and the test specimen and provides known resistance to thermal distortion

3.5
door length
direction of the door panel, door assembly or shutter which has the greatest dimension

3.6
door width
direction of the door panel, door assembly or shutter which has the shortest dimension

4 Test equipment

4.1 The test equipment shall be as specified in ISO 834-1. The furnace used shall be related to the orientation of the test specimen. For horizontal specimens, the floor furnace is applicable.

4.2 Measurement of heat flux from the unexposed surface of specimens shall be made as described in 9.4.

5 Test conditions

Test conditions require the application of the heating and pressure conditions of the standard test for a loadbearing horizontal separating element as defined in ISO 834-1.

6 Test specimen

6.1 Size of specimen

The test specimen and all its components shall be full size. When this is restricted by the size of the opening of the furnace (which is normally 3 m × 4 m), the door or shutter assembly shall be tested at the maximum size possible and the fire resistance of the full-sized assembly shall be derived by an extended application analysis. However, the minimum dimensions of the supporting construction shall not be less than that prescribed in 7.3.1.

6.2 Design of specimen

6.2.1 The design of the test specimen and the choice of supporting construction shall take into account the requirements of 7.3 if the widest field of direct application is to be achieved.

6.2.2 The test specimen shall be fully representative of the door or shutter assembly as intended for use in practice, including any appropriate surface finishes and fittings which are an essential part of the specimen and may influence its behaviour in a test construction.

6.2.3 If the test specimen is intended for use at an incline other than horizontal, the guidance for inclined specimens in ISO 3009 shall be followed.

6.3 Verification

6.3.1 The sponsor shall provide a specification to a level of detail sufficient to allow the laboratory to conduct a detailed examination of the specimen before the test and to agree on the accuracy of the information supplied. ISO 834-1 provides detailed guidance on verification of the test specimen.

6.3.2 When the method of construction precludes a detailed survey of the specimen without having to permanently damage it, or if it is considered that it will subsequently be impossible to evaluate construction details from a post-test examination, then one of two options shall be exercised by the laboratory, either:

— the laboratory oversees the manufacture of the door or shutter assembly(ies) that is to be the subject of the test; or

— the sponsor, at the discretion of the laboratory, be requested to supply an additional assembly or that part of the assembly which cannot be verified (e.g. a door leaf) in addition to the number required for the testing. The laboratory shall then choose freely which of these shall be subjected to the testing and which shall be used to verify the construction.

7 Installation of test specimen

7.1 General

7.1.1 The test specimen shall be installed in a manner as intended for use in practice, incorporating all hardware and other items, which may influence the performance of the specimen.

7.1.2 The test specimen shall be mounted in a supporting construction, the field of application of which covers the type (see 7.3.1) in which it is intended to be used. The design of the connection between the test specimen and the supporting construction, including any fixings and materials used to make the connection shall be as intended for use in practice and shall be regarded as part of the test specimen.

7.1.3 The whole area of the test specimen, together with at least the minimum dimensions of the supporting construction required by 7.3.1 shall be exposed to the heating conditions.

7.2 Supporting construction

The fire resistance of any supporting construction shall not be determined from a test in conjunction with a test specimen and shall be at least commensurate with that anticipated for the test specimen.

7.3 Test construction

7.3.1 Associated and supporting construction

The space between the specimen and the frame shall be filled with either

— associated construction, or

— supporting construction.

There shall be a minimum zone of supporting construction of 200 mm wide exposed within the furnace, each side and over the top of the aperture into which the test specimen is to be fixed. The thickness of the supporting construction may be increased outside of the 200-mm zone. The test construction may incorporate more than one test specimen providing that there is minimum separation of 200 mm between each specimen and between the specimens and the edge of the furnace.

7.3.2 Associated construction

When the test specimen is always installed in a specific, normally proprietary, form of construction, that is permanently associated with its intended use in practice, then the specimen shall be installed in a sample of this supporting construction.

7.3.3 Supporting construction

7.3.3.1 Where the test specimen is not permanently associated with a specific form of construction, the area between the test specimen and the support frame shall be filled with a rigid or flexible standard supporting construction as specified in ISO 834-5.

7.3.3.2 The choice of standard supporting construction shall reflect the range of intended use for the door or shutter assembly. The rules governing the applicability of the chosen standard supporting construction to other end use situations are given in Clause 13.

7.4 Gaps

7.4.1 The adjustment of the door leaf, leaves or shutter and gaps shall be within the tolerances of the design values stipulated by the sponsor. These shall be representative of those used as intended for use in practice so that appropriate clearances exist, e.g. between the fixed and moveable components.

7.4.2 In order to generate the widest field of direct application, the gaps shall be set between the middle value and the maximum value within the range of gaps given by the sponsor.

8 Conditioning

8.1 Moisture content

The test specimen shall be conditioned in accordance with ISO 834-1. Requirements for conditioning of supporting constructions are given in Annex A.

8.2 Mechanical

Some product standards exist for certification purposes that require mechanical testing before the start of the fire test. Durability requirements are given in the relevant product standard. When mechanical testing is required, the method used shall follow the requirements of the relevant product standard.

9 Application of instrumentation

9.1 Temperature measurements

9.1.1 Furnace temperature measuring instrument

Plate thermometers shall be provided in accordance with ISO 834-1. They shall be evenly distributed over a horizontal plane, 100 mm from the nearest plane of the test construction. There shall be at least one plate thermometer for every 1,5 m^2 of the exposed surface area of the test construction, subject to a minimum of four. The plate thermometer shall be oriented so that “side A” faces the back wall of the furnace.

9.1.2 Unexposed face thermocouples

9.1.2.1 Where no evaluation against the insulation criteria is required of the door or shutter assembly, or any part thereof, no temperature measurements are required.

9.1.2.2 Where compliance with the insulation criteria is required to be evaluated, thermocouples of the type specified in ISO 834-1 shall be attached to the unexposed face for the purpose of obtaining the average and maximum surface temperatures.

9.1.2.3 The temperature of the supporting construction in which the door or shutter assembly is mounted is not required to be measured and therefore, no thermocouples are required.

9.1.2.4 No thermocouple shall be placed within 50 mm of any hardware.

9.1.2.5 Position five thermocouples (for single or double leaf doors), one at the centre of each specimen leaf (single or multiple) and one at the centre of each quarter section. These shall not be located closer than 50 mm to any joint, stiffener or through component, nor closer than 100 mm to the edge of the leaf.

9.1.2.6 For door or shutter assemblies which incorporate discrete areas of different thermal insulation ≥0,1 m^2 (e.g. glazed panels within a door leaf), extra thermocouples shall be evenly distributed over the sum of the surface of those areas to determine the average temperature at a density of one thermocouple per square metre or part thereof, subject to a minimum of two. The average insulation performance of the sum of each area shall be determined.

9.1.2.7 When the total area of a single portion of the door or shutter assembly represents less than 0,1 m^2, it shall be disregarded for the purpose of ascertaining the average unexposed face temperature.

9.1.2.8 Temperature of door leaf or shutter.

Thermocouples shall be fixed to the face of each leaf or shutter as follows:

a) at mid-length, 100 mm in from the edges as specified below;

b) at mid-width, 100 mm from the edge as specified below;

c) 100 mm in from the edges as follows:

   1) the inside edges of the clear opening for shutters or sliding doors installed on the exposed side of the supporting construction;

   2) the visible part of the edge of the door leaf for

      i) hinged or pivoted doors opening away from the furnace,

      ii) shutters or sliding doors installed on the unexposed side of the supporting construction.

If due to the narrow width of the leaf (leaves) or shutter(s) the thermocouples specified in b) and c) are closer than 500 mm to each other, then those specified in b) are omitted.

If the leaf is <200 mm wide (e.g. as in a multi-leaf folding shutter), then the leaves will be treated as if they were one leaf with respect to application of unexposed face thermocouples for evaluating maximum temperature rise.

Additional thermocouples shall be fixed to other areas of the leaf or shutter, e.g. over any through connection or position where the temperature might be expected to be higher than the mean for the surface, subject to the limitations given in 9.1.2.9.

9.1.2.9 Temperature of other areas.

Thermocouples for determination of the maximum temperature rise of discrete panels of different thermal insulation within the door leaf shall be applied as for door leaves. However, if there is more than one other area of the same type then they shall be treated as one large area (as those for the average temperature rise are). In such cases thermocouples shall avoid any framework adjacent to the frame leaf.

9.1.2.10 Temperature of door frame.

Thermocouples shall be fixed at each of the following positions:

a) one at mid-length on each long dimension member;

b) one on each of the short dimension members of the frame at mid-width (100 mm away from the door joint of a multi-leaf door on the primary leaf side);

c) one on each of the short dimension members of the frame 50 mm in from each corner of the leaf opening.

At each of the positions, thermocouples shall be fixed as close as possible, i.e. with the centre of the disc 15 mm from the junction between the frame and the supporting construction. Irrespective of this, the distance of these thermocouples from the inside edge of the frame shall not be greater than 100 mm.

For single leaf doors, if due to the narrow width of the opening, the thermocouples specified in b) and c) are closer than 550 mm to each other, then that specified in b) is omitted.

9.2 Maximum temperature

9.2.1 The maximum temperature shall be determined from the five thermocouples fixed to determine the average temperature rise (as given in 9.1.2.5), the roving thermocouple and from additional thermocouples fixed as indicated in 9.2.2, 9.1.2.7, 9.1.2.8 and 9.1.2.9.

9.2.2 If the door or shutter assembly incorporates discrete areas of different thermal insulation ≥0,1 m^2 (e.g. glazed panels within a door or shutter area) which are evaluated separately with respect to average temperature rise, then the evaluation of maximum unexposed face temperature of those areas shall also be undertaken separately. This may require extra unexposed surface thermocouples to be applied as given in 9.1.2.6 and 9.1.2.7.

9.3 Pressure measurements

9.3.1 The pressure in the furnace shall be measured by means of one of the designs of sensors shown in ISO 834-1:1999, Figure 4.

9.3.2 The pressure measuring equipment shall be capable of operating within a range of −20 Pa to +30 Pa with a tolerance of ±2 Pa.

9.3.3 The pressure recording equipment shall be capable of recording data at 1-min intervals with a tolerance of ±1 s.

9.4 Heat flux measurement

9.4.1 General

This Clause describes a method for measuring heat flux. The hazard presented by radiation is evaluated in the test by measuring the total heat flux. However, as the convection heat transfer is negligible, the measurement is reported as heat flux in this part of ISO 3008. It considers the measurement of heat flux in a plane parallel to and at a distance of 1,0 m from the unexposed face of the test specimen. It includes the concept of both an average value, measured opposite the centre of the specimen and the maximum value, which will be greater than or equal to the average value if the specimen is not a uniform radiator.

Guidance is provided on the determination of the maximum value.

There is no requirement in measuring the heat flux from a surface with a temperature below 300 °C because the radiation emitted from such a surface is low (typically 6 kW/m^2, even with an emissivity of 1,0).

Heat flux measurements are not required for loaded test specimens as the equipment used for applying a test load will interfere with the radiation from the specimen, resulting in inaccurate readings.

9.4.2 Apparatus

Measurements of heat flux from the unexposed surface of specimens shall be made by an instrument complying with the following specifications.

a) The target of the instrument shall not be shielded by a window or subject to a gas purge, i.e. it shall be subject to convection, as well as radiation.

b) The suggested range of the instrument shall be 0 kW/m^2 to 50 kW/m^2.

c) The accuracy of the instrument shall be ±5 % of the maximum range.

d) The time constant of the instrument (time to reach 64 % of target value) shall be <10 s.

e) The view angle of the instrument shall be 180 ±5°.

9.4.3 Procedure

9.4.3.1 Positioning

9.4.3.1.1 General

Each heat flux meter shall be positioned 1,0 m from the unexposed surface of the test specimen.

At the start of the test, the target of each heat flux meter shall be parallel (±5°) to the plane of the unexposed surface of the test specimen. The target shall be pointing towards the unexposed surface of the test specimen.

There shall be no significant radiating surfaces other than the specimen within the field of view. The heat flux meter shall not be shielded or masked so that the field of view is restricted.

9.4.3.1.2 Specific locations

Measurements shall be taken at the following locations.

a) Opposite the geometric centre of the specimen. This is referred to as the average heat flux level.

b) At the point at which the maximum heat flux can be expected. Often this follows logically or can be calculated from the geometry of the specimen. If the specimen is symmetrical about its centre and a uniform radiator, this will coincide with the position described in 9.4.3.1.2 a).

c) If the specimen has areas of differing insulation and/or transmission, then it may be difficult to predict the point of maximum intensity with any degree of certainty. In these cases, the following procedure shall be used.

   i) Identify all areas where it is anticipated that the temperature will exceed 300 °C and that also have an area in excess of 0,1 m^2. Measure the heat flux opposite the notational centre of each area.

ii) Two or more identical adjacent parts of the specimen having the same length or width, separated by less than 0,1 m may be treated jointly as a single radiation surface.

iii) If the area or sub-areas of the specimen that is expected to remain below 300 °C is less than 10 % of the total area or sub-area under consideration, then that area or sub-area can be treated as a single radiating surface. This allows for breaks such as glazing bars.

9.4.4 Measurement

Measurements taken at each location described in 9.4.3.1.2 shall be recorded throughout the test at intervals not exceeding one minute.

NOTE Annex B provides an alternative method of estimating the energy radiated from the specimen surface to the surrounding area based of the Stefan-Boltzmann Radiation Law.

9.5 Loading

9.5.1 Throughout the fire test, a superimposed load shall be applied to the specimen to simulate the maximum load conditions.

9.5.2 The maximum load condition shall be as nearly as practicable, the maximum load allowed by the limiting condition of the design under nationally recognized structural design criteria for the floor or roof in which the door is installed.

9.5.3 A fire test shall be permitted to be conducted by applying a restricted load condition to the specimen that shall be identified for a specific load condition other than the maximum permitted load condition.

9.6 Deflection

9.6.1 Deflection shall be measured with appropriate instrumentation to provide a history of all significant movements (i.e. greater than 3 mm) of the test construction during the test. Components where significant movement is likely to occur are

a) door leaf or shutter relative to the frame,

b) the frame relative to the supporting construction, and

c) the supporting construction.

9.6.2 The principle of the measurement shall be by measurement against a fixed datum. The interval between measurements shall be chosen to present a history of deflection during the test. A suitable method for determining deflection of the test construction, including proposals for selection of suitable intervals between measurements, is given in ISO 3009.

Measurement of deflection is a mandatory requirement, although, there is no performance criteria associated with it. Information relating to the relative deflection between components of the test specimen, between the test specimen and the supporting construction, and of the supporting construction itself may be important in determining the extended field of application of the test result.

10 Test procedure

Before the fire test, an examination shall be carried out in the following sequence:

a) gap measurement (see 10.1);

b) test measurement (see 10.2).

10.1 Gap measurements

10.1.1 The clearance between moving components and fixed components of the door or shutter assembly (e.g. between door leaf/leaves and the frame) shall be measured. Sufficient measurements shall be made to adequately quantify the gaps. There shall be a minimum of three measurements made along each side of each leaf of the door. Measurements to determine the gaps shall be made at distances not greater than 750 mm apart and shall be given to an uncertainty not exceeding ±0,5 mm. Inaccessible gaps shall be measured indirectly.

10.1.2 If the gaps measured by the laboratory are not within those defined in 7.4 before the test, then the test result may restrict the direct field of application.

10.2 Test Measurements

10.2.1 Carry out the test and evaluate compliance with the integrity and insulation criteria using the equipment and procedures in accordance with ISO 834-1.

10.2.2 When monitoring for insulation the roving thermocouple shall not be employed where fixed thermocouples are not permitted.

10.2.3 Details of the procedure for assessing heat flux are given in ISO 3009.

11 Performance criteria

11.1 Integrity

The specimen shall be evaluated against the integrity criterion specified in ISO 834-1. These are the times for which the test specimen continues to maintain its separating function during the test, without either

a) causing the ignition of a cotton pad applied in accordance with ISO 834-1,

b) permitting the penetration of a gap gauge as specified in ISO 834-1, or

c) resulting in sustained flaming on the unexposed surface in excess of 10 s duration.

11.2 Insulation

Door or shutter assemblies shall comply with the following criteria.

a) For door or shutter assemblies, which incorporate discrete areas of different thermal insulation, compliance with the insulation criteria shall be determined separately for each area.

b) The specimen shall be evaluated against the maximum temperature rise criterion specified in ISO 834-1 (180 °C), with the exception that the limit for temperature rise of the frame of the door or shutter assembly shall be 360 °C. Compliance shall be derived from temperatures recorded from the thermocouples specified in 9.1.2 and 9.2 and the roving thermocouple.

c) The specimen shall be evaluated against the average temperature rise criterion specified in ISO 834-1 (140 °C). Compliance shall be derived from temperatures recorded from the thermocouples specified in 9.1.2.

11.3 Loadbearing capacity

This is the elapsed time for which the test specimen continues to maintain its ability to support the test load during the test.

12 Test report

In addition to the items required by ISO 834-1, the following shall also be included in the test report:

a) A reference that the test was carried out in accordance with this part of ISO 3008 (e.g. ISO 3008-3).

b) Details of how the test specimen was verified, as described in 6.3.

c) A reference to which standard supporting construction was chosen, if appropriate.

d) A description of the associated supporting construction, if appropriate. The construction details of the associated supporting construction shall be verified in the same way and shall be as thoroughly described as those of the test specimen.

e) Information concerning the conditioning of the supporting construction in the light of the relaxations allowed in Annex A.

f) If the specimen is loaded, the report shall indicate

   1) how the applied load was calculated,

   2) the design standard used to calculate the magnitude of the applied load,

   3) the details of the system used to apply the load,

   4) the time of load application relative to the start and finish of the test,

   5) the loadbearing capacity of the specimen.

g) If the specimen is loaded to other than the maximum load condition referenced in 9.5.3, the report shall define the condition of the loading used in the test and shall designate “restricted load condition” in the title of the test report.

h) The measurements as required by 10.1.

i) Information concerning any mechanical conditioning performed upon the test specimen.

j) At each specific measurement location, the time for the measured heat flux to exceed the value of 5 kW/m^2, 10 kW/m^2, 15 kW/m^2, 20 kW/m^2, and 25 kW/m^2 shall be reported. A clear statement should be made as to whether this is on the basis of average or maximum values.

k) The result stated in terms of the elapsed time, in completed minutes, between the commencement of heating and the time to failure of insulation and integrity.

13 Field of direct application of test results

13.1 General

13.1.1 The field of direct application of test results is restricted to governing the allowable changes to the test specimen following a successful fire resistance test. These variations can be introduced automatically without the need for the sponsor to seek additional evaluation, calculation or approval.

13.1.2 When extended product size requirements are envisaged, the dimensions of certain components within the test specimen can be less than those intended to be used at full size in order to maximize the extrapolation of the test results by modelling the interaction between components at the same scale.

13.1.3 Unless otherwise stated in 13.2 to 13.5, the construction of the door or shutter assembly shall be the same as that tested. The number of leaves and the mode of operation (e.g. sliding, swinging, single action or double action) shall not be changed.

13.1.4 Where the paint finish is not expected to contribute to the fire resistance of the door alternative, paints are acceptable and may be added to door leaves or shutter or frame products for which unfinished specimens were tested. Where the paint finish contributes to the fire resistance of the door (e.g. intumescent paints) then no change shall be permitted.

13.1.5 Decorative laminates and timber veneers up to 1, 5 mm thickness may be added to the faces (but not the edges) of hinged doors that satisfy the insulation criteria (normal or supplementary procedure). Decorative laminates and veneer applied to leaves other than timber and those in excess of 1,5 mm thickness shall be tested as part of the test specimen. For all products tested with decorative laminate faces the only variations possible shall be within similar types and thicknesses of material (e.g. for colour, pattern, manufacturer).

13.2 Timber constructions

13.2.1 The thickness of the door leaves shall not be reduced but may be increased. Likewise, the door leaf thickness and/or density may be increased provided the total increase in weight is not greater than 25 %.

13.2.2 For timber based panel products (e.g. particle board, block board, etc.), the composition (e.g. type of resin) shall not change from that tested. The density shall not be reduced but may be increased.

13.2.3 The cross sectional dimensions and/or the density of the timber frames (including rebates) shall not be reduced but may be increased.

13.3 Steel constructions

13.3.1 The dimensions of steel wrap around frames may be increased to accommodate increased supporting construction thicknesses. The thickness of the steel may also be increased by up to 25 %.

13.3.2 The number of stiffening elements for un-insulated doors and the number and type of fixing of such members within the panel fabrication may be increased proportionally with the increase in size but shall not be reduced.

13.4 Glazed constructions

13.4.1 The type of glass and the edge fixing technique, including type and number of fixings per metre of perimeter, shall not be changed from those tested.

13.4.2 The number of glazed apertures and each of the dimensions of glass in each pane included within a test specimen of timber or steel may be decreased but shall not be increased beyond the tested pane size.

13.4.3 The distance between the edge of glazing and the perimeter of the door leaf, or the distance between glazed apertures shall not be reduced from those incorporated in test specimens. Other positioning within the door can only be modified if this does not involve the removal or repositioning of structural members.

NOTE Attention is drawn to the fact that if relocating the glazing panel moves it closer to the heat flux meter, then there will be an increase in the heat flux measured.

13.5 Fixings/hardware

13.5.1 The number of fixings used to attach fire resisting doors to supporting constructions may be increased but shall not be decreased and the distance between fixings may be reduced but shall not be increased.

13.5.2 Changes in hardware are permitted, provided that it has been demonstrated (in fire testing according to this part of ISO 3008), that their inclusion in other doorsets of a quantifiably similar construction and configuration was not a cause of integrity failure.

13.5.3 Any movement restrictors such as locks, latches and hinges may be increased but shall not be decreased.

Annex A
(normative)

Conditioning requirements for supporting constructions

A.1 General

ISO 834-1 specifies that the test specimen shall be fully conditioned so that its strength and moisture content are approximate to that experienced in service. To impose that requirement on masonry or concrete supporting constructions could result in conditioning times of several months, which would be impractical. The purpose of this Annex is to specify the conditioning requirements necessary for supporting constructions. In doing this, consideration has been given to those aspects of conditioning (moisture content, strength) that may affect the fire resistance performance (integrity and insulation) of the test construction. The requirements represent a compromise between the need to test specimens fully conditioned and the practical aspects of laboratory testing. The requirements apply to both standard and associated supporting constructions.

A.2 Requirements

A.2.1 Concrete or masonry supporting constructions that use water based mortars, e.g. as described in ISO 834-1, shall be conditioned for a period of 28 days before fire testing.

A.2.2 Masonry walls constructed with masonry units that have been conditioned in accordance with ISO 834-1 and which use special adhesives that cure in short periods shall be conditioned for sufficient time for the special adhesive to cure or for 24 h, whichever is longer.

A.2.3 Lightweight standard supporting constructions, e.g. as described in ISO 834-1, shall be conditioned in accordance with ISO 834-1, with the exception of sealing materials such as gypsum plaster used to fill in the joints between the outer layers of facing boards, for which a period of 24 h is sufficient.

A.2.4 Hygroscopic sealing materials used to seal the gap between the supporting construction and the door assembly where the gap is ≤10 mm wide shall be conditioned for seven days before fire testing.

A.2.5 Hygroscopic sealing materials used to seal the gap between the supporting construction and the door assembly where the gap is >10 mm wide shall be conditioned for 28 days before fire testing.

A.2.6 Door frames which incorporate water-based materials (e.g. steel frames that have back filled or pressure grouted frames) shall be conditioned for a period of 28 days before fire testing.

Annex B
(informative)

Estimation of radiant heat flux using measured surface temperature and Stefan-Boltzmann law

B.1 General

Energy is radiated from one surface to another at a rate that is proportional to the emissivity of the radiating surface, the emissivity of the receiving surface, the relative size and orientation of the surfaces (i.e. "view factor") and the difference in the fourth powers of the absolute temperature of the surfaces. This relationship is described mathematically by the Stefan-Boltzmann law:

$$Q_{rad} = A\varepsilon_1\varepsilon_2 f\sigma(T_2^4 - T_1^4) \tag{B.1}$$

where

Q_{rad} is the total radiated energy (W);

A is the area of radiating surface (m^2);

ε_1 is the emissivity of receiving surface;

ε_2 is the emissivity of radiating surface;

f is the "view factor";

σ is the Stefan-Boltzmann constant = $5{,}67 \times 10^{-8}$ $W/m^2(K)^4$;

T_1 is the temperature of receiving surface (K);

T_2 is the temperature of radiating surface (K).

This is the principle that is used in the design, application and calibration of radiometers and optical/infrared pyrometers. Where it is practical to measure the temperature of a radiating body accurately and if the effective emissivity of the surface is known, the radiated energy can be readily and accurately determined.

B.2 Application

The measurement method specified in 9.4 uses a radiometer positioned such that the intent is to measure the total radiation from the specimen surface to a "black body" with a view factor of one. Thus, to estimate the equivalent radiation based on the above equation, it is appropriate to assume a view factor of 1, an emissivity of receiving surfaces of 1 and a temperature of the receiving surfaces equal to the laboratory ambient temperature. If the laboratory space is large, the last assumption will have a relatively small effect on the uncertainty of the calculation. However, if there is a surface near the specimen (such as a laboratory wall) that experiences significant heating, the temperature and emissivity of that surface can be used in the calculation.

B.2.1 Specimen temperature measurement

The specimen surface temperature is to be measured in sufficient locations to allow for calculation of an area-weighted average surface temperature. This will generally require placement of sensors at locations where thermal bridges through the sample are located as well as several in areas where construction is uniform. It is important to attach sensors in a manner that measures the true surface temperature as accurately as possible. The use of insulating pads should be avoided. For metal surfaces brazing or welding thermocouples to the surface is recommended or junctions may be riveted or screwed to the surface. For other materials thermocouples should be embedded into the surface slightly and held in place with high temperature adhesive or aluminium foil tape painted to match the underlying surface emissivity. A minimum of 100 mm of the thermocouple lead wire adjacent to the measuring junction should be placed in contact with the surface to avoid thermal shunting.

B.2.2 Specimen emissivity

For most materials emissivity values can be obtained from reference handbooks. Most building materials have emissivities in a range of 0,85 to 0,95, but values for materials such as glass and polished metals can vary substantially. In cases where the emissivity of a sample cannot be determined otherwise, it is recommended that it be measured with an emissometer. It should be noted, however, that the emissivity of some materials can change substantially during heating due to surface oxidation and other effects.

B.3 Example calculation

Specimen surface temperature = 540 K

Room temperature = 293 K

Specimen emissivity = 0,90

Specimen area = 2,5 m^2

$$Q_{rad} = 2{,}5 \times 0{,}90 \times 1 \times 5{,}67 \times 10^{-8}(540^4 - 293^4) = 9\ 907 \text{ Watts or } 3{,}96 \text{ kW/m}^2$$

NOTE If the area is set to unity and the result is divided by 1 000, the equation provides the radiant flux from a surface in terms of kW/m^2.

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