Fire resistance tests for door and shutter assemblies —

Part 1: Fire doors and shutters

The European Standard EN 1634-1:2000 has the status of a British Standard
National foreword

This British Standard is the official English language version of EN 1634-1:2000.

The UK participation in its preparation was entrusted by Technical Committee FSH/22, Fire resistance tests, to Subcommittee FSH/22/5, Test procedures for doors, which has the responsibility to:

— aid enquirers to understand the text;
— present to the responsible European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;
— monitor related international and European developments and promulgate them in the UK.

A list of organizations represented on this subcommittee can be obtained on request to its secretary.

The possibility of coexistence of this standard and the existing parts of BS 476 for a period of time yet to be determined is currently under discussion in CEN. Further information about the withdrawal of the relevant parts of BS 476 will be notified.

Cross-references

The British Standards which implement international or European publications referred to in this document may be found in the BSI Standards Catalogue under the section entitled “International Standards Correspondence Index”, or by using the “Find” facility of the BSI Standards Electronic Catalogue.

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Summary of pages

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Fire resistance tests for door and shutter assemblies - Part 1: Fire doors and shutters

This European Standard was approved by CEN on 18 February 1999.

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Foreword

This European Standard has been prepared by Technical Committee CEN/TC 127, 'Fire safety in buildings', the secretariat of which is held by BSI.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by July 2000, and conflicting national standards shall be withdrawn at the latest by October 2001.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement the European Standard; Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of the Construction Products Directive.

EN 1634 'Fire resistance tests for door and shutter assemblies' consists of the following:

Part 1: Fire doors and shutters

Part 2: Fire door hardware (in course of preparation)

Part 3: Smoke control doors (in course of preparation)
Introduction

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 the test elements or structures, their testing and disposal of test residues.

An assessment of all potential hazards and risks to health shall be made 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 EN 1634 specifies a method for determining the fire resistance of door and shutter assemblies designed for installation within openings incorporated in vertical separating elements, such as:

- hinged and pivoted doors;
- horizontally sliding and vertically sliding doors including articulated sliding doors, sectional doors;
- steel single skin folding shutters ( uninsulated );
- other sliding folding doors;
- tilting doors;
- rolling shutter doors.

This European Standard is used in conjunction with EN 1363-1.

Doors tested in accordance with this standard can be acceptable for certain lift landing door applications.

The testing of fire dampers and closures for conveyors and track bound transportation systems are specifically excluded.

No requirements are included for mechanical conditioning, e.g. ‘shakedown’ or durability, as these are included in the relevant product standard.

This method may also be used to determine the fire resistance of non-loadbearing horizontal doors by analogy. However, these are not specifically addressed here and the field of direct application given in clause 13 is not valid for horizontally oriented doors.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

EN 1363-1 Fire resistance tests - Part 1: General requirements
EN 1363-2 Fire resistance tests - Part 2: Alternative and additional procedures
prEN ISO 13943 Fire safety - Vocabulary (ISO/DIS 13943)

3 Definitions

For the purposes of this part of EN 1634, the definitions given in EN 1363-1 and ISO/DIS 13943, together with the following, apply:
3.1 door or shutter assembly (doorset): The complete assembly, including any frame or guide, door leaf or leaves, rolling or folding curtain, etc., which is provided for closing of permanent openings in separating elements. This includes all side-panels, vision panels or transom panels, together with the door hardware and any seals (whether provided for the purpose of fire or smoke control or for other purposes such as draught or acoustics) which are used in the assembly.

3.2 door hardware: Items such as hinges, handles, locks, panic bar(s), escutcheons, letter plates, kick plates, sliding gear, closing devices, electrical components, wiring, etc., which are, or can be, used in the door or shutter assembly.

3.3 single action: The action of a fire door leaf which only opens in one direction.

3.4 double action: The action of a fire door leaf which opens in both directions.

3.5 fire seal: A seal fitted to the leaf edge or frame reveal for the purpose of extending the period of integrity of the assembly.

3.6 smoke seal: A seal fitted to the leaf edge or frame reveal for the purpose of restricting the flow of smoke or hot gases.

3.7 floor: The upper surface of the horizontal element on which the door assembly is mounted and which extends from the exposed face to the unexposed face of the assembly.

3.8 cill: A member which connects two frame jambs together at the base which may or may not be set into the floor and remains visible.

3.9 gap: The clearance between two nominally adjacent surfaces and/or edges, e.g. between the edge of leaf and the reveal of the frame or face of the leaf and the frame stop.

3.10 through connection: A fixing or internal spacer that either penetrates through the door or shutter construction from one face to another or directly connects the faces one to the other.

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

3.12 associated supporting construction: A specific construction in which the door or shutter assembly is to be installed 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.

3.13 test specimen: A door or shutter assembly which is to be installed in a standard or associated supporting construction to allow it to be evaluated.

3.14 transom: A member that extends across the frame from jamb to jamb at the head of the leaf and which creates an aperture to house a transom panel.

3.15 transom panel: A fixed panel which is incorporated above a door and is bounded on all edges by either the frame head, the jambs or the transom.

3.16 flush over panel: A fixed panel fitted within the head and jambs above the door leaf without a transom fitted and which is of a similar thickness and appearance to the door leaf.

3.17 side panel: A fixed panel which is incorporated to one side of a door which is part of the test specimen.
3.18 primary leaf: The leaf of a multi-leaved door assembly that is the largest and/or has the handle attached to it as the preferred leaf for general operation. If the leaves of a multi-leaved door are the same size and if the handles (or other hardware such as push plates) are fitted to all leaves, then no primary leaf exists for that door assembly.

4 Test equipment

The test equipment specified in EN 1363-1 and, if applicable, EN 1363-2 shall be used.

5 Test conditions

The heating and pressure conditions and the furnace atmosphere shall conform to those given in EN 1363-1 or, if applicable, EN 1363-2.

6 Test specimen

6.1 Size

The test specimen and all its components shall be full size unless limited by the size of the front opening of the furnace which will normally be 3 m x 3 m. Door assemblies which cannot be tested at full size shall normally be tested to the maximum size possible consistent with 7.2.3.

6.2 Number

The number of test specimens shall be selected as described in EN 1363-1. If testing is carried out from one side only, whether due to the fact that the door assembly is symmetrical or because it is only required to resist fire from one side, this shall be stated in the test report.

6.3 Design

The design of the test specimen and the choice of supporting construction shall take into account the requirements of clause 13 if the widest field of direct application is to be achieved.

The sponsor shall declare to the laboratory the design gaps (see 3.9) including tolerances.

Where the door or shutter assembly incorporates side, transom or flush over panels, whether glazed or unglazed, these shall be tested as part of the door assembly. The side panel shall always be on the latch side.

The test specimen shall be fully representative of the door or shutter assembly 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 test.

6.4 Construction

The test specimens shall be constructed as described in EN 1363-1.

6.5 Verification

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 the accuracy of the information supplied. EN 1363-1 provides detailed guidance on verification of the test specimen.
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:

a) the laboratory shall request to oversee the manufacture of the door or shutter assembly(ies) which is to be the subject of the test; or

b) the sponsor shall, 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) to the number required for test. The laboratory shall then choose freely which of these shall be submitted to the test and which shall be used to verify the construction.

7 Installation of test specimen

7.1 General

The test specimen shall be installed, as far as possible, in a manner representative of its use in practice.

The specimen shall be mounted in a supporting construction which covers the type in which it is intended to be used. The design of the connection between the door or shutter assembly and the supporting construction, including any fixings and materials used to make the junction, shall be as used in practice and shall be regarded as part of the test specimen. The door and frame assembly shall be mounted within the supporting construction so that it is flush with the exposed face of the supporting construction, unless the normal mounting procedure does not allow this.

The whole area of the test specimen, together with at least the minimum dimensions of the supporting construction required by 7.2.3, shall be exposed to the heating conditions.

7.2 Supporting construction

7.2.1 General

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

7.2.2 Standard supporting construction

The choice of standard supporting construction shall reflect the intended normal use of the door or shutter assembly. The rules governing the applicability of the chosen standard supporting construction to other end use situations are given in 13.5.

The standard supporting construction shall be chosen from those given in EN 1363-1.

7.2.3 Erection of standard supporting or associated supporting constructions

Figures 1 to 8 illustrate the use of supporting constructions in conjunction with the mounting of specimens of different types of door or shutter assemblies.

For flexible standard supporting constructions and all associated supporting constructions the partition or wall shall be erected so that it can distort freely perpendicular to the plane of the construction along the vertical edges, i.e. there shall be a free edge at each end of the construction.

For rigid standard supporting constructions the wall shall be erected with no freedom to distort.
perpendicular to the plane of the wall along the vertical edges, i.e. it shall be fixed to the inside of the test frame as in practice.

The supporting construction shall be built within a test frame conforming to clause 4 of EN 1363-1:1999. The supporting construction shall be prepared in advance of the fitting of the specimen leaving an aperture of the desired size, except when it is normally erected in conjunction with the door or shutter assembly using appropriate fixing methods. 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 door and frame assembly 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 between each specimen and between the specimens and the edge of the furnace.

If the bottom of the door or shutter assembly is at floor level in practice, then at the bottom of the aperture continuity of the floor shall be simulated using a solid non-combustible rigid material which has a minimum width of 200 mm on each side of the assembly (i.e. from the exposed to the unexposed face). The furnace floor can be regarded as part of the simulation of the floor continuity provided that it is level with the base of the assembly. If a cill detail is incorporated as part of the door or shutter assembly this shall be incorporated within or placed on top of the extension. If the door or shutter assembly is not to be used at floor level, and provided that it has a frame detail to all four sides of the aperture, then it may be mounted simply within the thickness of the wall, without the extension.

**NOTE:** If the door assembly is tested in conjunction with a non-combustible floor then this may not represent the situation when the door is installed above a combustible flooring such as timber or carpet.

### 7.3 Gaps

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

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

**NOTE:** A door assembly with a specified range of gaps from 3 mm to 8 mm is tested with gaps set between 5.5 mm and 8 mm.

Examples of gap measurements are given in Figures 9 to 12.

### 8 Conditioning

#### 8.1 Moisture content

The test specimen shall be conditioned in accordance with EN 1363-1.

Requirements for conditioning of supporting constructions are given in annex A.

#### 8.2 Mechanical

Reference shall be made to the product standard for details of requirements for mechanical conditioning of the test specimen before fire testing, e.g. operational test, 'shakedown' or specimen self-closing test.
Durability requirements are given in the relevant product standard.

9 Application of instrumentation

9.1 Thermocouples

9.1.1 Furnace thermocouples (plate thermometers)

Plate thermometers shall be provided in accordance with EN 1363-1. They shall be evenly distributed over a vertical plane 100 mm from the nearest plane of the test construction (see Figure 13). There shall be at least one plate thermometer for every 1.5 of the exposed surface area of the test construction, subject to a minimum of four.

The plate thermometers shall be oriented so that side 'A' faces the back wall of the furnace.

9.1.2 Unexposed face thermocouples

9.1.2.1 General

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

Where compliance with the insulation criteria is required to be evaluated, thermocouples of the type specified in EN 1363-1 shall be attached to the unexposed face for the purpose of obtaining the average and maximum surface temperatures. General principles for the attachment and exclusion of thermocouples given in EN 1363-1 shall apply.

Evaluation of insulation against a supplementary procedure (see 9.1.2.4) is provided in addition to the normal requirement. The sponsor shall instruct the laboratory if he requires evaluation of the door or shutter assembly against the supplementary procedure as this requires the application of additional thermocouples for this purpose.

The temperature of the supporting construction in which the door assembly is mounted is not required to be measured and therefore no thermocouples are required to be attached to it.

No thermocouple shall be placed within 50 mm of any ironmongery.

Examples of the location of unexposed face thermocouples are shown in Figures 14 to 27.

9.1.2.2 Average temperature

Position five thermocouples (for single or double leaf doors), one at the centre of the leaf (leaves) 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 (leaves) or curtain.

For door or shutter assemblies which incorporate discrete areas of different thermal insulation ≥0.1 m² (e.g. flush over panels, transom panels, side panels, or 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.

When the total area of a single portion of the door or shutter assembly represents less than 0.1 m², it shall be disregarded for the purpose of ascertaining the average unexposed face temperature.

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9.1.2.3 Maximum temperature

a) General

The maximum temperature shall be determined from the five thermocouples fixed to determine the average temperature rise (as given in 9.1.2.2), the roving thermocouple and from additional thermocouples fixed as indicated in 9.1.2.3 b), 9.1.2.3 c) and 9.1.2.3 d).

If the door or shutter assembly incorporates discrete areas of different thermal insulation \( \geq 0.1 \text{ m}^2 \) (e.g. flush over panels, transom panels, side panels or glazed panels within a door 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 c) and d).

Thermocouples shall not be placed on fasteners with a surface diameter less than 12 mm unless they extend through the assembly.

b) Temperature of door frame

Thermocouples shall be fixed at each of the following positions:

i) one at mid-height on each vertical member;

ii) one on the horizontal top member of the frame (and any transom >30 mm wide, if fitted) at mid-width (100 mm away from the door joint of a multi-leaf door on the primary leaf side);

iii) on the horizontal top member of the frame (and any transom >30 mm wide, if fitted) 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. See Figure 16.

NOTE: For single leaf doors, if due to the narrow width of the opening the thermocouples specified in ii) and iii) are closer than 550 mm to each other, then that specified in ii) is omitted. See Figure 21.

c) Temperature of door leaf or shutter

Thermocouples shall be fixed to the face of each leaf (leaves) or shutter(s) as follows:

i) at mid-height, 100 mm in from the vertical edges as specified below;

ii) at mid-width, 100 mm down from the horizontal edge as specified below;

iii) 100 mm in from the vertical edges, 100 mm down from the horizontal edge as follows:

- the inside edges of the clear opening for:
  - hinged or pivoted doors opening towards the furnace;
  - shutters or sliding doors installed on the exposed side of the supporting construction.
- the visible part of the edge of the door leaf for:

- hinged or pivoted doors opening away from the furnace;
- shutters or sliding doors installed on the unexposed side of the supporting construction.

See Figures 14 to 21 and 23 to 27.

NOTE 1: If due to the narrow width of the leaf (leaves) or shutter(s) the thermocouples specified in ii) and iii) are closer than 500 mm to each other, then those specified in i) are omitted.

NOTE 2: 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.

Examples of the reduction in the requirement for unexposed face thermocouples with width are given in Figure 21.

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 9.1.2.3 a). The additional thermocouples shall be placed not less than 100 mm from the edges of the door leaf.

d) Temperatures of other areas

Thermocouples for determination of the maximum temperature rise of side, transom and flush over panels and 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. See Figures 26 and 27.

In addition, thermocouples shall be placed on flush over panels and transom panels above door leaves (but not discrete panels within the leaf) as follows:

i) at mid-width, 100 mm up from the horizontal edge;

ii) 100 mm in from the vertical edges, 100 mm up from the horizontal edges.

See Figures 23 and 24 for examples of the above. See Figure 22 for exclusion of thermocouples on panels on the basis of size and distance between thermocouples.

The rules for reducing the number of thermocouples on door leaves of decreasing width shall also apply to transom panels, side panels and flush over panels. See Figure 21 for examples.

9.1.2.4 Maximum temperature (supplementary procedure)

a) General

The maximum temperature shall be determined from the thermocouples used for the determination of maximum temperature together with additional thermocouples fixed as indicated in 9.1.2.4 b) and 9.1.2.4 c).

b) Temperature of door leaf or shutter
Thermocouples shall be fixed to the face of each leaf (leaves) or shutter(s) as follows:

i) at mid-height, 25 mm in from the vertical edges as specified below;

ii) at mid-width, 25 mm down from the horizontal edge as specified below;

iii) 25 mm in from the vertical edges, 25 mm down from the horizontal edge as follows:

- the inside edges of the clear opening for:
  - hinged or pivoted doors opening towards the furnace;
  - shutters or sliding doors installed on the exposed side of the supporting construction;

- the visible part of the edge of the door leaf:
  - hinged or pivoted doors opening away from the furnace;
  - shutters or sliding doors installed on the unexposed side of the supporting construction.

NOTE 1: If due to the narrow width of the leaf (leaves) or shutter(s) the thermocouples specified in ii) and iii) are closer than 575 mm to each other, then those specified in ii) are omitted.

NOTE 2: 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.

Examples of the variation in the requirement for unexposed face thermocouples with width are given in Figure 21.

c) Temperature of other areas

Thermocouples for determination of the maximum temperature rise of other areas (excluding discrete panels within doors) 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.

In addition, thermocouples shall be placed on flush over panels and transom panels above door leaves as follows:

i) at mid-width, 25 mm up from the horizontal edge;

ii) 25 mm in from the vertical edges, 25 mm up from the horizontal edge.

See Figures 23 and 24 for examples of the above. See Figure 22 for exclusion of thermocouples on side transom and flush over panels on the basis of size and distance between thermocouples.

The rules for reducing the number of thermocouples on door leaves of decreasing width shall also apply to transom panels, side panels and flush over panels. See Figure 21 for examples.
9.2 Pressure

Install pressure measuring devices in the furnace in accordance with EN 1363-1.

9.3 Deflection

Appropriate instrumentation shall be provided to determine a history of all significant movements (i.e. greater than 3 mm) of the test construction during the test. The following components are suggested as areas where significant movement is likely to occur:

- door leaf or shutter relative to frame;
- frame relative to supporting construction;
- supporting construction.

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 EN 1363-1.

NOTE: Measurement of deflection is a mandatory requirement although there are 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. Figures 28 to 31 show recommended positions for measuring deflection.

9.4 Radiation

If radiation is to be measured, radiometers shall be positioned as described in EN 1363-2.

10 Test procedure

10.1 Pre-test measurements, examination and preparation

10.1.1 General

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

a) any mechanical conditioning, e.g. “shakedown” carried out by the laboratory in accordance with the product standard;

b) gap measurements, see 10.1.2;

c) retention force measurements when a closing mechanism provides assistance to fire resistance by retention of the specimen, see 10.1.3;

d) final setting, see 10.1.4.

10.1.2 Gap measurements

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 prior to the test. Sufficient measurements shall be made to adequately quantify the gaps. There shall be a minimum of three measurements made along each side, top and bottom 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 accuracy not exceeding 0.5 mm. Inaccessible gaps shall be measured indirectly.

Figures 9 to 12 illustrate examples of the measurements to be taken at various positions for different door edge/frame rebate types. If the gaps measured by the laboratory are not within those defined in 7.3 before the test, then the test result may restrict the direct field of application, see clause 13.

10.1.3 Retention force measurements

The retention forces for all door assemblies which incorporate closing devices and which are meant to be opened unaided by mechanical power shall be measured. These measurements are needed to establish the magnitude of the forces used to retain the door leaf closed to ensure that they are representative of those used in normal practice.

For each door leaf, the retention force shall be determined as given below. For double action doors, the moment shall be determined for each direction of opening and for folding doors, the force shall be determined in the direction of opening.

The retention forces for all door assemblies which incorporate closing devices operated by egressing personnel without mechanical assistance shall be measured as follows:

Open the test door slowly, using a force gauge attached to the handle and operating against the direction of closing, to a distance of 100 mm away from its closed position. Record the highest gauge reading between the closed and 100 mm positions.

10.1.4 Final setting

Prior to the fire test, the door or shutter shall be subjected to a final closing involving opening the assembly to a distance of approximately 300 mm and returning it to the closed position. When applicable this shall be done by the closing device. If the assembly does not contain any closing device or it cannot be used in the furnace then the door assembly shall be closed by hand.

Doors may be latched prior to the fire test but shall not be locked unless the door can only be retained in the closed position during normal use by utilizing the lock (i.e. there is no latch or closing device to hold the door in the closed position). This condition is only applicable to doors normally maintained in a locked position. No key shall be left in the lock.

If the final setting procedures are carried out with the specimen in position on the furnace then the furnace shall be in an ambient pressure condition (i.e. with no air input or extraction).

10.2 Fire test

10.2.1 General

Carry out the test using the equipment and procedures in accordance with EN 1363-1 and if required EN 1363-2.

10.2.2 Integrity

When monitoring for integrity, the 6 mm gap gauge shall not be employed at the cill of the door or shutter assembly.

10.2.3 Insulation

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

Details of the procedure for assessing radiation are given in EN 1363-2.

11 Performance criteria

11.1 Integrity

The criteria by which the integrity performance of the test specimen shall be judged are given in EN 1363-1.

11.2 Insulation

11.2.1 General

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.

11.2.2 Average temperature rise

The specimen shall be evaluated against the average temperature rise criterion specified in EN 1363-1. Compliance shall be derived from temperatures recorded from the thermocouples specified in 9.1.2.2.

11.2.3 Maximum temperature rise

The specimen shall be evaluated against the maximum temperature rise criterion specified in EN 1363-1 (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 9.1.2.2, 9.1.2.3, and the roving thermocouple subject to the provisions given in 10.2.3.

11.2.4 Maximum temperature rise (supplementary procedure)

The specimen shall be evaluated against the maximum temperature rise criterion specified in EN 1363-1. Compliance shall be derived from temperatures recorded from the thermocouples specified in 9.1.2.2, 9.1.2.3, 9.1.2.4 and the roving thermocouple subject to the provisions given in 10.2.3.

11.3 Radiation

Details of the performance criteria for radiation are given in EN 1363-2.

12 Test report

In addition to the items required by EN 1363-1, the following shall also be included in the test report:

a) Reference that the test was carried out in accordance with EN 1364-1.

b) Details of how the test specimen was verified as described in 6.5.

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

d) A description of the associated supporting construction, if appropriate. The constructional
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) The gap measurements as required by 10.1.2.

g) The retention forces as required by 10.1.3.

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

i) The result stated in terms of the elapsed time, in completed minutes, between the commencement of heating and the time to failure of insulation under the normal and if appropriate, the supplementary procedure.

13 Field of direct application of test results

13.1 General

The field of direct application of 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.

NOTE: 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.

13.2 Materials and constructions

13.2.1 General

Unless otherwise stated in the following text the construction of the door 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.

13.2.2 Specific restrictions on materials and construction

a) Timber constructions

The thickness of the door leaves shall not be reduced but may be increased.

The door leaf thickness and/or density may be increased provided the total increase in weight is not greater than 25 %.

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

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

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%.

The number of stiffening elements for uninsulated 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.

c) Glazed constructions

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.

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

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 re-positioning of structural members.

NOTE: Attention is drawn to the fact that relocating the glazing panel may move it closer to the radiometer and may therefore increase the radiation measured.

13.2.3 Decorative finishes

a) Paint

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 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.

b) Decorative laminates

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 veneers 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).

13.2.4 Frames

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.

13.2.5 Hardware

Changes in hardware are permitted provided the alternative hardware has been demonstrated in another doorset of similar configuration.
The number of any movement restrictors such as locks, latches and hinges may be increased but shall not be decreased.

13.3 Permissible size variations

13.3.1 General

Doors of sizes different from those of tested specimens are permitted within certain limitations but the variations are dependent on product type and the length of time that the performance criteria are fulfilled.

13.3.2 Test periods

The amount of variation of size permitted is dependent on whether the classification time was just reached (category 'A') or whether an extended time (category 'B') in accordance with the following values was fulfilled before the test was concluded.

For category 'B':

<table>
<thead>
<tr>
<th>Classification time</th>
<th>All performance criteria fulfilled for at least</th>
</tr>
</thead>
<tbody>
<tr>
<td>15 minutes</td>
<td>18 minutes</td>
</tr>
<tr>
<td>20 minutes</td>
<td>24 minutes</td>
</tr>
<tr>
<td>30 minutes</td>
<td>36 minutes</td>
</tr>
<tr>
<td>45 minutes</td>
<td>52 minutes</td>
</tr>
<tr>
<td>60 minutes</td>
<td>68 minutes</td>
</tr>
<tr>
<td>90 minutes</td>
<td>100 minutes</td>
</tr>
<tr>
<td>120 minutes</td>
<td>132 minutes</td>
</tr>
<tr>
<td>180 minutes</td>
<td>196 minutes</td>
</tr>
<tr>
<td>240 minutes</td>
<td>260 minutes</td>
</tr>
</tbody>
</table>

13.3.3 Size variation related to product type

13.3.3.1 General

The rules to cover increase or decrease of size without additional considerations are applicable only to five main product groups:

i) hinged and pivoted doors;
ii) horizontally sliding and vertically sliding doors including sectional doors;
iii) steel single skin folding shutters ( uninsulated);
iv) other sliding folding doors;
v) rolling shutter doors.

No increases in size are permitted for doors satisfying the radiation criterion unless the insulation criterion is also satisfied. This is because any increase in size will increase the radiation received at a fixed distance away from the door. There are calculation methods which can be used to determine acceptable size increases for such doors; however, these are beyond the scope of direct application. Doors that satisfy both the radiation and insulation criteria may have their sizes increased as outlined in annex B. This is accepted because the increase in radiation resulting from a size increase allowed under this section, for an insulated door, will be such that it will still satisfy the radiation criterion. Size decreases are permitted for both doors which satisfy radiation and those which satisfy insulation and radiation.
Permissible variations for each product group are detailed in annex B.

Size increases for products which do not fall into one of the five groups given above are the subject of extended application.

13.3.3.2 Hinged and pivoted doors

a) For size variations (see annex B)

For category 'A' tests with no overrun of classification period no increase is allowed. Unlimited reductions from the tested specimen are permitted with the exception of insulated metal doors where the size reduction is limited.

For category 'B' tests (with overrun in accordance with 13.3.2) increases are only permitted provided that the door is tested with the gaps set between the middle value and the maximum value within the range of gaps given by the sponsor as stated in 7.3. If the gaps were not set according to 7.3 then no size increases are permitted using category 'B' time extensions. However, the test result is still applicable to door or shutter assemblies with gaps less than the average of the medium and maximum measured values.

b) Other changes

For smaller door sizes the relative positioning of movement restrictors (e.g. hinges, latches, etc.) shall remain the same as tested or any change to the distances between them will be limited to the same percentage reduction as the decrease of specimen size.

For larger door sizes the following shall also apply:

- the height of the latch above floor level shall be equal to or greater than the tested height, and such increase in height shall be at least proportional to the increase in door height;
- the distance of the top hinge from the top of door shall be equal to or less than that tested;
- the distance of the bottom hinge from bottom of door shall be equal to or less than that tested;
- where three hinges or distortion preventers are used, the distance between the bottom of the door and centre restraint shall be equal to or greater than that tested.

c) Side and transom panels

The rules for variation to tested specimens of side and transom panel arrangements are the same as those applied generally to hinged doors. If only one side panel can be tested due to the constraints of the furnace (3 m × 3 m) size then providing the latch side, side panel is tested using the maximum furnace opening available and providing a type 'B' overrun time has been proven, a second panel up to the same size may be added to the opposite side. The addition of a second side panel is not allowed for doors satisfying the radiation criterion, unless they also satisfy the insulation criterion for the reasons given in 13.3.3.1.

Similarly the result of a test on a door assembly incorporating a side panel on the latch side is also applicable when no side panel is fitted.

d) Timber constructions

The number, size, location and orientation of any joints in the timber framing shall not be changed.
Where decorative veneers of 1,5 mm or greater thickness, or other claddings which themselves provide constructive benefits, are part of the specimen, they shall not be substituted with alternatives of lesser thickness or strength.

13.3.3.3 Horizontally sliding and vertically sliding doors including sectional doors

For size variations (see annex B).

For category 'A' tests (with no overrun of classification period) unlimited size reduction is permitted with the exception of insulated metal doors where the size reduction is limited.

For category 'B' tests (with specified overrun of classification period) all smaller sizes are permitted and increases in height and width are permitted.

For modular panels tested to the maximum allowable furnace size (i.e. 2,6 m wide × 2,8 m high for a standard 3 m × 3 m furnace) the height and/or the width can be increased provided that the area is not increased by more than 50%. Additionally, specimens comprising joined panels shall incorporate at least one full size panel with examples of jointing technique at each end.

Both of the above extensions to width and height are only permissible if the overlaps at the rear and head of the door are adjusted to increase the tightness of the interlock (shown in Figure 32) by 10 mm per metre of increase in size.

13.3.3.4 Steel single skin folding shutters (uninsulated)

For size variations (see annex B).

For category 'A' tests with no overrun of classification period no size increases are permitted. Smaller sizes than the test specimen are permitted.

For category 'B' tests with the specified overrun of classification period all smaller sizes shall be permitted. Increases in height, width and area are permitted providing modular sizes are retained.

For modular panels tested to the maximum allowable furnace size (i.e. 2,6 m wide × 2,8 m high for a standard 3 m × 3 m furnace) the height and/or width can be increased provided that the area is not increased by more than 50%. Additionally, specimens comprising joined panels shall incorporate at least one full size panel with examples of jointing technique at each end.

Material thickness may be increased by up to 50% but it shall not be reduced beyond acceptable steel industry tolerances.

13.3.3.5 Sliding, folding doors (insulated)

For size variations (see annex B).

For category 'A' tests without over-run, no size increases are permitted. Smaller sizes than the test specimen are permitted subject to the size limitations in annex B.

For category 'B' tests with the specified over-run of classification period, smaller sizes are permitted. Increases in height and width are permitted as detailed in annex B.

13.3.3.6 Rolling shutter doors

Rules for the direct field of application for rolling shutters are not applicable to water cooled rolling shutters.

For size variations (see annex B)
For uninsulated shutters the material thicknesses may be increased up to 50% but it shall not be reduced beyond acceptable steel industry tolerances.

For insulated shutters the material thicknesses shall not be varied beyond the tolerances on thickness accepted by the steel industry.

The material thickness of side guides and barrel carrying end plates may be increased by up to 50% but it shall not be reduced beyond acceptable steel industry tolerances.

The clearance between the end of the shutter laths and the inside faces of the guides shall be increased in proportion to the increase in width of the laths (see Figure 32). The tightness (overlap) between the shutter curtain and the vertical guides shall not be reduced for size decreases, but shall be increased proportionally for size increases.

13.4 Asymmetrical door assemblies

13.4.1 General

EN 1363-1 states that for separating elements required to be fire resisting from both sides, two specimens shall be tested (one from each direction) unless the element is fully symmetrical. However, in some cases it is possible to develop rules whereby the fire resistance of an asymmetrical door assembly tested in one direction can apply when the fire exposure is from the other direction. The possibility to develop such rules increases if the consideration is limited to certain types of door assembly and on the criteria being applicable, e.g. integrity only doors. The following rules represent the minimum level of common agreement which shall be followed. The rationale behind the rules is given in annex C.

13.4.2 Specific rules

The rules governing the applicability of tests carried out in one direction to other directions are given in Table 1. They are based on the following premises:

- That the door leaves are themselves of symmetrical construction with the exception of the edges, e.g. double rebated doors.
- That any restraining/supporting ironmongery is of a sufficiently high melting point so that it will not melt when exposed to the heat of the test.
- That there is no change in the number of leaves or the mode of operation, e.g. sliding, swinging, single action or double action.

Table 1 lists the type of door assembly for which rules can be generated and gives the direction in which it should be tested to cover the opposite direction. The separate columns for the integrity and insulation criteria reflect the different ability to make rules for integrity only doors as opposed to those which satisfy both criteria. A '✓' means that it is possible to identify the direction of test which covers the opposite direction. An 'X' indicates that it is not possible to identify the direction which will cover the opposite direction.
Table 1 - Type of door assembly and direction to be tested to cover the opposite direction

<table>
<thead>
<tr>
<th>Type of door assembly</th>
<th>Direction to be tested to cover opposite direction</th>
<th>Integrity</th>
<th>Insulation</th>
<th>Radiation (if required)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hinged or pivoted, timber leaf, timber frame</td>
<td>Opening into furnace</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Hinged or pivoted, timber leaf, metal frame (no transom)</td>
<td>Opening into furnace</td>
<td>✓</td>
<td>✗</td>
<td>✓</td>
</tr>
<tr>
<td>Hinged, metal leaf, metal frame (not pivoted)</td>
<td>Opening away from furnace</td>
<td>✓</td>
<td>✗</td>
<td>✓</td>
</tr>
<tr>
<td>Roller shutter</td>
<td>Barrel and supporting components on fire side</td>
<td>✓</td>
<td>✗</td>
<td>1)</td>
</tr>
<tr>
<td>Sliding/folding</td>
<td>Sliding/folding supporting components on the fire side</td>
<td>✓</td>
<td>✗</td>
<td>1)</td>
</tr>
</tbody>
</table>

1) Subject of extended application on basis of calculation of the radiation.

13.5 Supporting constructions

13.5.1 General

The fire resistance of a door assembly tested in one form of standard supporting construction may or may not apply when it is mounted in other types of construction. Generally, the rigid and flexible types are not interchangeable and rules governing the direct application within each group are given in 13.5.2 to 13.5.4. However, in some cases it is possible for the result of a test on a particular type of door assembly tested in one form of standard supporting construction to be applicable to that door assembly when mounted in a different type of standard supporting construction. Specific rules governing the situation for hinged and pivoted door assemblies are given in 13.5.5. The rationale behind the rules is given in annex C.

13.5.2 Rigid standard supporting constructions (high density)

The fire resistance of a door assembly tested in a rigid standard supporting construction as specified in EN 1363-1 can be applied to a door assembly mounted in the same manner in a wall of the rigid type as follows:

a) masonry or lightweight concrete with a density of at least 800 kg/m³ having thicknesses of at least:
   - 100 mm for a fire resistance periods up to 90 minutes;
   - 150 mm for fire resistance periods in excess of 90 minutes;

b) solid concrete or concrete blocks with a density of at least 1 200 kg/m³ with thickness requirements as in a).
13.5.3 Rigid standard supporting constructions (low density)

The fire resistance of a door assembly tested in a rigid standard supporting construction as specified in EN 1363-1 can be applied to a door assembly mounted in the same manner in a wall provided the density and thickness of the wall are equal to or greater than that in which it was tested.

13.5.4 Flexible standard supporting constructions

The fire resistance of a door tested in one of the flexible standard supporting constructions specified in EN 1363-1 can be applied to a door mounted in the same manner in a wall or partition which is of the board covered type with studs made from steel or timber.

The fire resistance of the door is only applicable to a door mounted in a partition with a fire resistance equal to or greater than the partition in which it was tested.

The fire resistance of the partition shall have been established separately in a previous test.

13.5.5 Specific rules for hinged or pivoted door assemblies

a) For timber door leaves hung in timber frames the result of a test in a rigid standard supporting construction is applicable to that door assembly mounted in a flexible construction.

For timber door leaves hung in timber frames the result of a test in a flexible standard supporting construction is applicable to that door assembly mounted in a rigid construction.

b) For timber door leaves hung in metal frames the result of a test in a flexible standard supporting construction is applicable to that door assembly mounted in a rigid construction but not vice versa.

c) For insulated metal door leaves hung in metal frames there is no applicability of results in rigid standard supporting construction to flexible constructions or vice versa. To cover rigid and flexible types, tests shall be undertaken in each type of standard supporting construction.

d) For uninsulated steel doors, the result of a test in a rigid standard supporting construction is applicable to that door assembly mounted in a flexible construction, but not vice versa.

The rules above assume that the fixing methods used in each type of supporting construction are appropriate to that construction. Thus for example in a), the test on the timber door leaf in a timber frame will have been carried out with appropriate fixings for timber frames in rigid constructions. The result is applicable to a timber door leaf in a timber frame mounted into a flexible construction with appropriate fixings for timber frames in flexible constructions.

13.6 Associated supporting constructions

The fire resistance of a door tested in an associated supporting construction has no field of direct application. The applicability of the result to other supporting constructions shall be the subject of extended application.
ANNEX A (Normative)

CONDITIONING REQUIREMENTS FOR SUPPORTING CONSTRUCTIONS

A.1 General

EN 1363-1 specifies that the test specimen shall be fully conditioned so that its strength and moisture content approximate to those 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

Concrete or masonry supporting constructions that use water based mortars, e.g. as described in EN 1363-1, shall be conditioned for a period of 28 days before fire testing.

Masonry walls constructed with masonry units that have been conditioned in accordance with EN 1363-1 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 the longer.

A.2.2 Lightweight standard supporting constructions

Lightweight standard supporting construction, e.g. as described in EN 1363-1, shall be conditioned in accordance with EN 1363-1, 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.2.3 Hygroscopic sealing materials

Hygroscopic 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.

Hygroscopic 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.2.4 Door frames incorporating water based materials

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 (Normative)

**FIELD OF DIRECT APPLICATION**

**LIMTS OF PERMITTED SIZE VARIATIONS**

<table>
<thead>
<tr>
<th>Door type</th>
<th>Category 'A' allowances</th>
<th>Category 'B' allowances</th>
</tr>
</thead>
<tbody>
<tr>
<td>i) Hinged and pivoted doors</td>
<td>Unlimited size reduction is permitted for all types except insulated steel doors where a reduction to 50% width and 75% height of the tested specimen is the limit of variation. Size increase is not permitted.</td>
<td>Unlimited size reduction is permitted for all types except insulated steel doors where a reduction to 50% width and 75% height of the tested specimen is the limit of variation. Size increase is permitted except for those which satisfy integrity with radiation requirements up to: 15% height 15% width 20% area</td>
</tr>
<tr>
<td>ii) Horizontally and vertically sliding doors</td>
<td>Unlimited size reduction is permitted for all types except insulated steel doors where a reduction to 50% width and 75% height of the tested specimen is the limit of variation. Size increase is not permitted.</td>
<td>Unlimited size reduction is permitted for all types. Size increase is permitted except for those which satisfy integrity with radiation requirements up to: 50% height 50% width 50% area</td>
</tr>
<tr>
<td>iii) Metal single skin folding shutters (uninsulated)</td>
<td>Unlimited size reduction is permitted. Size increase is not permitted.</td>
<td>Unlimited size reduction is permitted for all types. Size increase is permitted for doors which satisfy integrity requirements, up to: 50% height 50% width 50% area</td>
</tr>
</tbody>
</table>
### Table B.1: Field of direct application - Limits of permitted size variations (concluded)

<table>
<thead>
<tr>
<th>Door Type</th>
<th>Category A: allowances</th>
<th>Category B: allowances</th>
</tr>
</thead>
<tbody>
<tr>
<td>(iv) Other sliding/folding doors</td>
<td>Unlimited size reduction is permitted for all types except insulated steel doors where a reduction to 50% width and 75% height of the tested specimen is the limit of variation. Size increase is not permitted.</td>
<td>Unlimited size reduction is permitted. Size increase with radiation requirements up to: 15% height, 15% width, 20% area</td>
</tr>
<tr>
<td>(v) Rolling shutter doors</td>
<td>Unlimited size reduction is permitted. Size increase is not permitted.</td>
<td>Unlimited size reduction is permitted except for those which satisfy integrity with radiation requirements up to: 30% height, 10% width</td>
</tr>
</tbody>
</table>
ANNEX C (Informative)

BACKGROUND TO FIELD OF DIRECT APPLICATION STATEMENTS FOR ASYMMETRICAL CONSTRUCTIONS AND SUPPORTING CONSTRUCTIONS

C.1 General

The purpose of this annex is to give the rationale behind the field of application statements made in 13.4 on testing some types of door assembly from only one direction and in 13.5 on the field of application of some types of door assembly when mounted in different types of construction from which they were tested.

For the purposes of this annex two generic types of door assembly are considered: timber and metal. In this context a timber door leaf or frame is one in which the majority of the construction and the major components are made from timber which includes, for example, hardwood, softwood, particle board, blockboard, hardboard, plywood, medium density fibreboard and other cellulosic based materials. A metal door leaf or frame is one in which the majority of the construction and the major components are made from metal which includes, for example, steel and aluminium.

Door and shutter assemblies made from new or composite materials are specifically excluded from this annex as there is not sufficient evidence of their behaviour in fire to be able to provide guidance on the weakest side against fire attack. Examples of such materials are inorganic based doors (e.g. calcium silicate, vermiculite, fibre cement based boards) and plastics based doors (e.g. glass reinforced polyester, PVCu). For door assemblies constructed from such materials, asymmetrical specimens will always need to be tested from both sides (i.e. a minimum of two specimens).

The considerations below assume that the fixing methods used in each type of supporting construction are appropriate to that construction. Thus, a test on a door assembly in a rigid standard supporting construction will have been carried out with appropriate fixings for that door assembly in rigid constructions. If the result is applicable to a flexible construction then appropriate fixings for that door assembly mounted in a flexible construction should be used.

C.2 Hinged door assemblies

C.2.1 General

For the purposes of this annex three generic types of hinged or pivoted door types are considered: timber leaves in timber frames, timber leaves in metal frames and metal leaves in metal frames. Each of these behave differently and consequently the weaker direction for one type is not necessarily the same as that for another. In addition, the weaker direction for integrity performance is not necessarily the same as that for insulation performance. Therefore each type of door assembly is considered separately with respect to both integrity and insulation performance. The influences of supporting constructions are also considered. Figure 33 shows examples of leaf/frame supporting construction interactions.
C.2.2 Timber leaves hung in timber frames

C.2.2.1 Integrity performance

C.2.2.1.1 Leaf/frame interaction

As timber shrinks when it burns, the fire side of the leaf attempts to shrink in relation to the non-fire side resulting in a timber leaf tending to bow towards the fire at the top and bottom edges. The door frame will attempt to behave similarly, but because it is fixed to the supporting construction and is generally of thicker and/or larger section timber and therefore stiffer, the frame may not move as much as the leaf in a test. See Figure 33.

If the door opens towards the fire, then as described above, the top and bottom edges of the leaf will attempt to bow towards the fire and thus away from the door stop. This provides the opportunity for the passage of flames and hot gases from the furnace to escape, aided by positive pressure from within the furnace causing integrity failure. If the door opens away from the fire, then the top and bottom edges tend to bow towards the fire and towards the stop which tends to aid the performance of the door.

C.2.2.1.2 Supporting construction

A rigid supporting construction such as that described in EN 1363-1 will tend to restrain any bowing of the door frame, whereas a flexible supporting construction such as that described in EN 1363-1 will attempt to distort a timber doorframe in the opposite direction from which it would naturally want to move as discussed above. However, because most timber door assemblies have a frame which is of sufficiently large cross-section so that they do not bow in their own right and are strong enough to resist the forces induced by a flexible supporting construction, the choice of supporting construction is of less importance when considering the weakest direction in test.

C.2.2.2 Insulation performance

The dominating factor on the insulation performance will be that timber based leaves and frames are inherently insulating and therefore the insulation performance is unlikely to vary significantly whichever way the leaf opens.

C.2.2.3 Summary

For evaluating a timber leaf hung in a timber frame, a test with the leaf opening towards the fire is the most onerous condition for the integrity criterion. There is no particularly onerous direction with respect to the insulation criterion.

The effect of rigid v. flexible supporting constructions are not significant with this type of door assembly. It therefore follows that tests in rigid standard supporting constructions are applicable to flexible constructions and vice versa.

C.2.3 Timber leaves hung in metal frames

C.2.3.1 Integrity performance

C.2.3.1.1 Leaf/frame interaction

The timber leaf will behave as in C.2.2.1.1 in that it will attempt to bow towards the fire at its top and bottom edges. However, the frame will behave differently. Steel expands in fire and thus the frame will attempt to extend on the fire side relative to the non-fire side which may result in it bowing away from the fire at its top and bottom edges. Thus the frame tends to bow in the opposite direction to the leaf.

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If the door opens towards the fire, then as described above, the top and bottom edges of the leaf will tend to bow towards the fire and away from the door stop. This provides the opportunity for the passage of flames and hot gases to escape from the furnace, aided by positive pressure from within the furnace causing premature integrity failure. This is exacerbated by the contrary bowing of the metal frame. If the door opens away from the fire, then the top and bottom edges tend to bow towards the fire and towards the stop which tends to aid the performance of the door.

For door assemblies with a transom, the temperature of the transom will be higher with a door opening away from the furnace due to more metal being available on the exposed face for absorbing heat. This will result in a more severe condition at the top of the leaf due to higher temperatures causing increased erosion at this position.

C.2.3.1.2 Supporting construction

A rigid supporting construction such as that described in EN 1363-1 will tend to restrain any bowing of the metal door frame, providing there is adequate fixing, whereas a flexible supporting construction such as that described in EN 1363-1 will bow in sympathy with it exaggerating the mismatch between the materials of the door leaf and the frame. It therefore follows that for timber door leaves hung in metal frames the most onerous direction is with the leaf opening into the furnace with the door assembly mounted in a supporting construction of the flexible type.

C.2.3.2 Insulation performance

The dominating factor on the insulation performance of the leaf will be that timber based leaves are inherently insulating and therefore the insulation performance of the leaf is unlikely to vary significantly whichever way the leaf opens.

However, for the metal frame it can be argued that opening away from the furnace is the worst orientation since more of the door frame is exposed to fire to conduct the heat through to the unexposed face and there is less area of frame on the unexposed face from which to dissipate heat. However, it is generally recognized that this type of door assembly often fails insulation by virtue of failing integrity in addition to failing insulation independently.

C.2.3.3 Summary

For evaluating a timber leaf hung in a metal frame without a transom, a test with the leaf opening towards the fire is the most onerous condition for the integrity criterion.

A test with the leaf opening away from the fire can be the most onerous for the integrity criterion for assemblies with a transom.

With respect to the insulation criterion there is no clear direction which is more onerous than any other. However, it is generally recognized that this type of door assembly often fails insulation by virtue of failing integrity, in addition to failing insulation independently.

A test with the door assembly mounted in a flexible supporting construction is more onerous than one in a rigid construction.
C.2.4 Metal leaves hung in metal frames

C.2.4.1 Integrity performance

C.2.4.1.1 Leaf/frame interaction

As metal expands in fire, the fire side of the leaf will try to extend in relation to the non-fire side resulting in a metal leaf tending to bow away from the fire at the top and bottom edges. The door frame will attempt to behave similarly, but because it is fixed to the supporting construction may not move as much as the leaf in a test depending on the supporting construction.

If the door opens away from the fire, then the top and bottom edges try to bow away from the fire and away from the doorstop. This provides the opportunity for the passage of flames and hot gases from the furnace, aided by positive pressure from within the furnace causing integrity failure. In addition failure by gap gauge may occur. If the door opens towards the fire, then as described above, the top and bottom edges of the leaf will attempt to bow away from the fire and towards the door stop which aids the performance of the door.

C.2.4.1.2 Supporting construction

A rigid supporting construction assuming adequate fixing such as that described in EN 1363-1 will tend to restrain any bowing of the metal door frame, whereas a flexible supporting construction such as that described in EN 1363-1 may tend to bow in sympathy with it thus allowing the door frame bowing to follow that of the leaf. This may reduce the tendency for any gaps to form between them. It therefore follows that for metal door leaves hung in metal frames the most onerous direction might be with the leaf opening away from the furnace with the door assembly mounted in a supporting construction of the rigid type. However, there can be exceptions to this condition and therefore no general rule can be made.

C.2.4.2 Insulation performance

It can be argued that a more severe condition is for the leaf opening towards the furnace since the leaf is exposed along the whole of its length and width, there being no protection by the stop. However, it can also be argued that opening away from the furnace is likely to be the worst orientation for the frame since more of it is exposed to fire to conduct the heat through to the unexposed face and there is less area of frame on the unexposed face from which to dissipate heat.

It is likely that the difference between the insulation performance of the frame and the insulation performance of the leaf will be the deciding factor in the insulation performance of the door assembly as a whole. Since it can be argued that the leaf will perform worse opening into the furnace, but that the frame will perform worse with the leaf opening away, then in order to evaluate the insulation of the complete door assembly, a specimen opening in each direction will need to be tested.

C.2.4.3 Summary

For evaluating a metal leaf hung in a metal frame, a test with the leaf opening away from the fire is the most onerous condition for the integrity criterion.

With respect to the insulation criterion, it can be argued that the leaf will perform worse opening into the furnace, but that the frame will perform worse with the leaf opening away, therefore in order to evaluate the insulation of the complete door assembly, a specimen opening in each direction will need to be tested.

A test with the door assembly mounted in a rigid supporting construction is no more or less onerous than one in a flexible supporting construction and therefore separate tests will be needed for each
C.3 Pivot hung door assemblies

C.3.1 General

In this context only pivot hung doorsets with offset pivots are considered, since centrally pivoted doors are normally symmetrical and are therefore not the subject of this annex.

The considerations of failure of integrity and insulation resulting from the interactions of different leaf/frame materials, and the influence of supporting constructions are generally the same as those for hinged doors.

The essential difference with offset pivot hung door assemblies is that the pivots, if exposed to the furnace conditions, will conduct significant quantities of heat back into the leaf. This may cause premature integrity failure in the case of timber doors by increased erosion around the fixing points and may cause premature insulation failure by conducting heat back to the leaf which may be conducted through to the unexposed face in the case of metal door leaves. If the pivots are of insufficiently high melting point then it is possible that they can melt allowing the doors to drop onto the cill.

If the pivots are mounted on the unexposed face, then there is little likelihood of excess heat being conducted to the leaf or of the pivots melting.

C.3.2 Conclusion

For timber leaves in timber frames and timber leaves in metal frames, the considerations of failure with respect to both criteria are the same as those for hinged doors discussed in C.2.2 and C.2.3.

For metal doors hung in metal frames, the worst case is with the door opening away from the furnace with respect to integrity failure caused by bowing. However, with respect to integrity failure caused by melting of the pivots, the worst case is with the door opening into the furnace (i.e. with the pivots inside the furnace). Therefore, a test with a door opening in each direction will be needed.

With respect to insulation failure caused by the pivots on the fire side conducting heat back into the leaf, the worst case is with the door opening into the furnace. With respect to insulation failure in metal framed door assemblies in general, the worst case is with the door opening away from the fire. Both the above are irrespective of door leaf material.

C.4 Rolling shutter door assemblies

C.4.1 Integrity performance

There are several aspects of the performance of rolling shutters, for example the ability of the barrel and other structural components to support themselves and the ability of the laths to remain interlocked at elevated temperatures. The direction of fire attack will have little or no bearing on the performance of the laths, but will have a significant bearing on the performance of 'loadbearing' components such as the barrel, axle, bearing supports, etc. For these components the worst case is with them mounted inside the test furnace subject to direct fire attack where the elevated temperatures may cause failure of the components to support the loads required of them.

C.4.2 Insulation performance

For those rolling shutters that are insulated it is considered that although the insulation performance may be similar to hinged doors, the arguments for determining the weaker side are not so conclusive. In addition the guide supporting steelwork may require extra protection from furnace heating. The constructions thus need to be tested from both directions.
C.4.3 Conclusion

For evaluating a non-insulating rolling shutter door assembly, a test with the loadbearing components such as the barrel, axle supports, etc. on the fire side is the most onerous for the integrity criterion and therefore only one specimen needs to be tested in that configuration.

For evaluating an insulating rolling shutter door assembly, a test from both directions is needed.

C.5 Sliding/folding door assemblies

C.5.1 General

There are several aspects of the performance of sliding/folding door assemblies that are similar to those of rolling shutters, e.g. loadbearing components exposed to fire. Also there are several aspects of the performance of sliding/folding door assemblies that are similar to those of hinged/pivoted doors, e.g. firstly leaves which will distort according to the material they are made of, and secondly by how they are connected to the frame and each other.

C.5.2 Integrity performance

With regard to integrity it is more onerous to have the 'loadbearing' parts of the door assembly exposed to the highest temperatures and therefore these parts should be mounted within the furnace.

C.5.3 Insulation performance

As with rolling shutters discussed in C.4, the more of the frame and other components of the door assembly that are inside the furnace, the greater the surface area available for absorption of heat which may be conducted to the non-fire side thus causing an insulation failure. Conversely, if there are less of these components inside the furnace to absorb heat then such a transference is less likely. The argument with regard to dissipation of heat on the non-fire side also supports testing with the frame and other components on the fire side, otherwise there is a greater area of specimen to dissipate heat away from the non-fire side.

C.5.4 Conclusion

For evaluating a sliding/folding door assembly, a test with the loadbearing components such as the runners/hanging mechanism, etc. on the fire side is likely to be the most onerous direction for both integrity and insulation, but no firm conclusion is possible.
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