BS EN 1634-1:2014

BSI Standards Publication

Fire resistance and smoke control tests for door and shutter assemblies, openable windows and elements of building hardware

Part 1: Fire resistance test for door and shutter assemblies and openable windows

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National foreword

This British Standard is the UK implementation of EN 1634-1:2014. It supersedes BS EN 1634-1:2008 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee FSH/22/-/5, Fire resistance tests for doors.

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

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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Essais de résistance au feu et d'étanchéité aux fumées des portes, fermetures, fenêtres et éléments de quincailleries - Partie 1: Essais de résistance au feu des portes, fermetures et fenêtres

Feuerwiderstandsprüfungen und Rauchschutzprüfungen für Türen, Tore, Abschlüsse, Fenster und Baubeschläge - Teil 1: Feuerwiderstandsprüfungen für Türen, Tore, Abschlüsse und Fenster

This European Standard was approved by CEN on 29 December 2012.

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Foreword

This document (EN 1634-1:2014) 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of an identical text or by endorsement, at the latest by July 2014, and conflicting national standards shall be withdrawn at the latest by July 2014.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 1634-1:2008.

The following changes have been made since the previous edition (not exhaustive):

— definitions updated to include Operable fabric curtain;

— removal of requirement for sponsor declaration on gap values;

— changes to gap measuring requirements in Clause 7;

— increased reference to Extended Application;

— modifications to unexposed face thermocouples in Clause 9;

— redefined temperature measurement requirements in Clause 11 for the normal procedure;

— inclusion of openable windows and operable fabric curtains in Direct Application;

— changes to extended application for gaps in Direct Application;

— changes to figures.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association.

EN 1634, "Fire resistance and smoke control tests for door and shutter assemblies, openable windows and elements of building hardware" consists of the following parts:

— *Part 1: Fire resistance test for door and shutter assemblies and openable windows* (the present document);

— *Part 2: Fire resistance characterisation test for elements of building hardware*;

— *Part 3: Smoke control test for door and shutter assemblies*.

According to the CEN-CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

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.

It is imperative that an assessment of all potential hazards and risks to health is made and that safety precautions are identified and provided. Written safety instructions need to be issued. Appropriate training should be given to relevant personnel. Laboratory personnel should ensure that they follow written safety instructions at all times.

1 Scope

This European Standard specifies a method for determining the fire resistance of door and shutter assemblies and openable windows designed for installation within openings incorporated in vertical separating elements, such as:

a) hinged and pivoted doors;

b) horizontally sliding and vertically sliding doors including articulated sliding doors and sectional doors;

c) folding doors, sliding folding doors /shutters;

d) tilting doors;

e) rolling shutter doors;

f) openable windows;

g) operable fabric curtains.

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

The testing of fire dampers is covered by EN 1366-2.

The testing of closures for conveyor systems is covered by EN 1366-7.

By prior agreement with the test sponsor, additional information may be gained for individual elements of building hardware in order to fulfil the performance criteria identified in EN 1634-2. Based on the observations recorded during the test, the results may be presented in a separate report which should be in accordance with the requirements of EN 1634-2.

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.

EN 1363-1:2012, *Fire resistance tests - Part 1: General Requirements*

EN 1363-2, *Fire resistance tests - Part 2: Alternative and additional procedures*

EN 12519:2004, *Windows and pedestrian doors - Terminology*

EN 13501-2, *Fire classification of construction products and building elements — Part 2: Classification using data from fire resistance tests, excluding ventilation services*

EN 14600, *Doorsets and openable windows with fire resisting and/or smoke control characteristics - Requirements and classification*

EN 15269 (all parts), *Extended application of test results for fire resistance and/or smoke control for door, shutter and openable window assemblies, including their elements of building hardware*

EN ISO 13943:2010, *Fire safety - Vocabulary (ISO 13943:2008)*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 1363-1:2012, EN 12519:2004, EN ISO 13943:2010 and the following apply.

3.1
door or shutter assembly
doorset
pedestrian doorset or industrial type doorset including any frame or guide, door leaf or leaves, rolling or folding curtain, etc., which is provided to give a fire resisting capability when used for the closing of permanent openings in fire resisting separating elements, which includes any side panel(s), flush over panel(s), transom panel(s) and/or glazing together with the building hardware and any seals (whether provided for the purpose of fire resistance or smoke control or for other purposes such as draught or acoustics) which form the assembly

3.2
openable (for windows only)
applying to windows with one or more moveable leaf or leaves including any side or over panel(s), perimeter frame and any elements of building hardware

3.3
building hardware
hinges, handles, locks, exit devices, escutcheons, letter plates, kick plates, sliding gear, closing devices, electrical components, wiring, etc., which are, or can be, used in the doorset

3.4
single action
action of a door leaf of a (single or double leaf) doorset which only opens in one direction

3.5
double action
action of a door leaf of a (single or double leaf) doorset which opens in both directions

3.6
floor
upper surface of the horizontal element on which the doorset is mounted and which extends from the exposed face to the unexposed face of the doorset

3.7
sill
member which connects two frame jambs together at the base which may or may not be set into the floor and remains visible

3.8
gap
clearance between two nominally adjacent surfaces and/or edges (primary gaps are between the edge of the leaf and the reveal of the frame, between the face of the leaf and the frame stop and between adjacent leaves)

Note 1 to entry: This does not refer to the integrity failure gap for which the gap gauges are referenced in 10.2.2.

3.9
through component or connection
internal spacer or fixing that either penetrates through the door or shutter construction from one face to another or directly connects the faces one to the other

3.10
standard supporting construction
form of construction used to close off the furnace and to support the doorset or openable window 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

Note 1 to entry: Supporting constructions which are considered to be 'standard supporting constructions' are those listed in EN 1363–1.

3.11
associated supporting construction
specific construction in which the doorset or openable window 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

3.12
test specimen
doorset or openable window which is to be installed in a standard or associated supporting construction to allow it to be evaluated

3.13
transom
horizontal member fitted between vertical frame members to create an aperture above into which a panel, glazing etc. might be fitted

3.14
over panel
panel which is incorporated within a doorset or openable window and fitted above the leaf or leaves and can be a transom panel or a flush over panel

3.15
transom panel
panel which is incorporated within a doorset or openable window and fitted above the leaf or leaves and is bounded on all edges by the frame head, the jambs and the transom

3.16
flush over panel
panel which is incorporated within a doorset or openable window and fitted above the leaf or leaves within the frame head and the jambs and with no transom

3.17
side panel
panel which is incorporated within a doorset or openable window and fitted at one side of a leaf and is bounded on all edges by the perimeter frame, the jambs and the transom (when applicable)

3.18
operable fabric curtain
doorset with a leaf constructed from woven material combined with other materials in one or more sections

Note 1 to entry: The complete assembly includes any frames and/or guides.

4 Test equipment

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

5 Test conditions

Appropriate mechanical pre-test conditioning shall be completed in accordance with the requirements in EN 14600.

The heating and pressure conditions and the furnace atmosphere shall conform to those given in EN 1363-1 or, if applicable, EN 1363-2 except for openable windows where the pressure at the top of the test specimen shall be 20 Pa.

6 Test specimen

6.1 General

Guidance on the selection of test specimen(s) is given in EN 14600 and the EN 15269 series of extended application standards.

The figures included with this standard show test specimen(s) of different types of doorsets. The figures may also be used by analogy for openable windows.

6.2 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 3,0 m x 3,0 m. Doorsets and openable windows which cannot be tested at full size shall normally be tested to the maximum size possible consistent with 7.2.3.

6.3 Number

The number of test specimens required to determine the fire resistance of a doorset or an openable window shall be selected in accordance with EN 1363-1 and 13.4 of this standard.

6.4 Design

The design of the test specimen and the choice of supporting construction shall take into account the requirements of EN 15269 (all parts) and Clause 13 of this standard if the widest field of application is to be achieved.

Where the doorset or openable window incorporates side, transom or flush over panels, whether glazed or unglazed, these shall be tested as part of the assembly. If only one side panel is incorporated, this shall always be installed on the latch side of the doorset or openable window.

The test specimen shall be fully representative of the doorset or openable window intended for use in practice, including any aspects of design that are an essential part of the test specimen and may influence its behaviour in the test.

6.5 Construction

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

6.6 Verification

The sponsor shall provide a specification to a level of detail sufficient to allow the laboratory to conduct a detailed examination of the test specimen before the test and to agree the accuracy of the information supplied (e.g. a parts list and drawings giving materials, dimensions and mounting and fixing methods,

including those for items of building hardware). EN 1363-1 provides detailed guidance on verification of the test specimen.

When the method of construction precludes a detailed survey of the test 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 doorset or openable window 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 test specimen or that part of the test specimen which cannot be verified (e.g. a door leaf) to the number required for testing; the laboratory shall then choose freely which of these shall be submitted to the test and which shall be used to verify the construction.

6.7 Building hardware

Any item of building hardware shall be measured, analysed and described in detail before the test commences. Where it is not possible to confirm the manufacturer's description it shall be clearly stated that the manufacturer's declaration has been used.

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 test 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 doorset or openable window 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 test specimen 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 provided does not allow this.

The whole area of the test specimen, together with at least the minimum dimensions of the supporting construction, 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 doorset or openable window and shall be at least commensurate with that anticipated for the product.

7.2.2 Standard supporting construction

The choice of standard supporting construction shall reflect the intended normal use of the doorset or openable window. 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 and associated supporting constructions

Figures 1 to 8 illustrate the use of supporting constructions in conjunction with the mounting of test 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 supporting construction along the vertical edges, i.e. there shall be a free edge at each vertical end of the test 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 EN 1363-1. The supporting construction shall be prepared in advance of the mounting of the test specimen leaving an aperture of the desired size, except when it is normally erected in conjunction with the doorset or openable window using appropriate fixing methods.

There shall be a minimum zone of supporting construction of 200 mm wide within the furnace opening, 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 a minimum width of 200 mm supporting construction to separate test specimens within a rigid supporting construction but a minimum width of 300 mm supporting construction to separate test specimens within a flexible or an associated supporting construction and a minimum separation of 200 mm between each test specimen and the edges of the test frame.

If the bottom of the doorset or openable window is at floor level in practice, then at the bottom of the aperture continuity of the floor shall be simulated using a floor extension of a solid non-combustible material which has a minimum dimension of 200 mm from the leaf or leaves on each side of the test specimen (i.e. from the exposed and the unexposed face) and which has a density of at least 450 kg/m^3 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 test specimen. If a sill detail is incorporated as part of the doorset or openable window this shall be incorporated within or placed on top of the floor extension. If the doorset or openable window 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 a floor extension.

NOTE When a doorset or openable window is tested in conjunction with a non-combustible floor covering then, in certain circumstances, this will not represent the situation when the doorset or openable window is installed in conjunction with a combustible floor covering, e.g. timber or textile.

7.3 Gaps

The adjustment of the door leaf(-ves) or shutter and gaps shall be representative of those used in practice so that appropriate clearances exist (e.g. between the fixed and moveable components); however in all cases the maximum through gap shall not exceed 25 mm at the sill or 6 mm by 150 mm in other areas as these gaps would constitute Integrity failure (gap gauge method).

The size of the gaps between the fixed and the moveable components of a doorset or window will have an influence on its overall fire performance. Therefore the size of these gaps that will be permitted in practice will depend on the size of the gaps in the test specimen. These may be different for different parts of the door or window e.g. leading edge to frame, hinged edge to frame, leaf top edge to frame, leaf bottom edge to frame/sill, meeting stiles.

Certain gaps are more critical than others and these have been identified as ‘primary’ gaps, i.e. gaps perpendicular to the face of the leaf or tightness, as shown in Figures 9 to 12 and Figure 33. Measurements shall be taken in accordance with 10.1.2.

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

Mechanical pre-test conditioning of the test specimen before fire testing shall be carried out as required by EN 14600.

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 ± 50 mm from the nearest plane of the test construction (see Figure 13). 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 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 doorset or openable window, 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 of the doorset for the purpose of obtaining the average and maximum surface temperatures. For door leaves, the positioning relates to the part of the door leaf visible from the unexposed side. 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 doorset or openable window also against the supplementary procedure as this requires the application of additional thermocouples for this purpose.

The temperature of the supporting construction in which the test specimen 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 100 mm (or 50 mm when evaluating for the supplementary procedure) from the centre of any component of building hardware which passes through the doorset or openable window.

If a thermocouple has to be relocated because of these requirements, then any other restriction (e.g. the distance from the door leaf edge) shall be maintained when the new location is selected.

If the same situation occurs on the door frame, an equivalent solution shall be followed.

NOTE This can result in some thermocouples being positioned on elements of building hardware.

Where a fire resisting sliding door incorporates a pass door, the pass door, including its frame, shall be fire resisting to at least the same classification as the sliding door into which it is mounted. There shall not be any thermocouples positioned closer than 100 mm (25 mm for the supplementary procedure) either side of the clearance gaps between the pass door leaf and its frame.

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 door leaf (leaves) and one at the centre of each quarter section. These thermocouples shall not be located in any position excluded for the measurement of maximum temperature (in the normal procedure) and shall not be closer than 50 mm to any joint, stiffener or through component, nor closer than 100 mm to the edge of the door leaf (or leaves) or curtain.

For doorsets or openable windows which incorporate discrete areas of different thermal insulation ≥ 0,1 m^2 (e.g. flush over panels, transom panels, side panels, or glazed panels within a door leaf but not astragals), extra thermocouples shall be evenly distributed over the surface of those areas to determine the average temperature at a density of one thermocouple per square metre or part thereof. When the total area of a single portion of the doorset or openable window represents less than 0,1 m^2, it shall be disregarded for the purpose of ascertaining the average unexposed face temperature.

9.1.2.3 Maximum temperature

9.1.2.3.1 General

The maximum temperature shall be determined from the 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 9.1.2.3.2, 9.1.2.3.3 and 9.1.2.3.4.

If the doorset or openable window incorporates discrete areas of different thermal insulation ≥ 0,1 m^2 (e.g. flush over panels, transom panels, side panels or glazed panels within a door leaf but not astragals) which are required to be 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 9.1.2.3.3 and 9.1.2.3.4. See Figure 28.

Thermocouples shall not be placed on fasteners with a surface diameter less than 12 mm.

9.1.2.3.2 Temperature of frame

Thermocouples shall be fixed at:

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

b) one on the horizontal top member of the frame and any transom (≥ 12 mm wide) fitted, at mid width (100 mm away from the door joint of a multi-leaf doorset on the primary leaf side). The positioning of the transom thermocouples in vertical direction shall be symmetrical relative to the edges. See Figures 23 and 24 in terms of transom;

c) one on the horizontal top member of the frame and any transom (≥ 12 mm wide) fitted, 50 mm in from each corner of the frame at the point of leaf entry. The positioning of the transom thermocouples in vertical direction shall be symmetrical relative to the edges. See Figures 23 and 24 in terms of transom and Figure 16 for point of leaf entry.

At each of the positions, the thermocouple shall be fixed as close as possible to the junction between the frame and the supporting construction, i.e. with the centre of the copper disc 20 mm from the junction between the frame and the supporting construction at the nearest position from the junction. 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.

For the frame, the positioning relates to the part of the frame visible from the unexposed side.

For a single leaf doorset or openable window, if due to the narrow width of the opening the thermocouples specified in 9.1.2.3.3 b) and c) are closer than 550 mm to each other, then that specified in b) is omitted (see Figure 21).

9.1.2.3.3 Temperature of door leaf or shutter

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

a) at mid-height, 100 mm in from the visible part of the vertical edges as specified below;

b) at mid-width, 100 mm down from the visible part of the horizontal edge as specified below;

c) 100 mm in from the visible part of the vertical edges, 100 mm down from the visible part of the horizontal edge as follows:

    1) the inside edges of the clear opening for:

        i) hinged or pivoted doorsets or openable windows opening towards the furnace;

        ii) shutters or sliding doorsets or openable windows 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 doorsets or openable windows opening away from the furnace;

        ii) shutters or sliding doorsets or openable windows installed on the unexposed side of the supporting construction.

See Figures 14 to 27.

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

If the door leaf is < 200 mm wide (e.g. as in a multi-leaf folding shutter) then the door leaves shall 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 door leaf or shutter (e.g. over any through component/connection or position where the temperature might be expected to be higher than the mean for

the surface subject to the limitation given in 9.1.2.3.1. The additional thermocouples shall be placed not less than 100 mm from the edges of the door leaf.

Where the door leaf(leaves) incorporate discrete areas of different thermal insulation that are required to be evaluated separately, the maximum temperature rise of these areas shall be measured from additional thermocouples distributed in accordance with Figures 25, 26 and 27, unless a visible part of the perimeter of the framework of the door leaf is less than 115 mm wide in which case the door leaf shall be treated as one complete discrete area. (See Figure 26).

In all cases thermocouples shall be placed as follows:

If the visible width of the framework of the door leaf is ≥ 115 mm wide, position the thermocouples on the door leaf 100 mm in from the inside edges of the clear opening or from the visible part of the edge of the door leaf, as defined in 9.1.2.3.3.

If the visible width of the framework of the door leaf is between 85 mm and 115 mm wide, position the thermocouples on the discrete area of different thermal insulation as close as possible to the framework of the door leaf.

If the visible width of the framework of the door leaf is ≤ 85 mm, position the thermocouples on the discrete area of different thermal insulation 100 mm in from the inside edge of the clear opening for:

— hinged or pivoted doorsets or openable windows opening towards the furnace;

— shutters or sliding doorsets or openable windows installed on the exposed side of the supporting construction.

If the visible width of the framework of the door leaf is ≤ 85 mm, position the thermocouples on the discrete area of different thermal insulation 100 mm in from the visible part of the edge of the door leaf for:

— hinged or pivoted doorsets or openable windows opening away from the furnace;

— shutters or sliding doorsets or openable windows installed on the unexposed side of the supporting construction.

9.1.2.3.4 Temperatures of other areas

Thermocouples for determination of the maximum temperature rise of side, transom and flush over panels and discrete areas 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). See Figures 25 and 26.

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

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

2) 100 mm from the vertical edges, 100 mm from the horizontal edges. See Figures 22 and 23 for examples.

See Figure 28 for exclusion of thermocouples on discrete areas 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)

9.1.2.4.1 General

The maximum temperature shall be determined from the thermocouples used for the determination of maximum temperature (as given in 9.1.2.3) together with additional thermocouples fixed as indicated in 9.1.2.4.2 and 9.1.2.4.3.

9.1.2.4.2 Temperature of door leaf or shutter

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

a) at mid-height, 25 mm in from the visible part of the vertical edges as specified below;

b) at mid-width, 25 mm down from the visible part of the horizontal edge as specified below;

c) 25 mm in from the visible part of the vertical edges, 25 mm down from the visible part of the horizontal edge as follows:

   1) the inside edges of the clear opening for:

      i) hinged or pivoted doorsets or openable windows opening towards the furnace;

      ii) shutters or sliding doorsets or openable windows 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 doorsets or openable windows opening away from the furnace;

      ii) shutters or sliding doorsets or openable windows installed on the unexposed side of the supporting construction.

Additional thermocouples shall be fixed to other areas of the door leaf or shutter (e.g. over any through component/connection or position where the temperature might be expected to be higher than the mean for the surface subject to the limitations given in 9.1.2.3.1. The additional thermocouples shall be placed not less than 25 mm from the edges of the door leaf.

Where the door leaf (leaves) incorporate discrete areas of different thermal insulation that are required to be evaluated separately, the maximum temperature rise of these areas shall be measured from additional thermocouples distributed in accordance with Figures 25, 26 and 27, unless any visible part of the perimeter of the framework of the door leaf is less than 40 mm wide in which case the door leaf shall be treated as one complete discrete area.

In all cases thermocouples shall be placed as follows:

If the visible width of the framework of the door leaf is ≥ 40 mm wide, position the thermocouples on the door leaf 25 mm in from the inside edges of the clear opening or from the visible part of the edge of the door leaf, as defined in 9.1.2.4.2.

If the visible width of the framework of the door leaf is between 10 mm and 40 mm wide, position the thermocouples on the discrete area of different thermal insulation as close as possible to the framework of the door leaf.

If the visible width of the framework of the door leaf is ≤ 10 mm, position the thermocouples on the discrete area of different thermal insulation 25 mm in from the inside edge of the clear opening for.

— hinged or pivoted doorsets or openable windows opening towards the furnace;

— shutters or sliding doorsets or openable windows installed on the exposed side of the supporting construction.

If the visible width of the framework of the door leaf is ≤ 10 mm, position the thermocouples on the discrete area of different thermal insulation 25 mm in from the visible part of the edge of the door leaf for:

— hinged or pivoted doorsets or openable windows opening away from the furnace;

— shutters or sliding doorsets or openable windows installed on the unexposed side of the supporting construction;

or place the thermocouples on the visible part of the door leaf for:

— hinged or pivoted doorsets or openable windows opening away from the furnace;

— shutters or sliding doorsets or openable windows installed on the unexposed side of the supporting construction.

If due to the narrow width of the door 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.

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

Examples for reducing the number of unexposed face thermocouples for single leaf hinged or pivoted leaves less than 1 200 mm wide are given in Figure 21.

9.1.2.4.3 Temperature of other areas

Thermocouples for determination of the maximum temperature rise of side, transom and flush over panels and discrete areas 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). See Figures 25 and 26.

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:

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

2) 25 mm from the vertical edges, 25 mm from the horizontal edges.

See Figures 22 and 23 for examples of the above.

See Figure 28 for exclusion of thermocouples on discrete areas 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.

Where the doorset is likely to be subjected to Extended Application procedures, the relevant Extended Application standard may specify specific additional thermocouples to be fitted to the specimen. These should be considered prior to testing and fitted if relevant in conjunction with the manufacturer's instructions.

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 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;

— double leaf doorsets or openable windows between primary and secondary leaves;

— frame relative to supporting construction;

— flexible and/or associated 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 can be important in determining the field of extended application of the test results. Figures 29 to 32 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 examination and preparation

10.1.1 General

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

a) any mechanical conditioning;

b) gap measurements (see 10.1.2);

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

d) final setting (see 10.1.4).

10.1.2 Gap measurements

Primary gaps as defined in 3.8 shall be measured prior to the fire resistance test in accordance with the sequence given in 10.1.1. 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 or calculated. Where flexible and/or movable seals/components are incorporated in the doorset, they shall not be included in the gap measurement.

Figures 9 to 12 illustrate examples of the measurements to be taken at various positions for different door edge/frame rebate types.

10.1.3 Closing force measurements

The closing forces for all doorset or openable windows which incorporate closing devices and which are meant to be opened without the aid of mechanical power shall be measured. These measurements are needed to establish the magnitude of the forces used to retain the door leaf or leaves closed to ensure that they are representative of those used in normal practice.

For each door leaf, the closing force shall be determined as given below. For double action doorsets or openable windows the force shall be determined for each direction of opening and for folding doors, the force shall be determined in the direction of opening.

The closing forces for all doorsets or openable windows which incorporate closing devices operated without the aid of mechanical power shall be measured.

Open each leaf 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 resistance test, the test specimen shall be subjected to a final closing involving opening the leaf or leaves to a distance of approximately 300 mm and returning it to the closed position. When possible this shall be done by the closing device. If the leaf (or leaves) does not contain any closing device or it cannot be used in the furnace then the leaf or leaves shall be closed by hand.

When a doorset or openable window is intended to be supplied both with and without a door closing device, the closing force may be released after the completion of the retention measurements required in 10.1.1 c).

Leaves may be latched prior to the fire resistance test but shall not be locked unless the leaf can only be retained in the closed position during normal use by utilising the lock (i.e. there is no latch or closing device to hold each leaf 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 test 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 resistance 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 sill of the doorset, i.e. only the 25 mm gap gauge shall be used at the sill of the doorset.

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 measuring 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

The test specimen shall be evaluated against the insulation levels specified in 11.2.2, 11.2.3, 11.2.4 and 11.2.5.

11.2.2 Discrete areas

For doorsets or openable windows which incorporate discrete areas of different thermal insulation, compliance with the insulation criteria shall be determined separately for each area.

11.2.3 Average temperature rise

The test 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.

11.2.4 Maximum temperature rise (normal procedure - Classification I_2 according to EN 13501-2)

The test 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 for any frame member or transom member adjacent to the leaf/leaves of the doorset or openable window 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.

11.2.5 Maximum temperature rise (supplementary procedure - Classification I_1 according to EN 13501-2)

The test specimen shall be evaluated against the maximum temperature rise criterion specified in EN 1363-1 (180°C). 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

The test specimen shall be evaluated against the radiation levels specified 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 1634-1;

b) details of how the test specimen was verified as described in 6.6;

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

d) 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) description of the type of floor covering, if any, used in the test construction;

g) gap measures as required by 10.1.2 and the permitted gap size as in 13.3.3.2.5;

h) closing forces as required by 10.1.3 including, if the test specimen was locked, latched or held in the closed position by a closing device during the test;

i) information concerning any mechanical conditioning performed upon the test specimen;

j) results stated in terms of the elapsed time, in completed minutes, between the commencement of the test and the time to failure of integrity and, when required, the time to failure of insulation under the normal and, if appropriate, the supplementary procedure and, where required, the full time history of the radiation as specified in EN 1363-2; the results shall be reported on each of the performance criteria listed in Clause 11;

k) in cases where the sponsor has requested that the test be continued beyond the first failure, all other failures shall also be recorded.

Following prior agreement of the test sponsor, a separate report can be produced to cover the performance of individual elements of building hardware. The separate report shall, as a minimum, contain the following information:

l) reference to the full test report;

m) name of the producer/supplier of the item of building hardware under test; its trade name and/or the manufacturer's code for the product, a visual representation and a full description of the product including any protection, with particular reference to dimension of components, location and fixing details and materials used within the building hardware items;

n) full description of any intumescent or ablative protection applied adjacent to the item of building hardware;

o) duration for which the test specimen complied with the relevant criteria, expressed in minutes from the start of the test;

p) full description of the test specimen including construction, dimensions, mass, direction of opening, fixing method, all items of hardware and materials.

The field of direct application may only be defined following the identification of classification(s). The field of (direct and, where applicable, extended) application should be included in the classification report.

13 Field of direct application of test results

13.1 General

The field of direct application defines the allowable changes to the test specimen following a successful fire resistance test. These variations can be applied 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 construction

13.2.1 General

Unless otherwise stated in the following text, the materials and construction of the doorset or openable window shall be the same as that tested. The number of leaves and the mode of operation (e.g. sliding, single action or double action) shall not be changed.

13.2.2 Specific restrictions on materials and construction

13.2.2.1 Timber construction

The thickness of the door panel(s) shall not be reduced but may be increased.

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

For timber based board 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.

13.2.2.2 Metal construction

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

The type of metal shall not be changed from that tested.

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

13.2.2.3 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 (width and height) of glass in each pane included within a test specimen may be:

— decreased in proportion with size reductions; or

— decreased by a maximum of 25 % for integrity only and/or radiation control constructions and for insulation specimens where the unexposed surface temperature for both the construction and the glazing have been maintained for the classification period; or

— reduced for doorsets, without restriction, providing that the total area of the tested pane(s) is less than 15 % of the door leaf or side/over panel area.

The number of glazed apertures and each of the dimensions of glass in each pane included within a test specimen shall not be increased.

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 relative to the glazing.

13.2.3 Decorative finishes

13.2.3.1 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 frames for which unfinished test 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.

13.2.3.2 Decorative laminates

Decorative laminates and timber veneers up to 1,5 mm thickness may be added to the faces (but not the edges) of doors that satisfy the insulation criteria (normal or supplementary procedure).

Decorative laminates and timber veneers applied to door leaves that do not satisfy the insulation criteria (normal or supplementary procedure) and/or those in excess of 1,5 mm thickness shall be tested as part of the test specimen. For all doorsets tested with decorative laminate faces, the only variations possible shall be within similar types and thicknesses of material (e.g. for colour, pattern, supplier).

13.2.4 Fixings

The number of fixings per unit length used to attach doorsets 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 Building hardware

The number of hinges and dog bolts may be increased but shall not be decreased.

NOTE 1 The number of movement restrictors such as locks and latches is not covered by direct application.

Where a doorset has been tested with a door closing device fitted, but with the retention force released in accordance with 10.1.4, the doorset may be provided either with or without that closing device, i.e. where self closing characteristics are not required.

NOTE 2 Interchange of building hardware is not covered by the field of direct application.

13.3 Permissible size variations

13.3.1 General

Doorsets 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.

The increase and decrease of dimensions permitted by the field of direct application are applicable to the overall size and to each door leaf, each side panel and each over panel independently.

In accordance with 13.2.2.3, the dimensions (width and height) of any glass pane cannot be increased.

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 values shown in Table 1 were fulfilled before the test was concluded.

For category 'B':

Table 1 — Category B overrun requirements

Classification time (min)	All performance criteria fulfilled for at least minutes
15	18
20	24
30	36
45	52
60	68
90	100
120	132
180	196
240	260

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 six main product groups:

a) hinged and pivoted doorsets and openable windows;

b) horizontally sliding and vertically sliding doorsets including sectional doorsets;

c) steel single skin folding shutters doorsets (uninsulated);

d) other sliding and folding doorsets (insulated);

e) rolling shutter doorsets;

f) openable fabric curtains.

No increases in size are permitted for doorsets which are required to satisfy radiation control levels unless the insulation criteria are 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 control levels 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 required radiation control levels. Size decreases are permitted for both doors which satisfy radiation control levels and those which satisfy insulation criteria and radiation control levels.

Permissible variations for each product group are detailed in Annex B which also contains some examples relating to hinged/pivoted doorsets.

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

13.3.3.2 Hinged and pivoted doorsets and openable windows

13.3.3.2.1 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 specified overrun of classification period) all smaller sizes are permitted and increases in height and width are permitted as stated in Annex B.

13.3.3.2.2 Other changes

For smaller doorset sizes the relative positioning of movement restrictors (e.g. hinges and latches) 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 test specimen size.

For larger doorset sizes the following shall also apply:

a) 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;

b) the distance of the top hinge from the top of door leaf shall be equal to or less than that tested;

c) the distance of the bottom hinge from bottom of door leaf shall be equal to or less than that tested;

d) where three hinges or distortion preventers are used, the distance between the bottom of the door leaf and centre restraint shall be equal to or greater than that tested.

13.3.3.2.3 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 doorsets.

If only one side panel can be tested due to the constraints of the furnace size then providing a type 'B' overrun time has been proven, a second panel up to the same size may be added to the opposite side. Where an additional side panel is to be added to a tested single-leaf doorset then the tested panel shall be positioned on the latch side.

The addition of a second side panel is not allowed for doorsets satisfying the radiation control levels, unless they also satisfy the insulation criteria for the reasons given in 13.3.3.1.

13.3.3.2.4 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 test specimen, they shall not be substituted with alternatives of lesser thickness or strength.

13.3.3.2.5 Gaps

The maximum size of the primary gaps identified in 7.3 is restricted to the following sizes in practice:

$$x = (a + b)/2 + 2 \text{ mm}$$

where

- x is the maximum permitted gap size;
- a is the maximum measured gap size;
- b is the mean measured gap size.

The minimum size of the primary gaps may be reduced.

The permitted gap size may be different for different parts of the door or window.

13.3.3.3 Horizontally sliding and vertically sliding doorsets 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 doorsets 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 as stated below:

For test specimen with door leaves manufactured to the maximum size allowable in a standard 3,0 m by 3,0 m furnace, the height and/or the width can be increased provided that the area is not increased by more than 50 %. Additionally, test specimens comprising joined panels shall incorporate at least one full size panel with at least one example of each jointing technique for height and width as applicable.

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 33) by 10 mm per metre of increase in size.

The maximum gap at the bottom of the door may be decreased from the maximum tested but shall not be increased above the maximum tested.

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 specified overrun of classification period) all smaller sizes are permitted and increases in height and width are permitted as stated below:

For test specimens with door leaves manufactured to the maximum size allowable in a standard furnace (3,0 m x 3,0 m), the height and/or the width can be increased provided that the area is not increased by more than 50 %. Additionally, test specimens comprising joined panels shall incorporate at least one full size panel with at least one example of each jointing technique for height and width as applicable.

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 and folding doorsets (insulated)

For size variations, see Annex B.

For Category 'A' tests without overrun, 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 overrun 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 doorsets

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 rolling shutters the material thickness may be increased up to 50 % but it shall not be reduced beyond acceptable metal industry tolerances.

For insulated rolling shutters the material thickness shall not be varied beyond the tolerances on thickness accepted by the metal 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 metal 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 33). The tightness between the shutter curtain and the vertical guides and the overlap between the guides and the wall shall not be reduced for size decreases, but shall be increased at least proportionally for the increase in width.

13.3.3.7 Operable fabric curtains

For size variations, an unlimited size reduction is permitted.

For operable fabric curtains the material thickness of side guides and barrel carrying end plates may be increased up to 50 % but it shall not be reduced beyond acceptable metal industry tolerances.

13.4 Asymmetrical assemblies

13.4.1 General

EN 1363-1 states that for separating elements required to be fire resisting from both sides, two test specimens shall be tested (one from each direction) unless the element is fully symmetrical, i.e. the construction of the doorset is identical on both sides of the centre line when viewed in plan (from above). 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 2 and are based on the following premises:

— that each of the door leaves are themselves of symmetrical construction with the exception of the edges (e.g. lock/leading edge and hinge edge or double rebated doors);

— that any restraining/supporting elements of building hardware has been included in a test to EN 1634-1 when exposed in both directions so that they will retain their function 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);

— that side, over and transom panels are excluded from Table 2 unless they are fully symmetrical.

Table 2 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 'Yes' means that it is possible to identify the direction of test which covers the opposite direction. A 'No' indicates that it is not possible to identify the direction which will cover the opposite direction.

Table 2 — Type of doorset and direction to be tested to cover the opposite direction

Type of doorset	Direction to be tested to cover opposite direction	Integrity	Insulation	Radiation
Hinged or pivoted, timber leaf, timber frame	Opening into the furnace	yes	yes	yes
Hinged or pivoted, timber leaf, metal frame (no transom)	Opening into the furnace	yes	no	yes
Hinged, metal leaf, metal frame (not pivoted)	Opening away from Furnace	yes	no	yes
Rolling shutter	Barrel and supporting components fixed on the face of the supporting wall on the fire side	yes	no	no
Sliding/folding	Sliding/folding supporting components fixed on the face of the supporting wall on the fire side	yes	no	no
Operable fabric curtains	Not possible to define a scenario			

[a] This only applies to doors without insulation in the core and with a movement restrictor at approximately mid-height on the hinge side.

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 13.5.4. The rationale behind the rules is given in Annex C.

13.5.2 Rigid standard supporting constructions (high or low density)

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

13.5.3 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 metal 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.

13.5.4 Specific rules for hinged or pivoted doorsets

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.

b) 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.

c) 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.

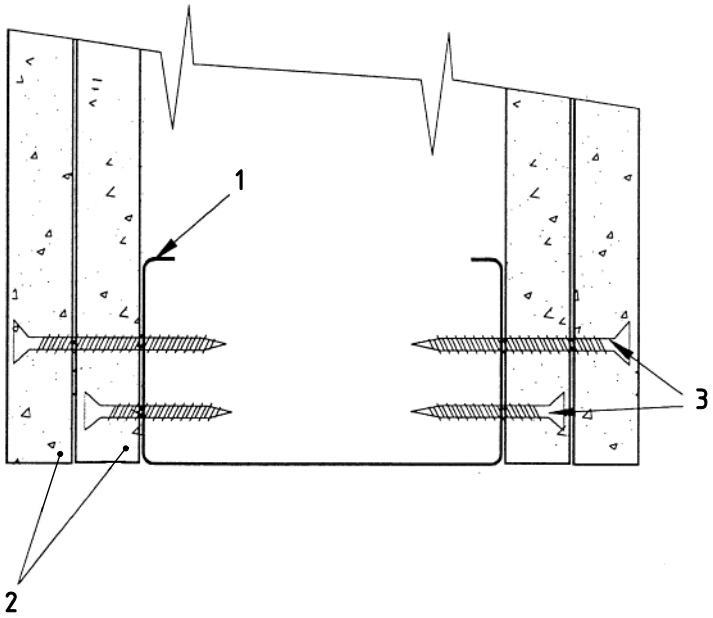
d) For insulated metal door leaves hung in metal frames, there is no applicability of results in rigid standard supporting construction to flexible constructions or vice versa; to cover rigid and flexible types, tests shall be undertaken in each type of standard supporting construction.

e) For uninsulated metal 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.



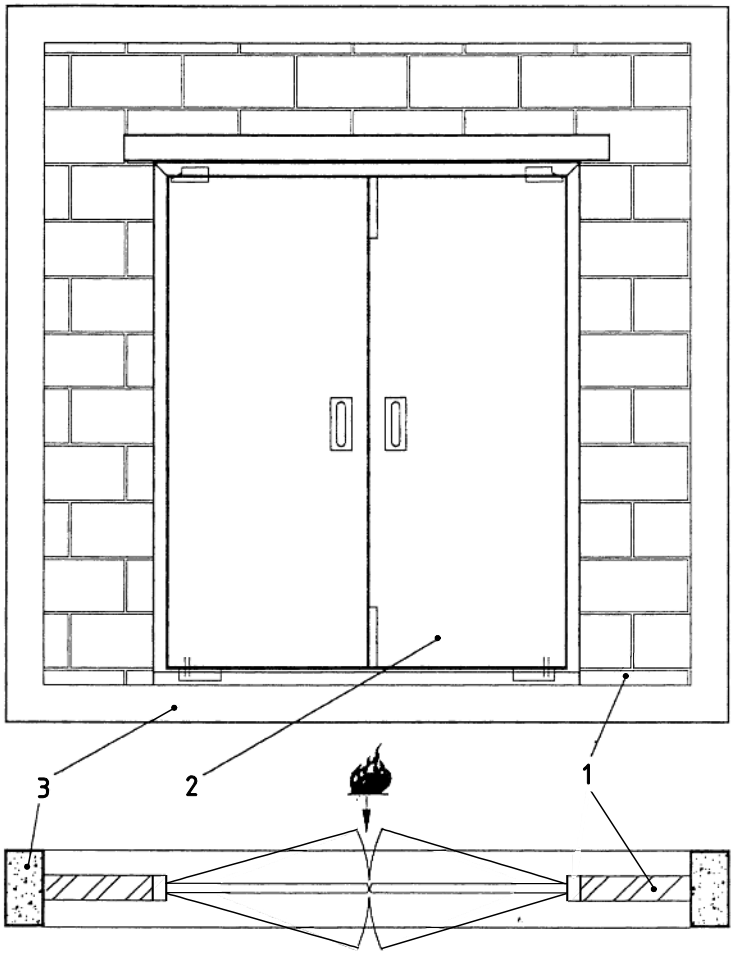
Key

1 steel ‘C’ stud

2 12,5 mm gypsum plasterboard

3 screws at 300 mm fixing centres

Figure 1 — Example of horizontal cross section of a flexible standard supporting construction



Key

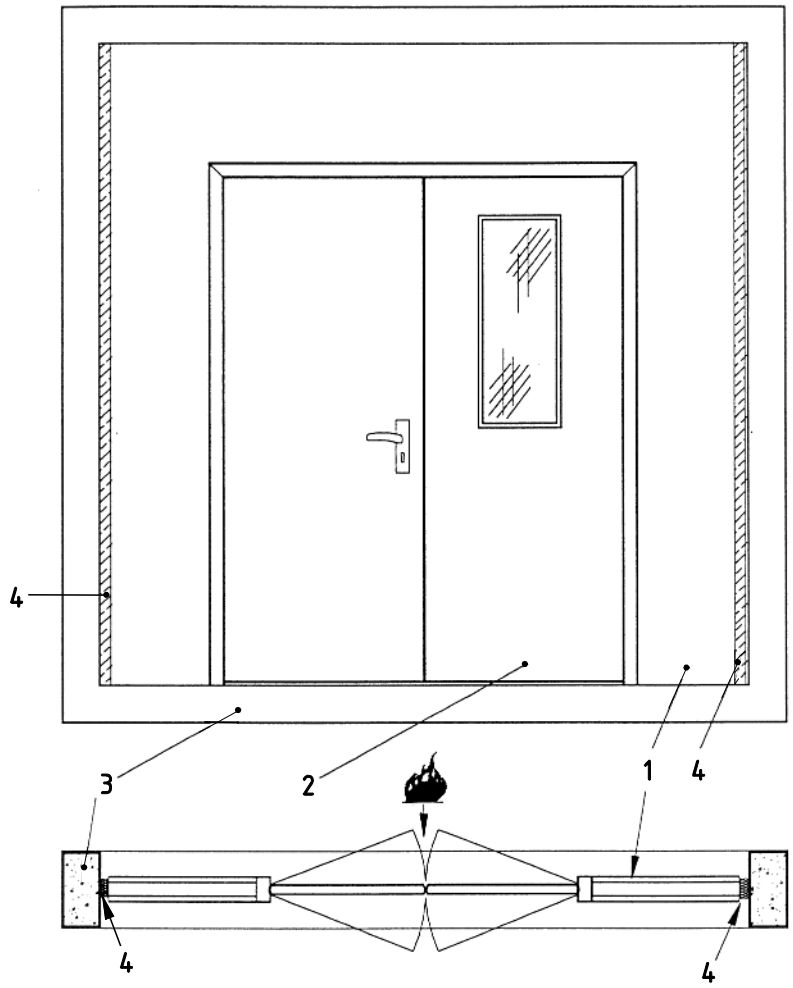
1 standard supporting construction (blockwork)

2 door assembly (test specimen)

3 test frame

NOTE 1 + 2 form the test construction.

Figure 2 — Example of a doorset in a rigid standard supporting construction



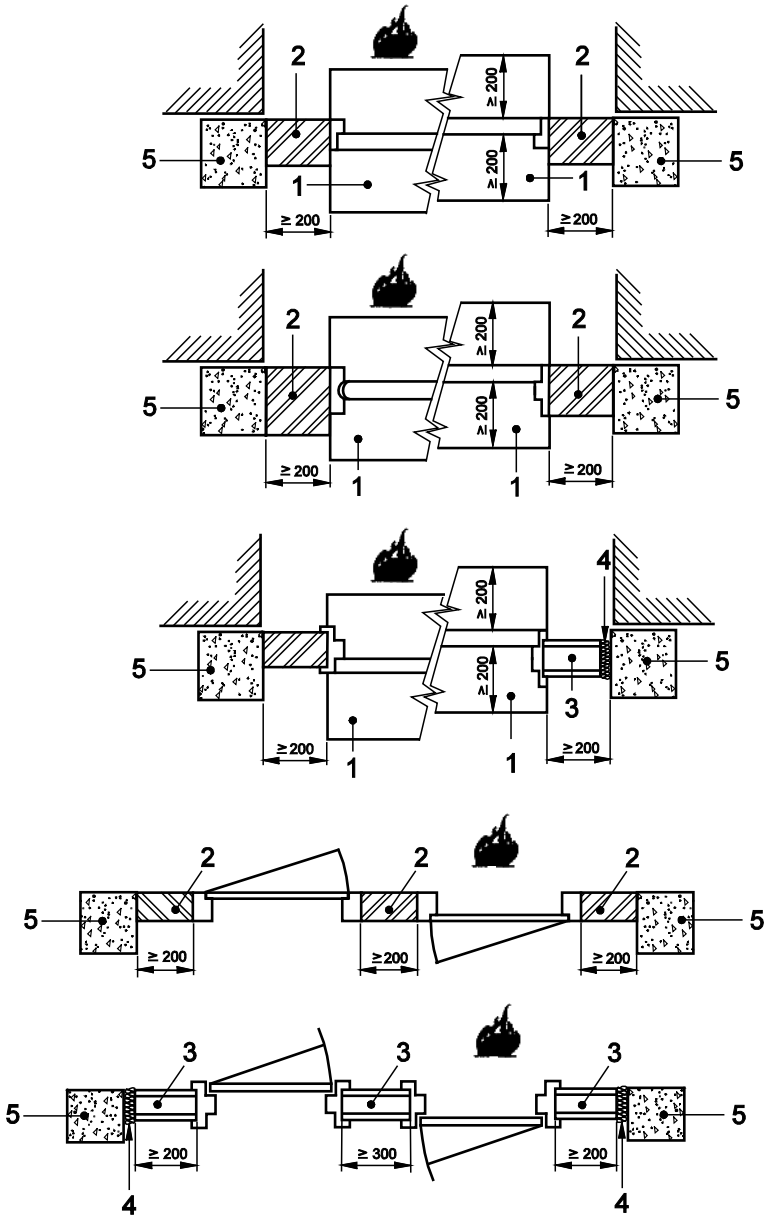
Key

1 standard or associated supporting construction
2 door assembly (test specimen)
3 test frame
4 free edge

NOTE 1 + 2 form the test construction.

Figure 3 — Example of a doorset in a flexible standard or associated supporting construction

Dimensions in mm

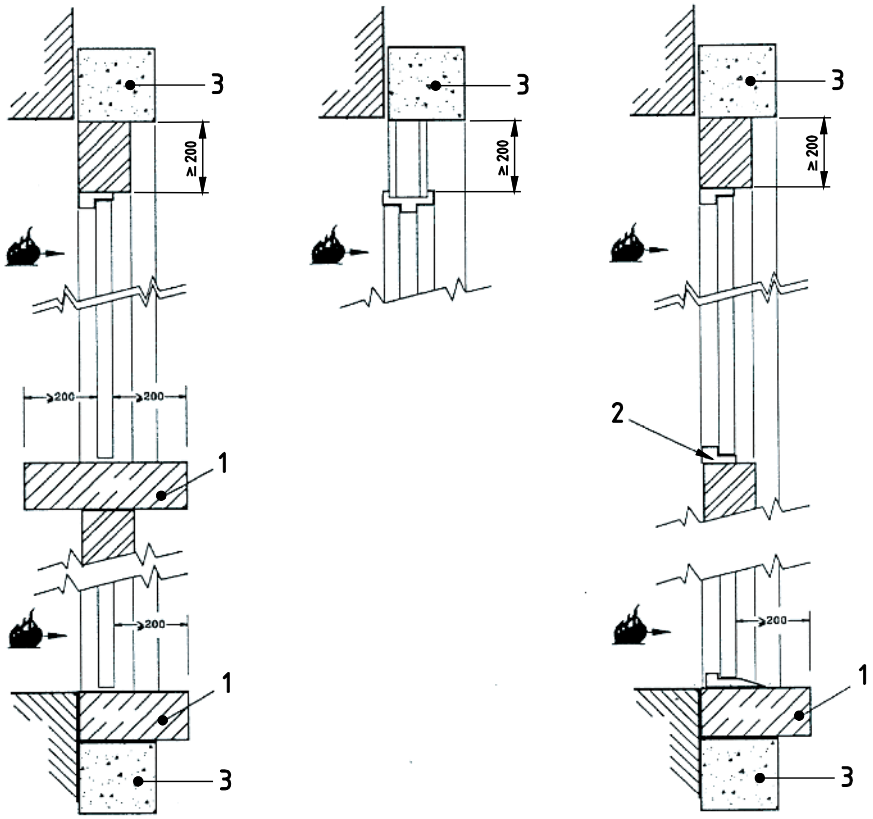


Key

1 floor
2 rigid standard supporting construction
3 flexible standard or associated supporting construction
4 free edge
5 test frame

Figure 4 — Examples of horizontal sections for mounting hinged doorset test specimens

Dimensions in mm



Key

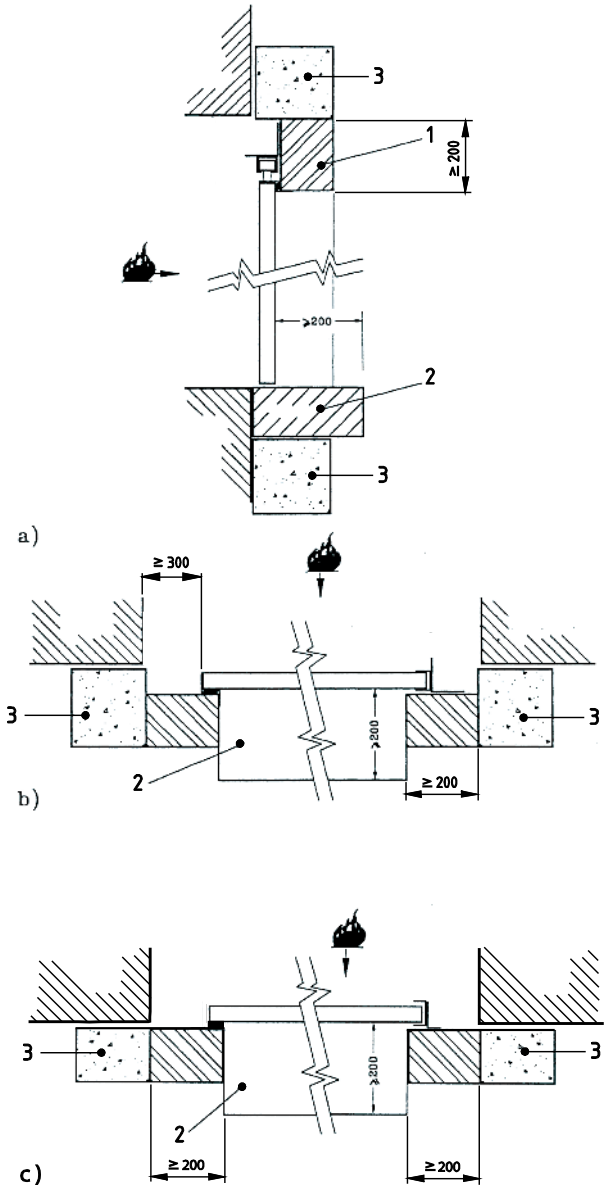
1 floor, solid, non-combustible material

2 supporting construction

3 test frame

Figure 5 — Examples of vertical section for mounting hinged doorset test specimens

Dimensions in mm

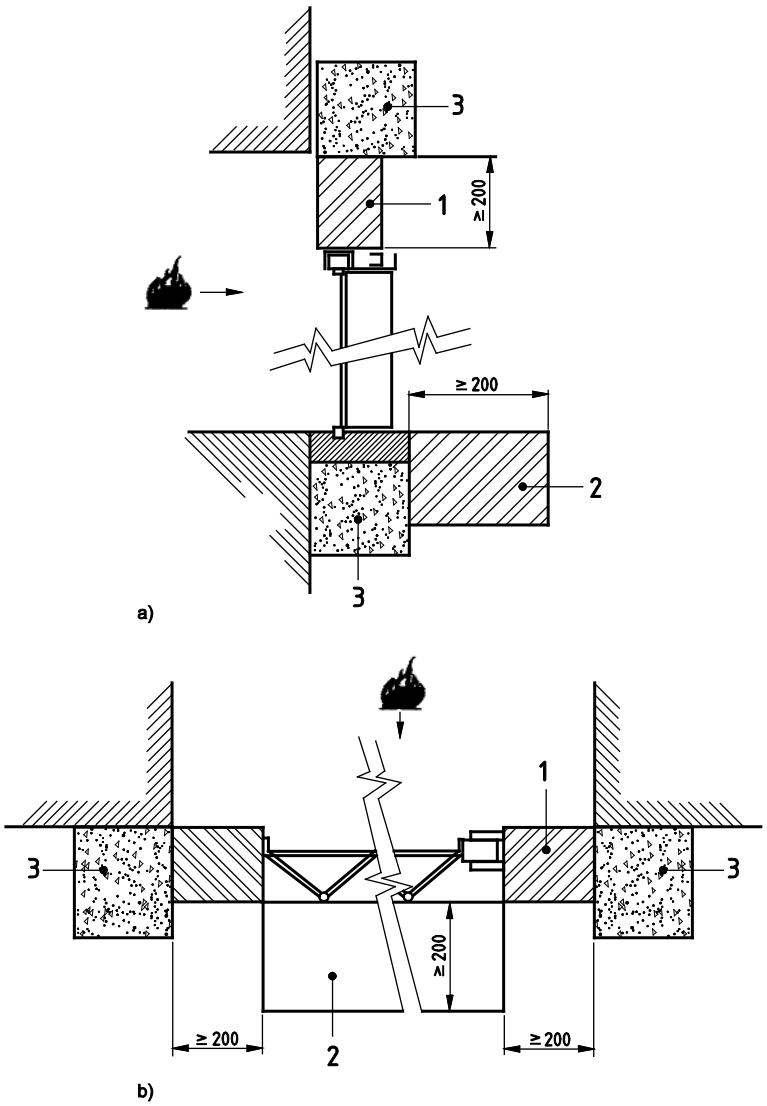


Key

a) vertical section
b) horizontal section
c) horizontal section
1 supporting construction
2 floor, solid, non-combustible material
3 test frame

Figure 6 — Example of mounting for sliding doorset test specimen

Dimensions in mm



Key

a) vertical section

b) horizontal section

1 rigid supporting construction

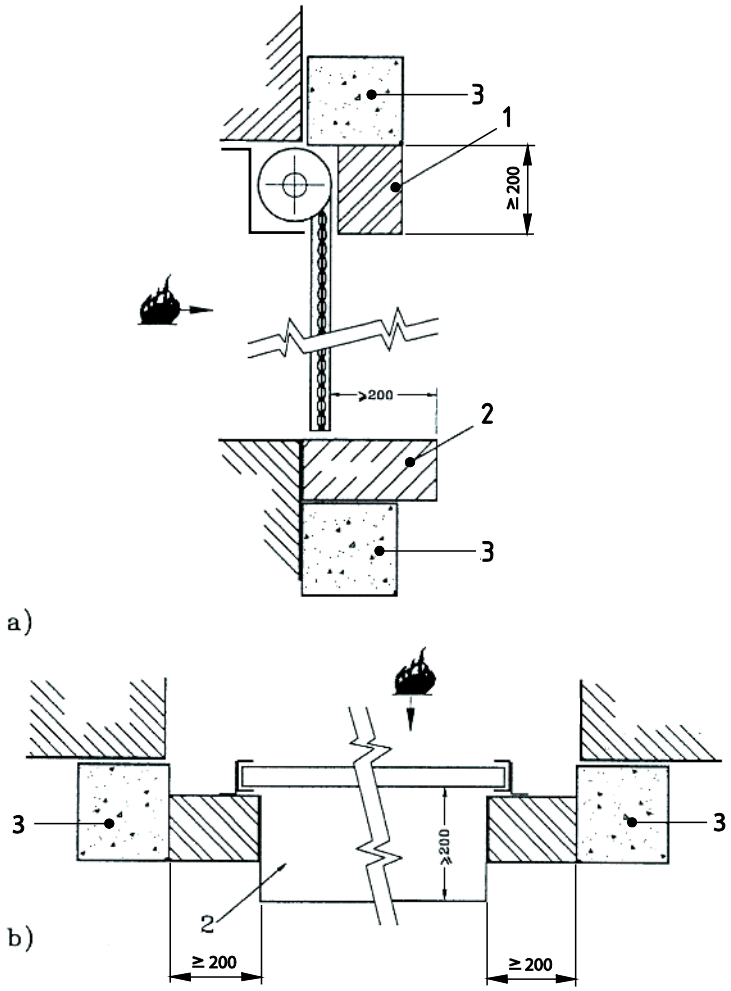
2 floor, solid, non-combustible material

3 test frame

NOTE This figure covers both folding doorset and sliding/folding doorset.

Figure 7 — Example of mounting for folding doorset test specimen

Dimensions in mm



Key

a) vertical section
b) horizontal section
1 rigid supporting construction
2 floor, solid, non-combustible material
3 test frame

Figure 8 — Example of mounting for rolling shutter doorset test specimen

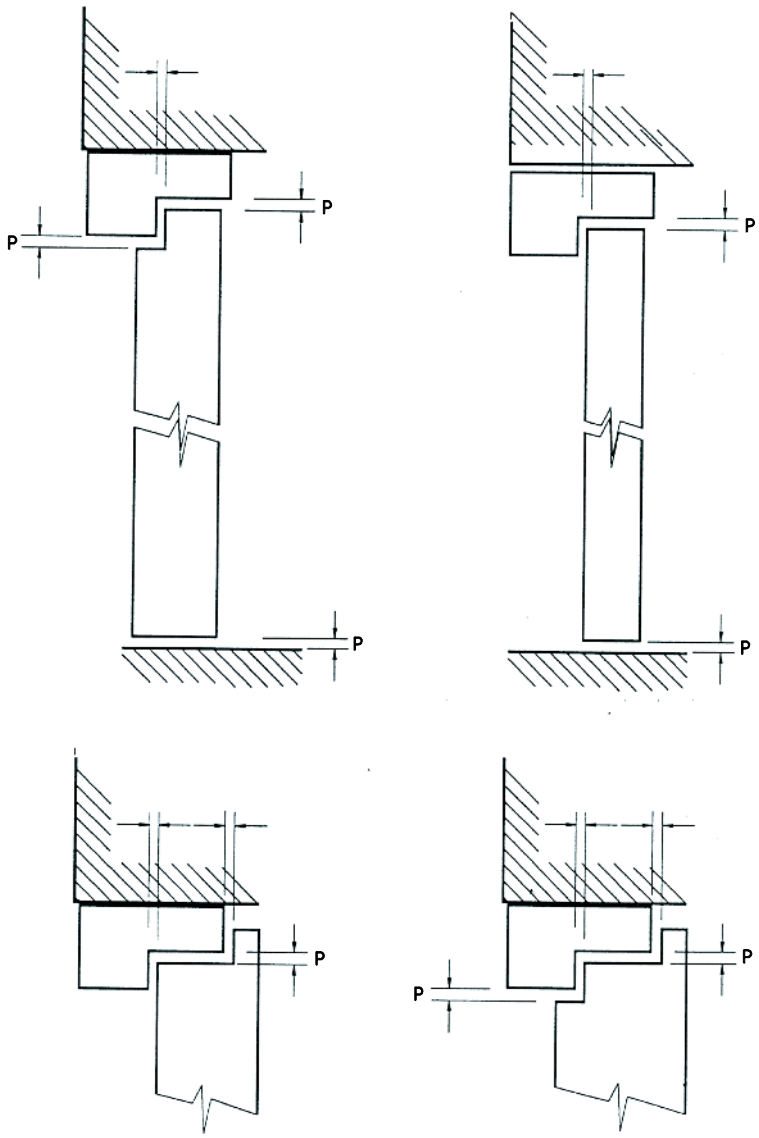
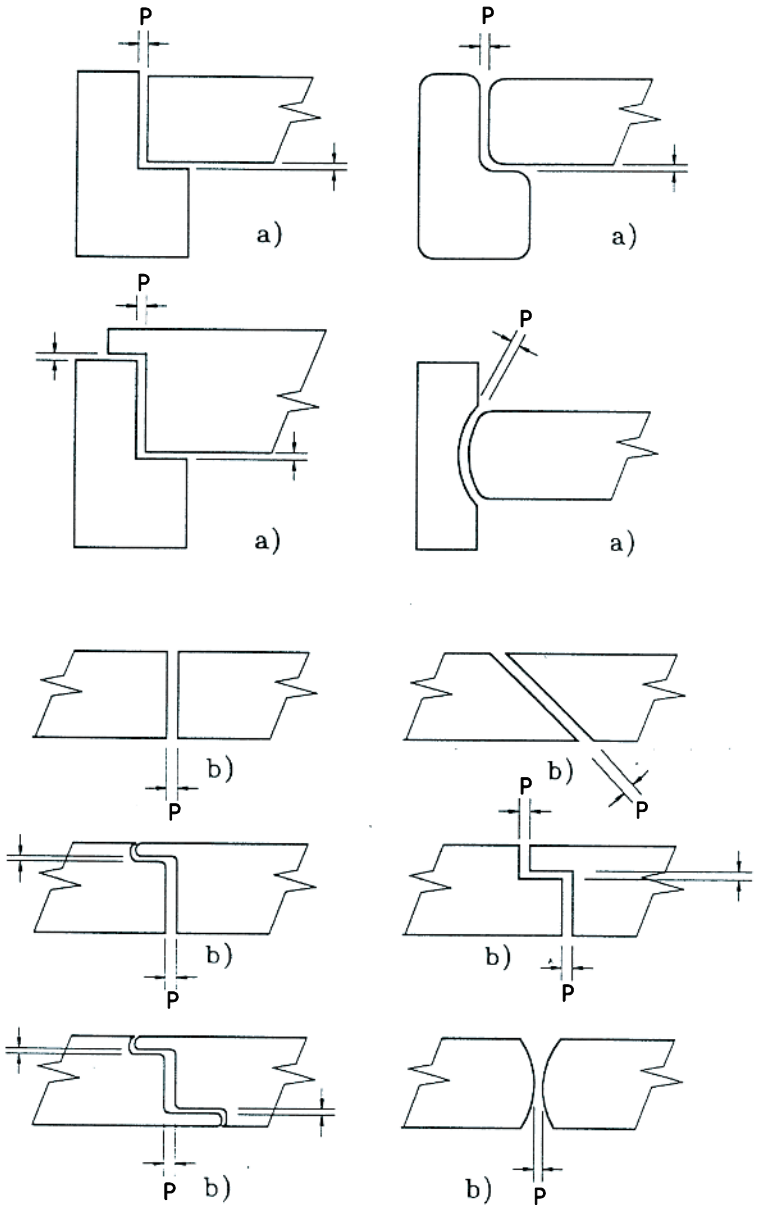


Figure 9 — Examples of primary gap measurements for hinged, pivoted doorsets and openable windows, vertical sections



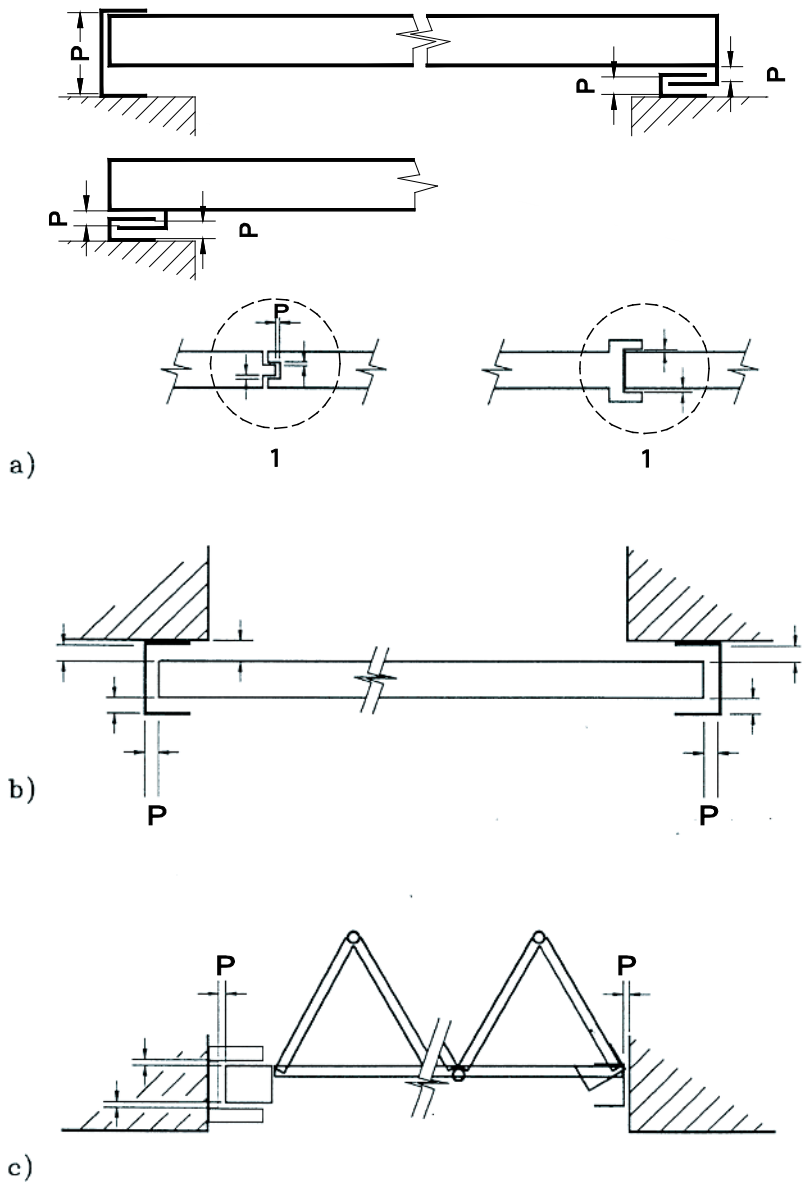
Key

a) single and double leaf door

b) double leaf doors

P primary gap

Figure 10 — Examples of primary gap measurements for hinged, pivoted doorsets and openable windows, horizontal sections

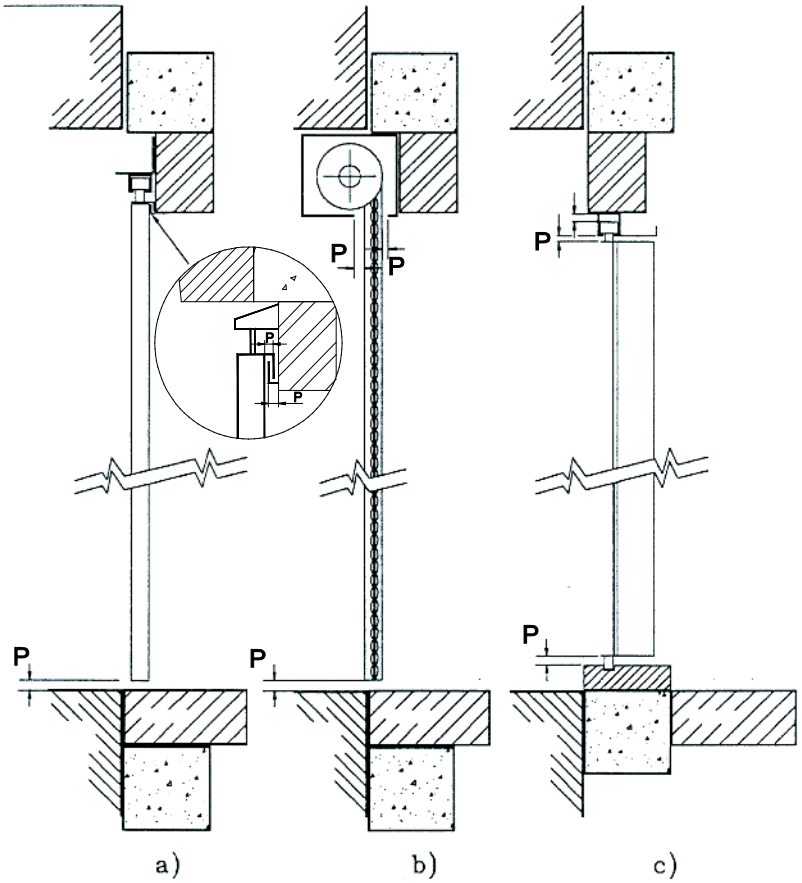


Key

a) sliding doors
b) rolling shutters doorset
c) folding doors
p primary gaps
1 meeting edge

NOTE For overlaps, see Figure 33.

Figure 11 — Examples of primary gap measurements, horizontal sections

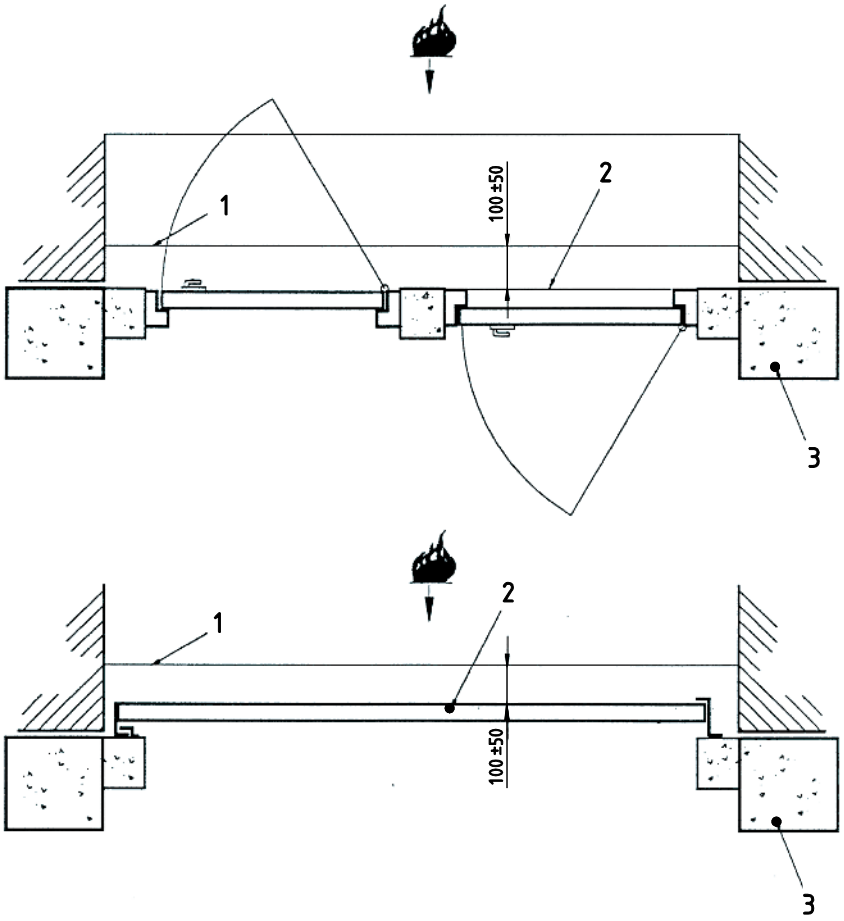


Key

a) sliding door
b) rolling shutter doorset
c) folding door
p primary gaps

Figure 12 — Examples of primary gap measurements, vertical sections

Dimensions in mm

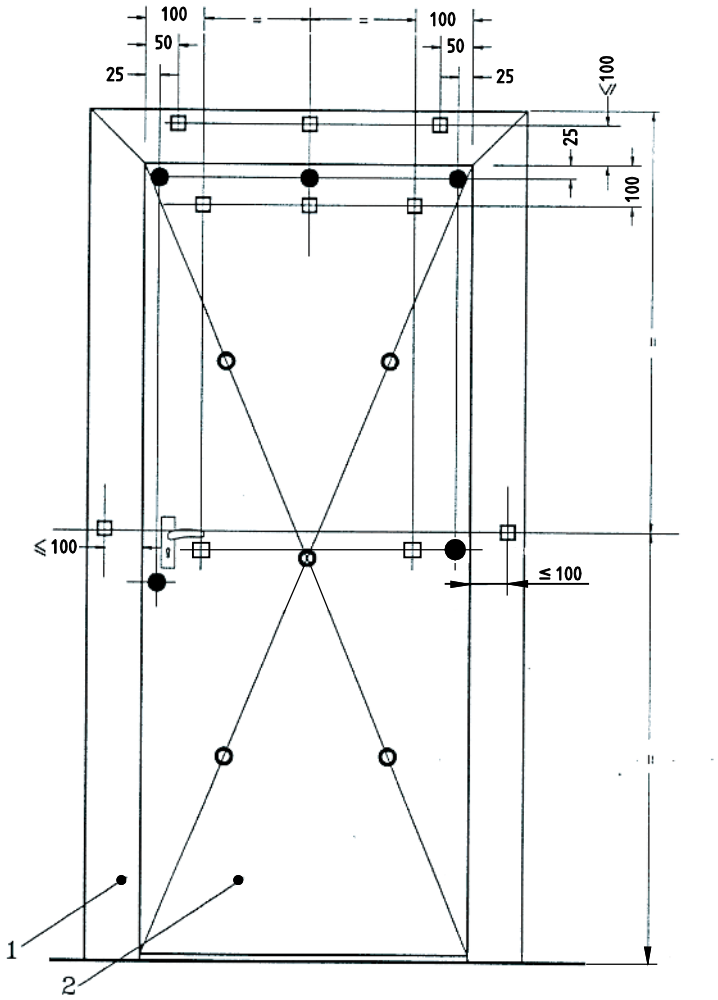


Key

1 plane of furnace thermocouples
2 nearest plane of test construction
3 test frame

Figure 13 — Examples of positioning of furnace thermocouples, horizontal sections

Dimensions in mm



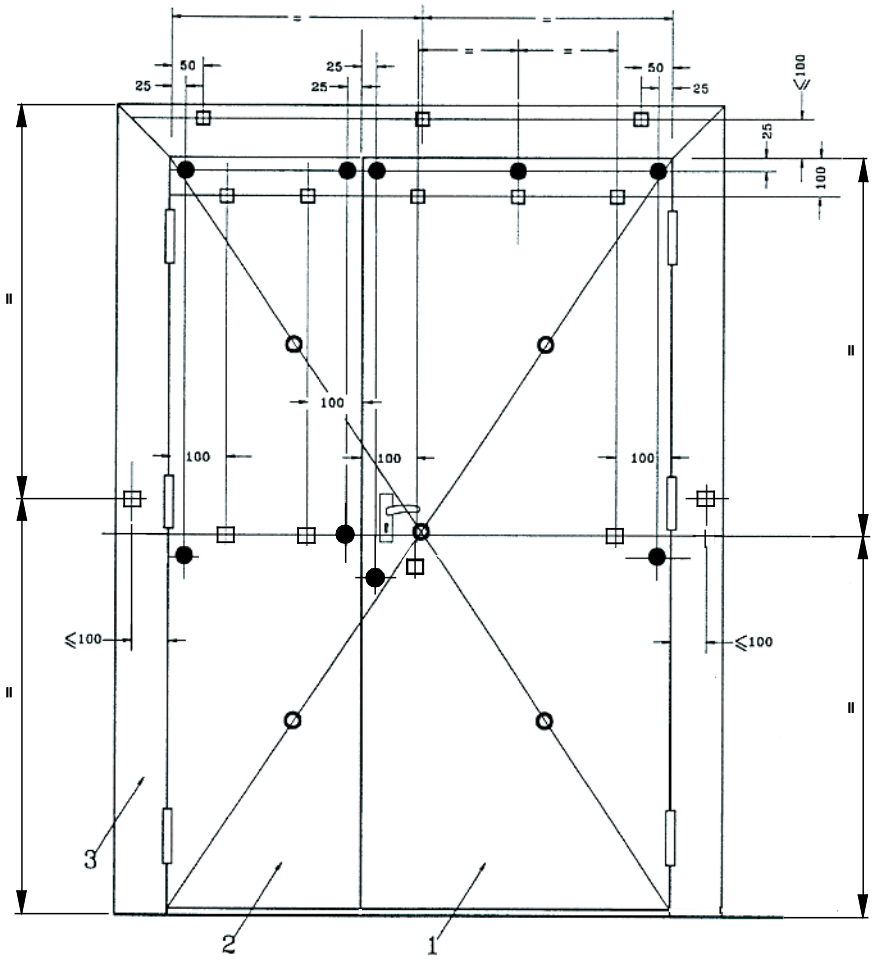
Key

- ○ thermocouples for average temperature rise
- □ thermocouples for maximum temperature rise
- ● additional thermocouples for maximum temperature rise (supplementary procedure)
- 1 door frame
- 2 door leaf

Where the positioning of the thermocouples appears to be in conflict with an element of building hardware, the positioning shall be modified in accordance with 9.1.2.1.

Figure 14 — Example of location of unexposed face thermocouples, general arrangement (hinged single leaf doorset, 1 200 mm visible door leaf width)

Dimensions in mm



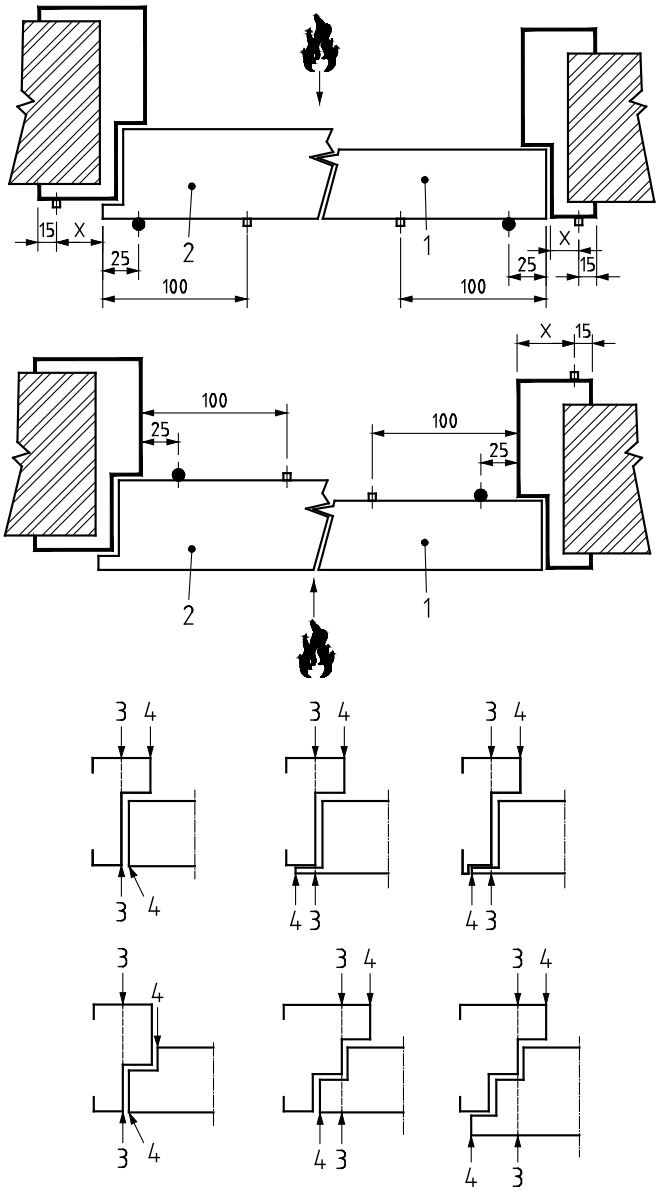
Key

- ○ thermocouples for average temperature rise
- □ thermocouples for maximum temperature rise
- ● additional thermocouples for maximum temperature rise (supplementary procedure)
- 1 primary leaf
- 2 secondary leaf
- 3 door frame

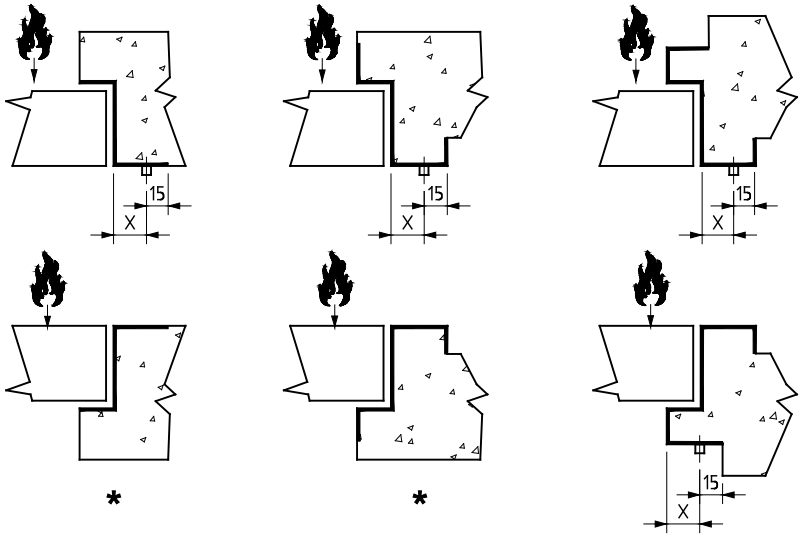
Where the positioning of the thermocouples appears to be in conflict with an element of building hardware, the positioning shall be modified in accordance with 9.1.2.1.

Figure 15 — Example of location of unexposed face thermocouples, general arrangement (hinged double leaf doorset, visible primary door leaf width of 1 200 mm wide, visible secondary door leaf width < 1 200 mm wide)

Dimensions in mm



a)



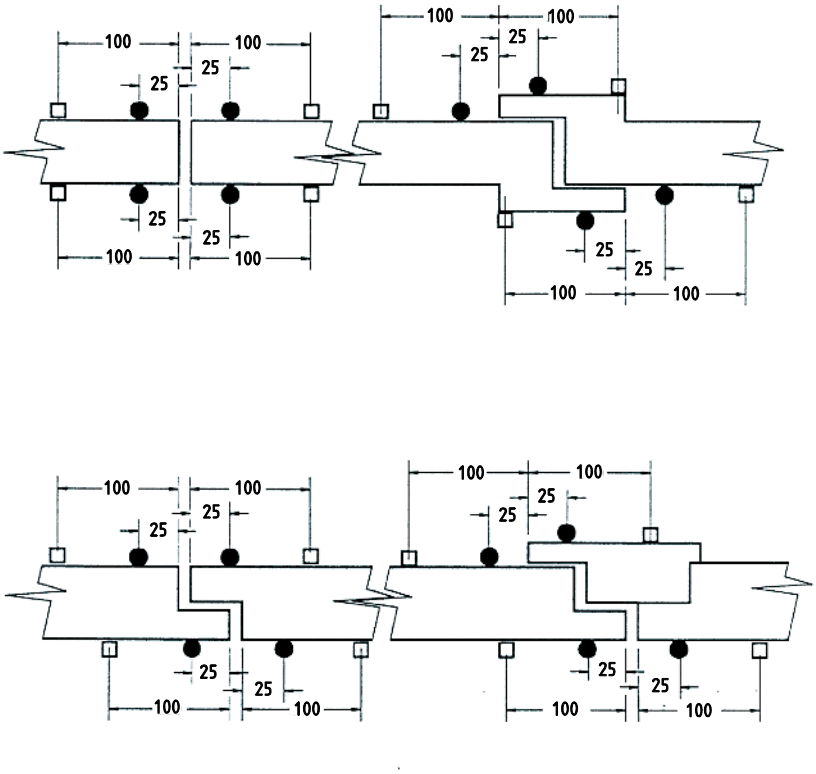
b)

Key

X < 15 mm	no thermocouple
X 15 mm to 100 mm	thermocouple as shown on the drawing
X > 100	thermocouples placed X = 100
*	no thermocouple on the frame from this side
1	door leaf with single rebate
2	door leaf with double rebate
3	point of leaf entry
4	reference point for location of unexposed face thermocouples

Figure 16 — Examples of location of unexposed face thermocouples at periphery of hinged and pivoted doorset (detailed)

Dimensions in mm

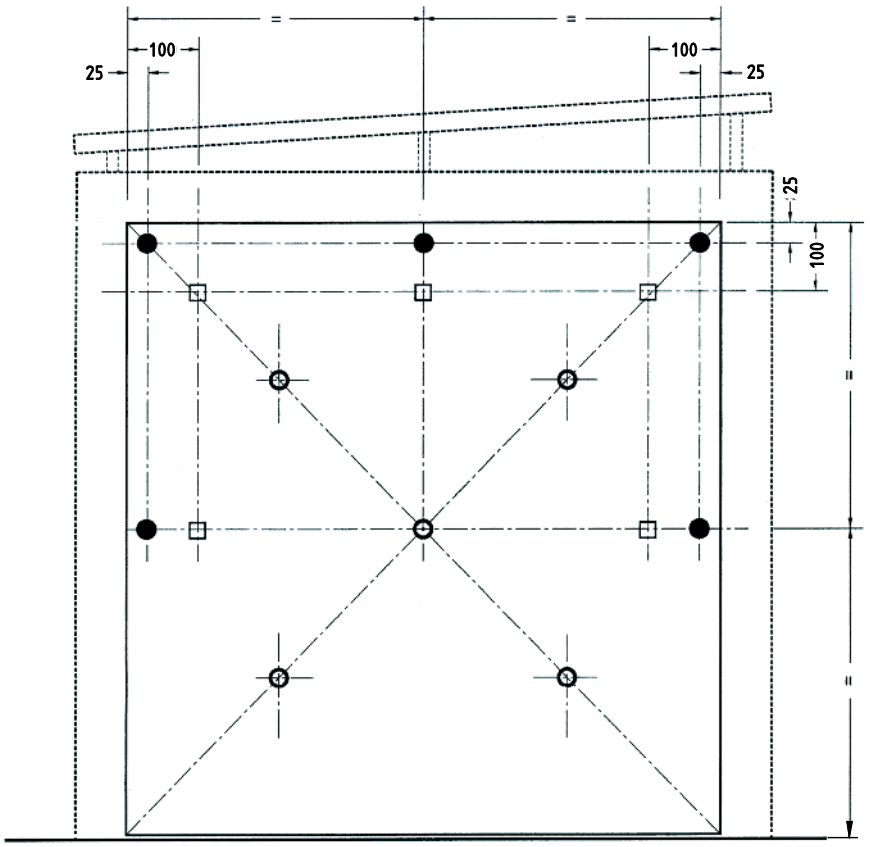


Key

- ☐ thermocouples for maximum temperature rise
- ● additional thermocouples for maximum temperature rise (supplementary procedure)

Figure 17 — Examples of location of unexposed face thermocouples on meeting edges (hinged or pivoted double leaf doorset)

Dimensions in mm

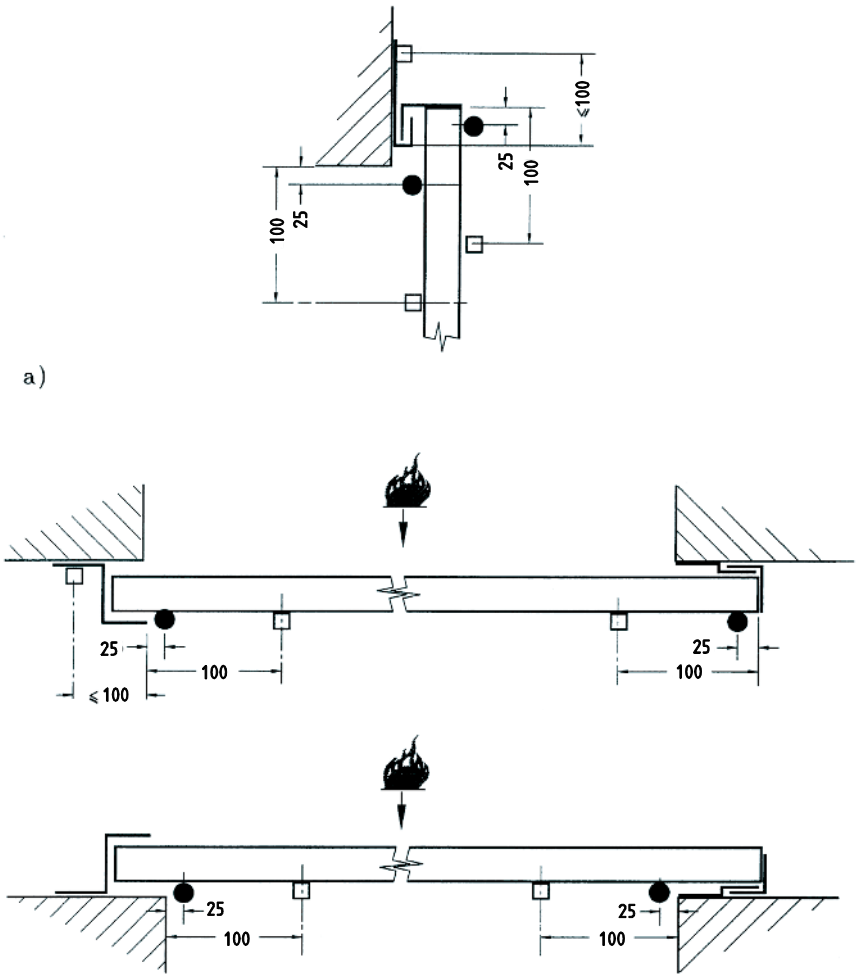


Key

- o thermocouples for average temperature rise
- □ thermocouples for maximum temperature rise
- ● additional thermocouples for maximum temperature rise (supplementary procedure)

Figure 18 — Example of location of unexposed face thermocouples, single leaf sliding doorset

Dimensions in mm



Key

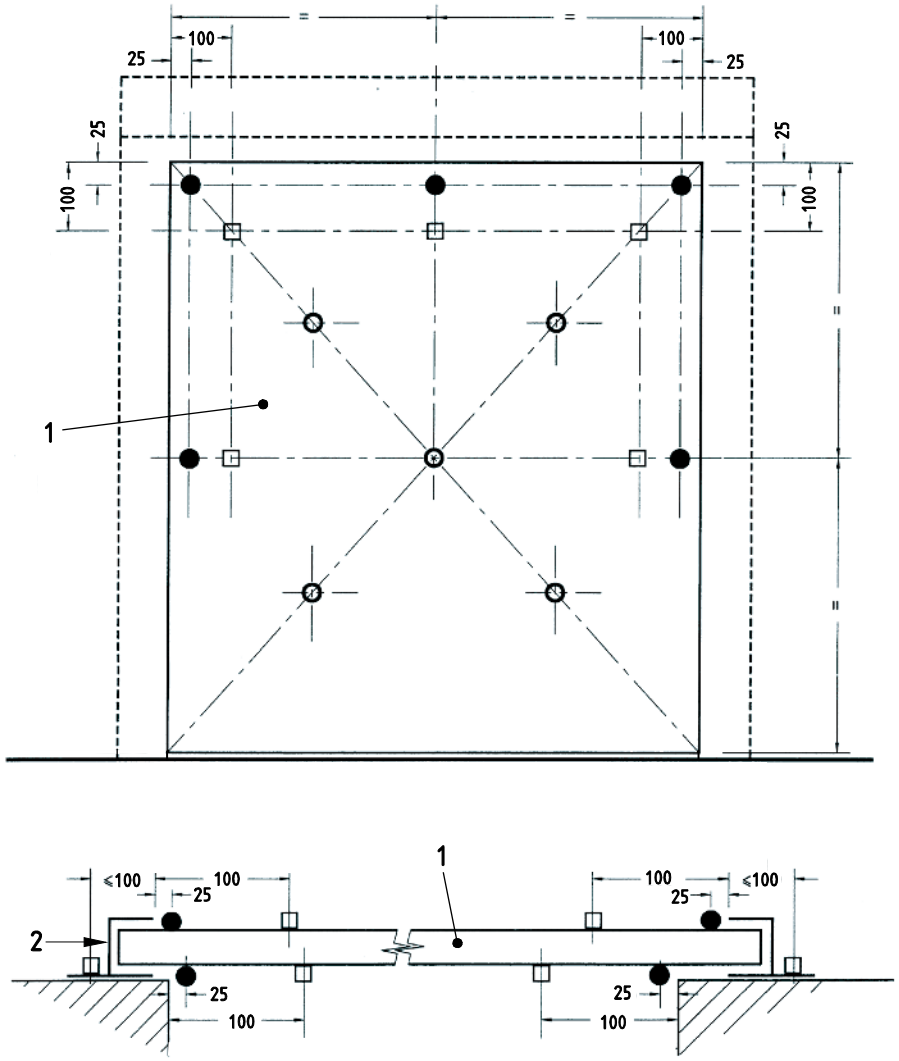
□ thermocouples for maximum temperature rise

● additional thermocouples for maximum temperature rise (supplementary procedure)

a) Cross section showing fire attack from either side

Figure 19 — Example of location of maximum unexposed face thermocouples, single leaf sliding doorset

Dimensions in mm

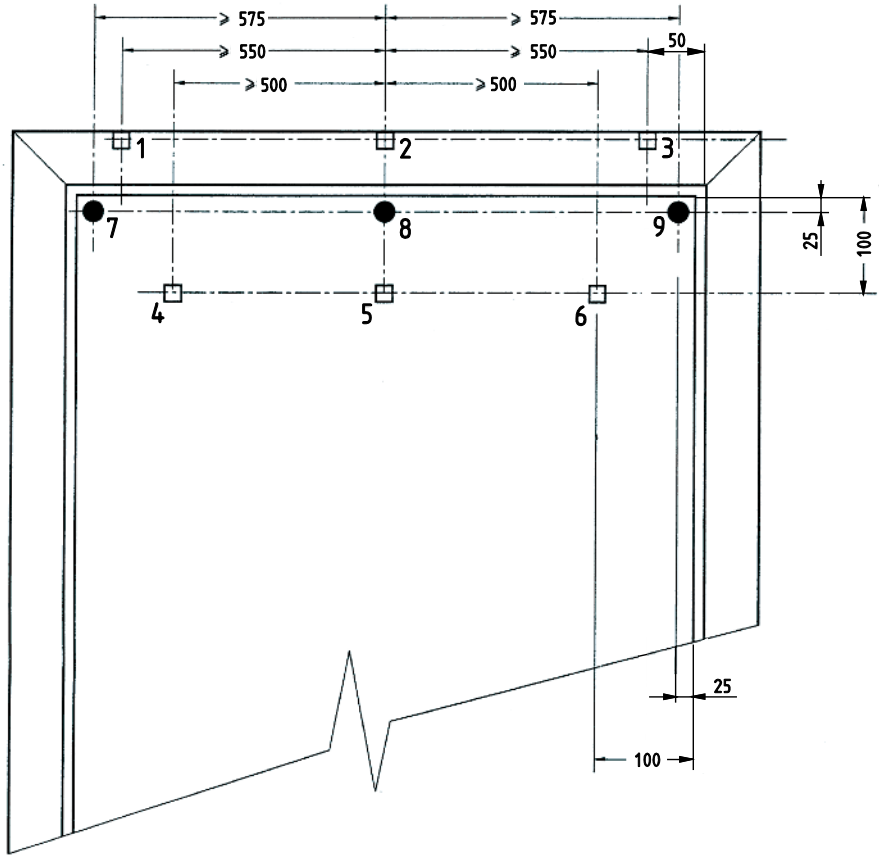


Key

- ○ thermocouples for average temperature rise
- □ thermocouples for maximum temperature rise
- ● additional thermocouples for maximum temperature rise (supplementary procedure)
- 1 shutter curtain
- 2 side guides

Figure 20 — Example of location of unexposed face thermocouples, general arrangement (rolling shutter doorset)

Dimensions in mm



Key

□ thermocouples for maximum temperature rise

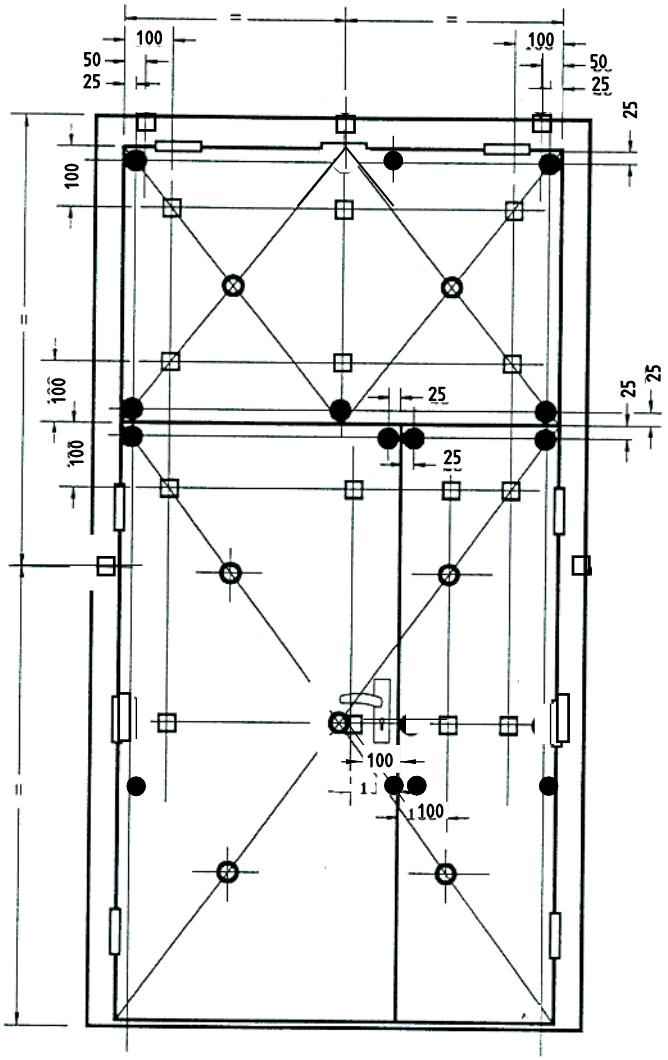
● additional thermocouples for maximum temperature rise (supplementary procedure) numbers 7 to 9

Thermocouples always required: numbers 1, 3, 4, 6, 7 and 9.

Thermocouples not required if dimensions less than those shown on the diagram above: numbers 2, 5 and 8.

Figure 21 — Reduction in number of unexposed face thermocouples for single leaf hinged/pivoted door leaves less than 1 200 mm wide

Dimensions in mm



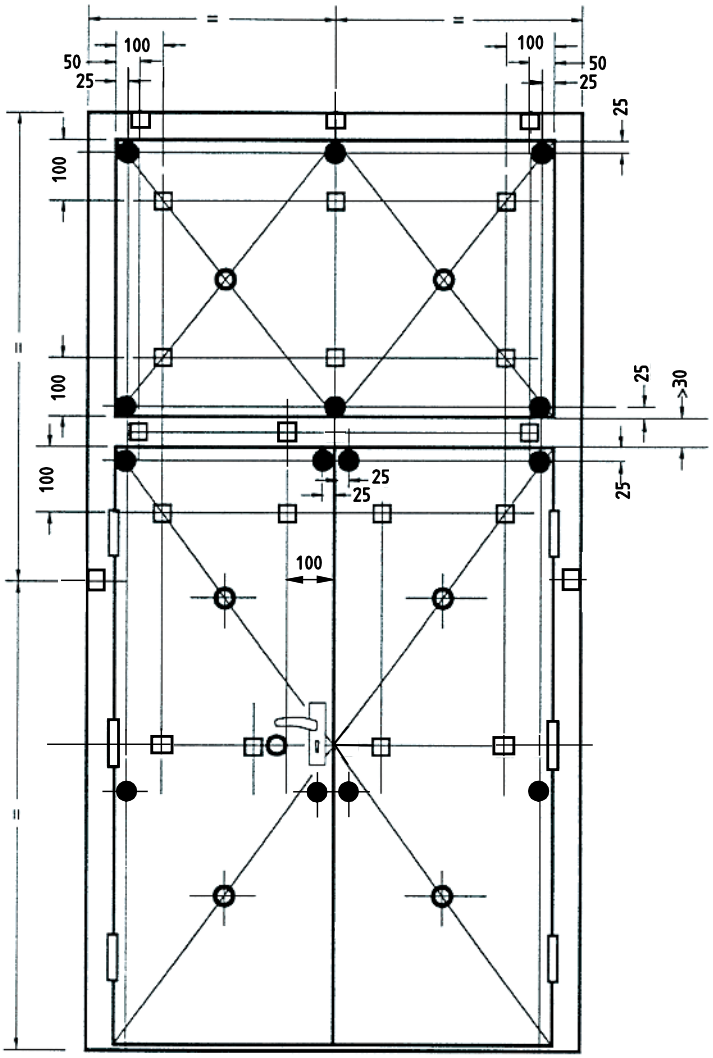
Key

- ○ thermocouples for average temperature rise
- □ thermocouples for maximum temperature rise
- ● additional thermocouples for maximum temperature rise (supplementary procedure)

Where the positioning of the thermocopuples appears to be in conflict with an element of building hardware, the positioning shall be modified in accordance with 9.1.2.1.

Figure 22 — Example of location of thermocouples on unexposed face for double leaf doorset incorporating hinged flush over panel (largest leaf width < 1 200 mm)

Dimensions in mm



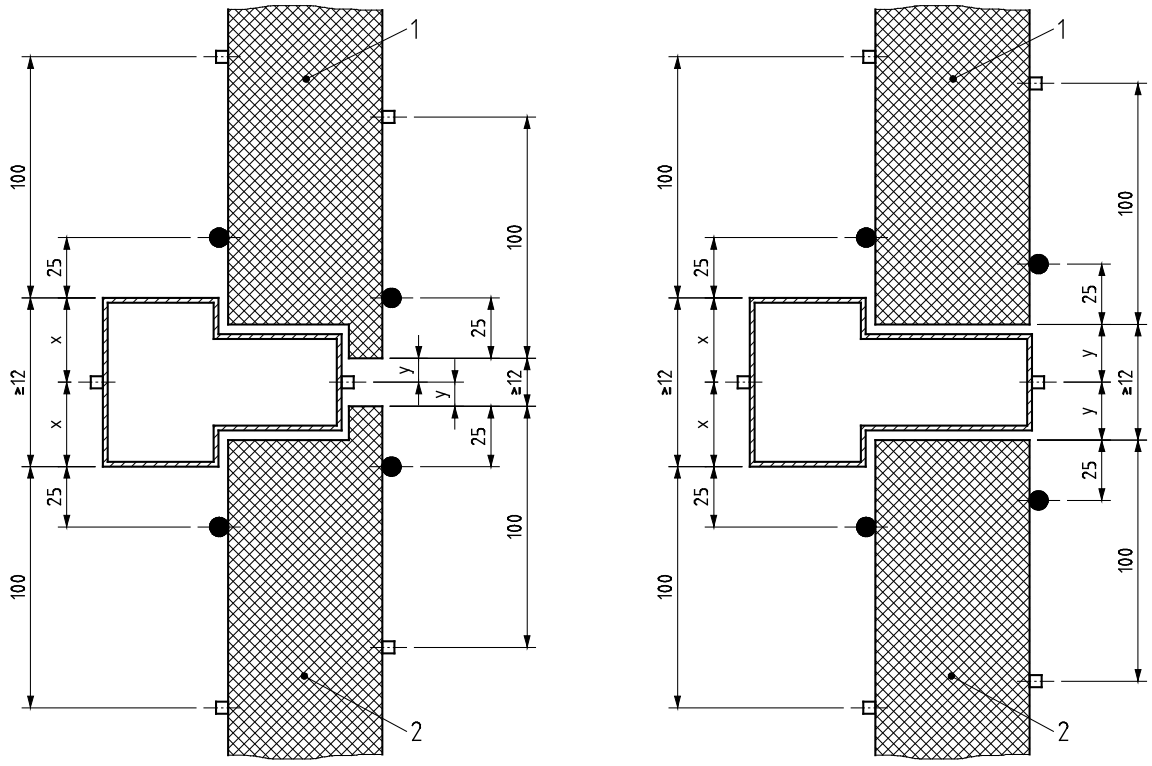
Key

- o thermocouples for average temperature rise
- □ thermocouples for maximum temperature rise
- ● additional thermocouples for maximum temperature rise (supplementary procedure)

Where the positioning of the thermocouples appears to be in conflict with an element of building hardware, the positioning shall be modified in accordance with 9.1.2.1.

Figure 23 — Example of location of thermocouples on unexposed face for double leaf doorset incorporating transom panel (largest leaf width < 1 200 mm)

Dimensions in mm

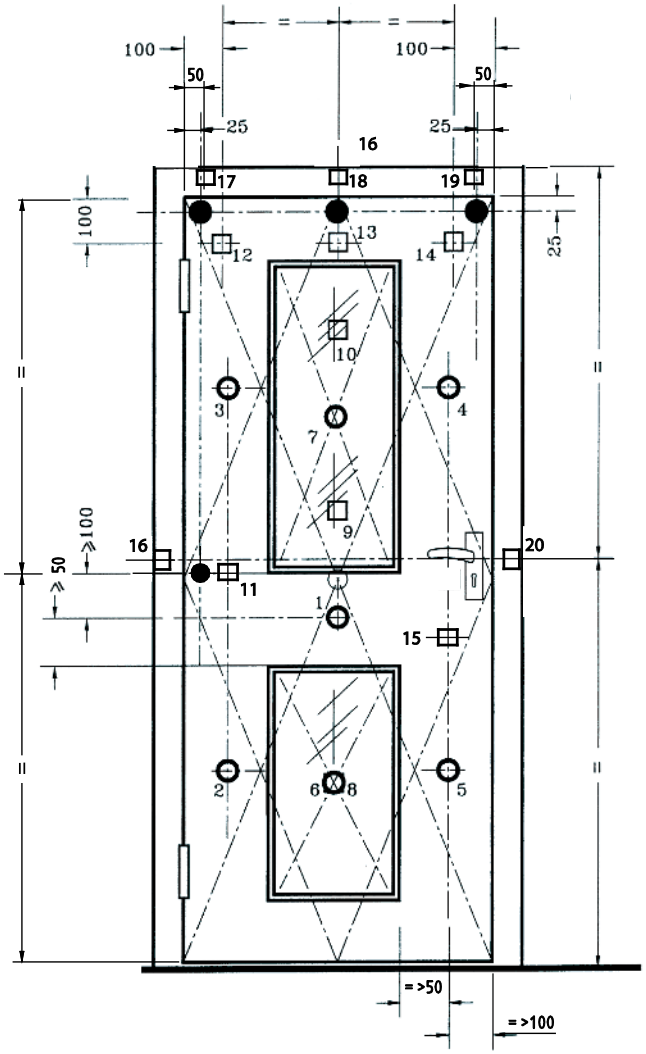


Key

- □ thermocouples for maximum temperature rise
- ● additional thermocouples for maximum temperature rise (supplementary procedure)
- 1 transom panel
- 2 door leaf

Figure 24 — Example of location of thermocouples on unexposed face for doorset incorporating a transom panel

Dimensions in mm



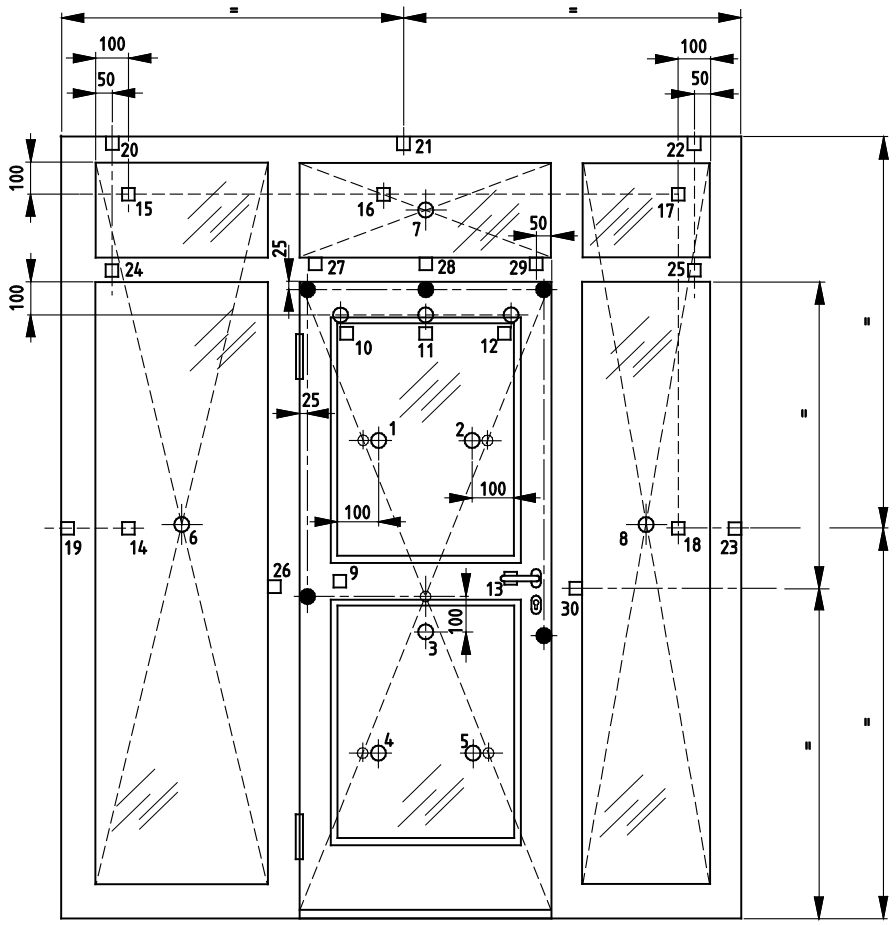
Key

○	thermocouples for average temperature rise
□	thermocouples for maximum temperature rise
•	additional thermocouples for maximum temperature rise (supplementary procedure)
Average temperature glazed area:	average of thermocouples 6 and 7
Maximum temperature glazed area:	maximum of thermocouples 6 to 10
Average temperature door leaf:	average of thermocouples 1 to 5
Maximum temperature door leaf:	maximum of thermocouples 1 to 5 and 11 to 15
Maximum temperature door frame:	maximum of thermocouples 16 to 20

Where the positioning of the thermocouples appears to be in conflict with an element of building hardware, the positioning shall be modified in accordance with 9.1.2.1

Figure 25 — Example of location of unexposed face thermocouples on hinged doorset incorporating glazing (width of door leaf > 1 200 mm)

Dimensions in mm



Key

- o thermocouples for average temperature rise
- □ thermocouples for maximum temperature rise
- • additional thermocouples for maximum temperature rise (supplementary procedure)

Average temperature door leaf: average of thermocouples 1 to 5

Maximum temperature door leaf: maximum of thermocouples 1 to 5 and 9 to 13

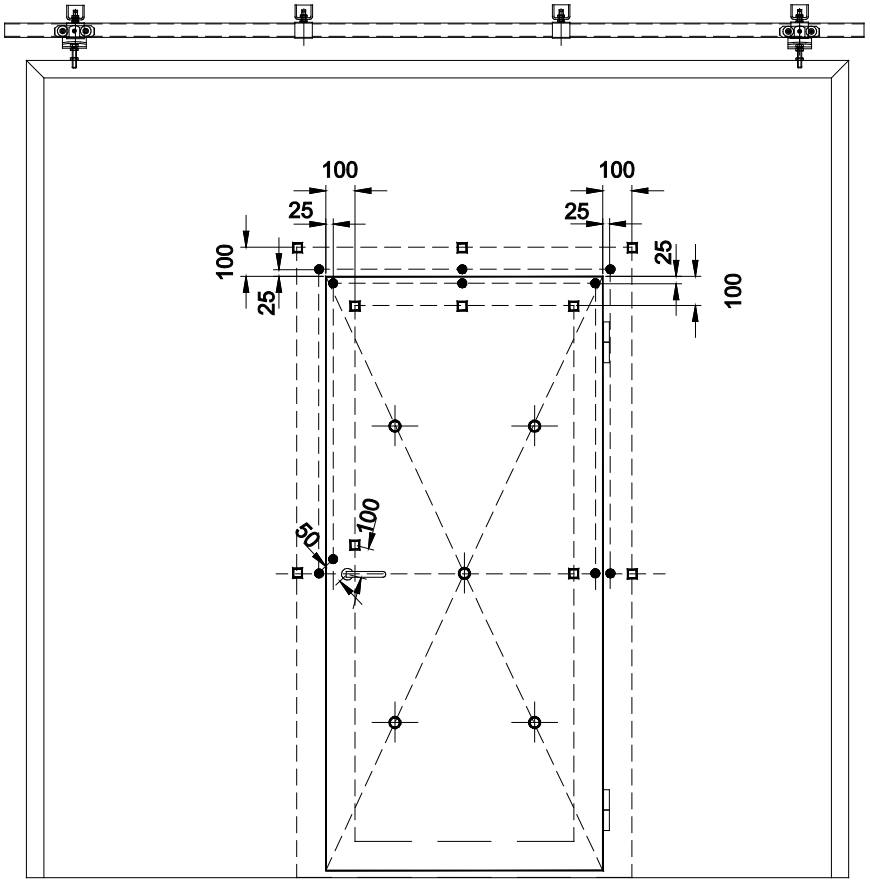
Average temperature side/over panels: average of thermocouples 6 to 8

Maximum temperature side/over panels: maximum of thermocouples 6 to 8 and 14 to 25

Maximum temperature of frame- or transom member adjacent to the leaf: maximum of thermocouples 26 to 30 (180 °C for I_1 / 360 °C for I_2)

Figure 26 — Example of location of thermocouples on unexposed face of doorset incorporating side/over panels

Dimensions in mm

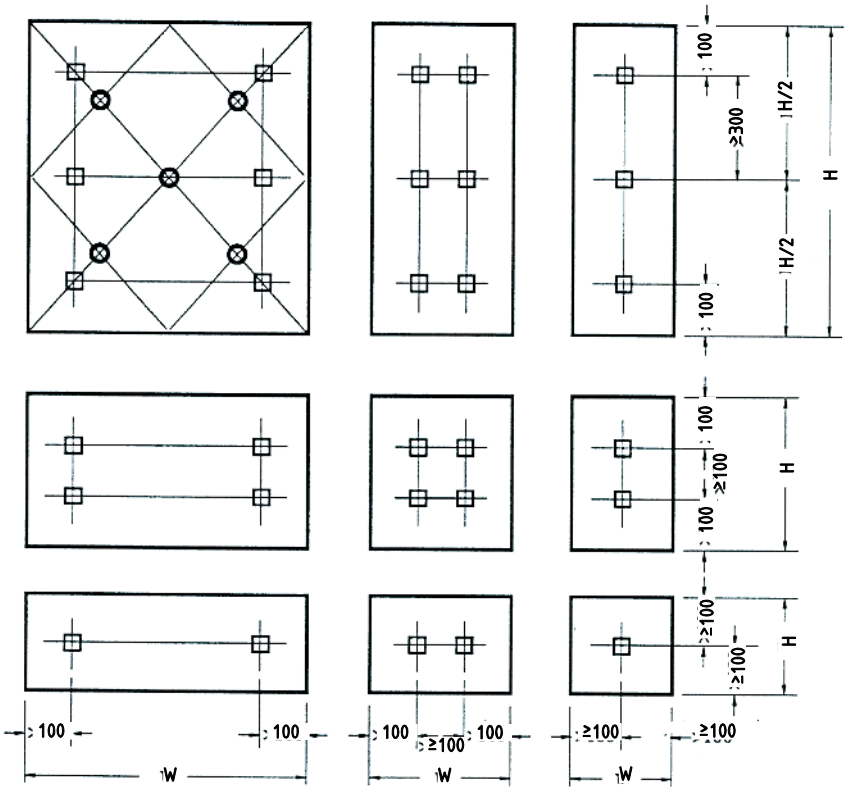


Key

- o thermocouples for average temperature rise
- □ thermocouples for maximum temperature rise
- ● additional thermocouples for maximum temperature rise (supplementary procedure)

Figure 27 — Example of location of thermocouples on unexposed face of sliding doorset incorporating a pass door

Dimensions in mm

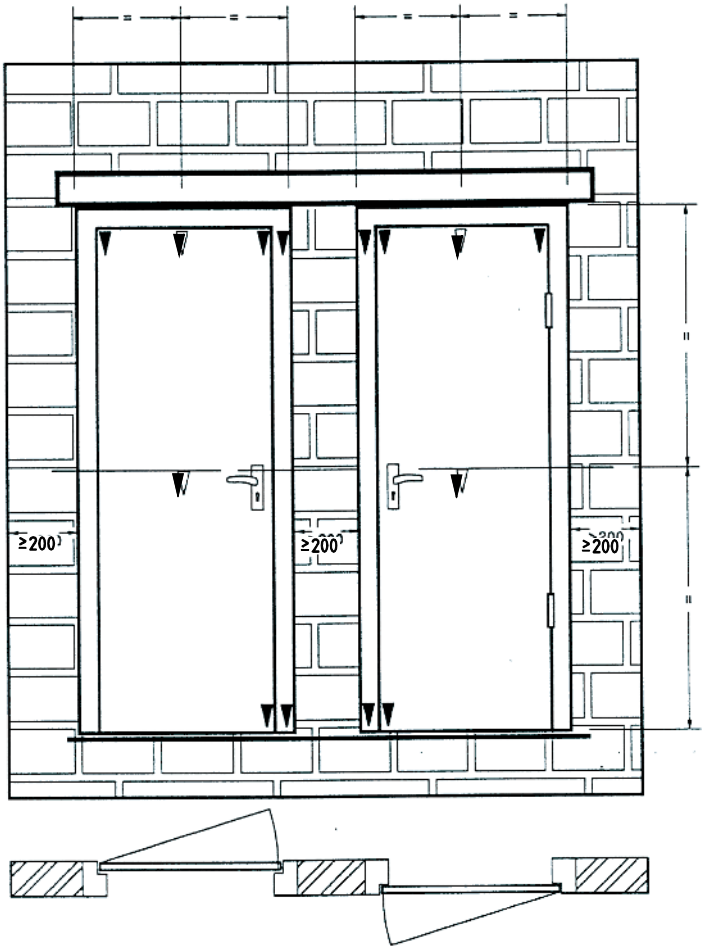


Key

- o thermocouples for average temperature rise
- □ thermocouples for maximum temperature rise
- W width of discrete area
- H height of discrete area

Figure 28 — Examples of location of thermocouples for discrete areas (e.g. in door leaves, side panels and over panels) assuming there is only one of each type in the test specimen

Dimensions in mm

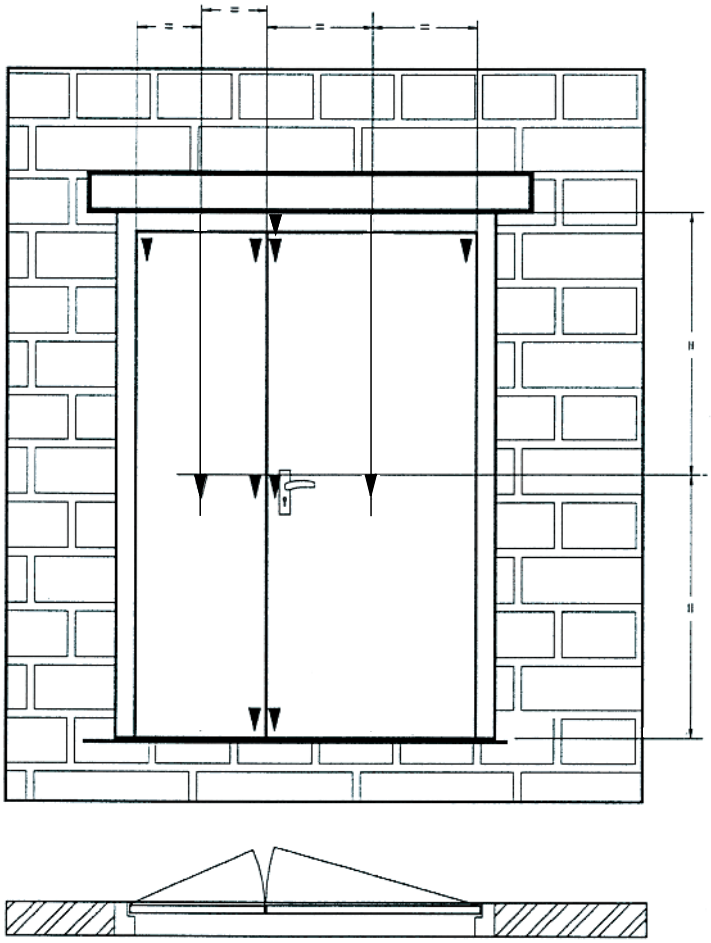


Key

▼ suggested position for measuring deflection

Figure 29 — Suggested positions for deflection measurements, hinged single leaf doorsets

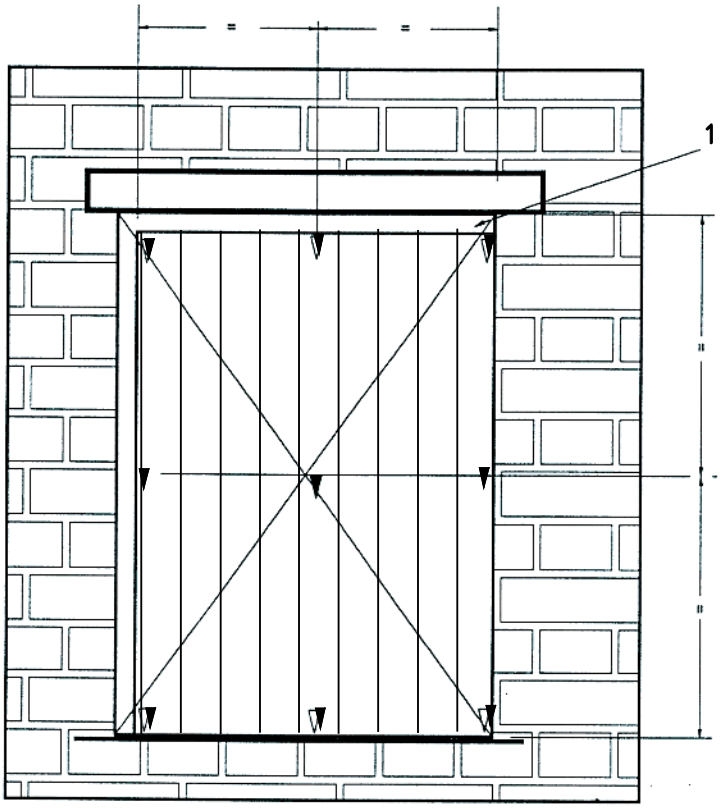
Dimensions in mm



Key

▼ suggested position for measuring deflection

Figure 30 — Suggested positions for deflection measurements, hinged double leaf doorsets



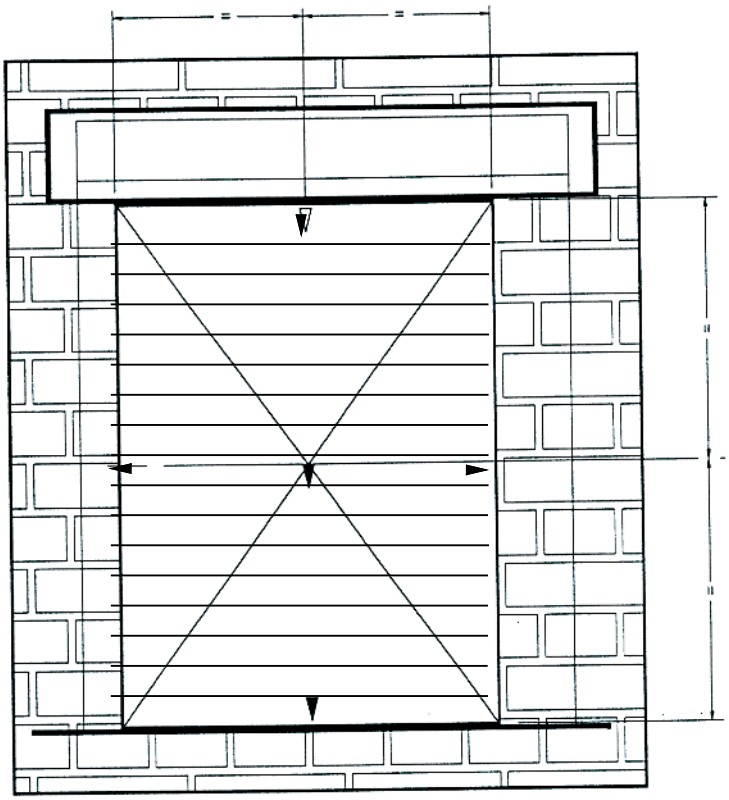
Key

▼ suggested position for measuring deflection

1 track

NOTE This figure also applies to folding doorsets.

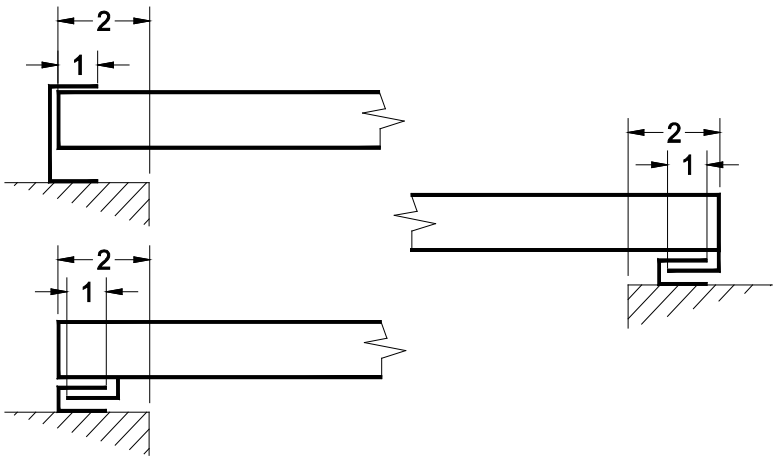
Figure 31 — Suggested positions for deflection measurements, sliding folding doorsets



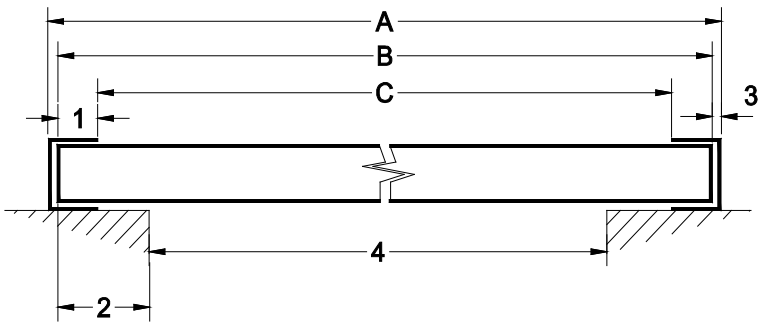
Key

▼ suggested position for measuring deflection

Figure 32 — Suggested positions for deflection measurements, rolling shutter doorsets



a)



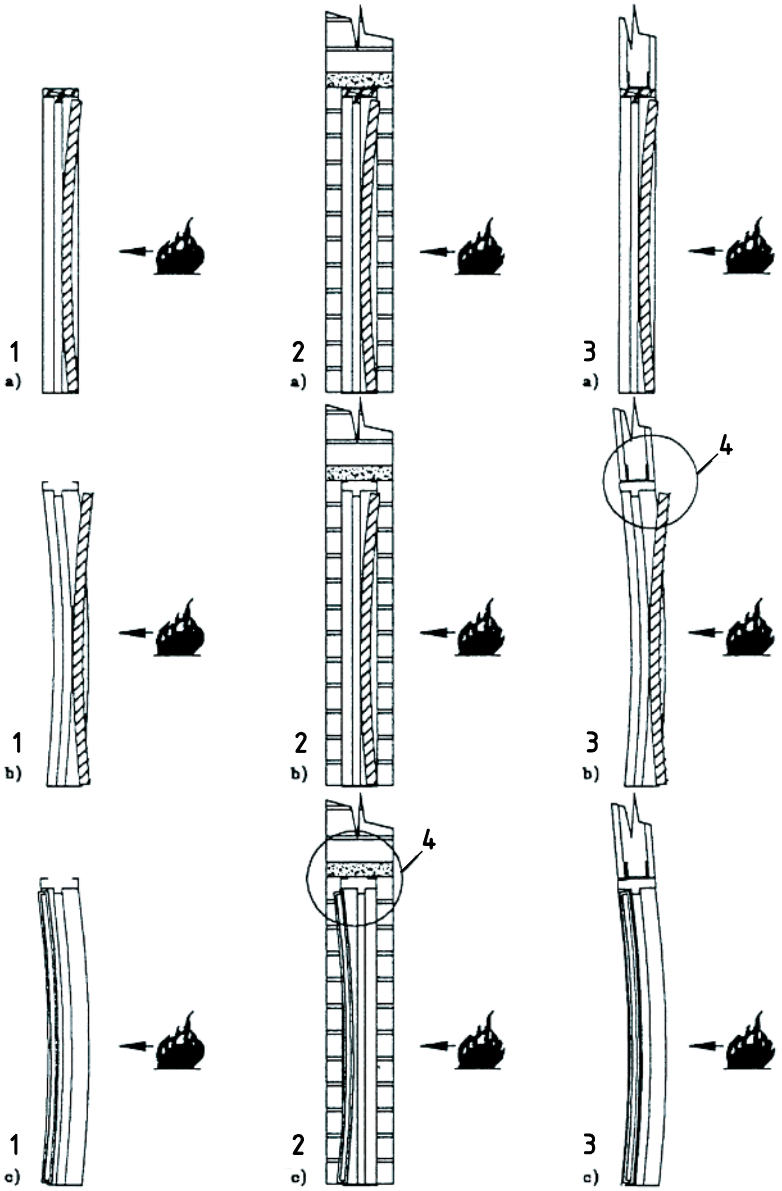
b)

Key

a) sliding door
b) rolling shutter doorset
A clearance distance between inside of guides
B width of rolling shutter curtain
C distance between vertical guides
1 tightness
2 overlap
3 clearance gap
4 clear opening

Tightness of the interlock B-C/2

Figure 33 — Examples of tightness of interlocking of leaf within guides for sliding and rolling shutter doorsets



Key

a) timber leaf, timber frame, opening into the furnace
b) timber leaf, metal frame, opening into the furnace
c) metal leaf, metal frame, opening away from the furnace
1 leaf to frame interaction
2 influence of rigid supporting construction (e.g. blockwork)
3 influence of flexible supporting construction (e.g. partition wall)
4 worst case

Figure 34 — Interaction between door leaves and door frames of differing materials and the influence of differing supporting constructions, hinged and pivoted doors

Annex A
(normative)

Conditioning requirements

A.1 General

EN 1363-1 specifies that the test specimen shall be 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, sealing materials and infilled door frames. In doing this consideration has been given to those aspects of conditioning (e.g. 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

When a test specimen is mounted within a supporting construction, e.g. a non-loadbearing wall mounted in a concrete or masonry wall supporting construction, full conditioning of the supporting construction may not be necessary if it can be demonstrated that there will be no influences on the behaviour of the specimen caused by excessive moisture resulting in e.g., lack of strength, spalling, moisture induced deformation, temperature influences, etc. Any changes to the requirements for conditioning supporting constructions are given in the specific test method.

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 Water based sealing materials

Water based 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.

Water based 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. metal 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 limits of permitted size variations

Table B.1 — Field of direct application - Limits of permitted size variations

Type of doorset	Category 'A' allowances	Category 'B' allowances
Hinged and pivoted doorsets and openable windows	Unlimited size reduction is permitted for all types except insulated metal doors where a reduction to 50 % width and 75 % height of the tested specimen is the limit of variation. Size increase is not permitted.	Unlimited size reduction is permitted for all types except insulated metal doors where a reduction to 50 % width and 75 % height of the tested specimen is the limit of variation. Size increase is permitted only for those which are required to satisfy integrity or integrity and insulation and then only up to: 15 % height; 15 % width; 20 % area
Horizontally and vertically sliding doorsets	Unlimited size reduction is permitted for all types except insulated metal doors where a reduction to 50 % width and 75 % height of the tested specimen is the limit of variation. Size increase is not permitted.	Unlimited size reduction is permitted for all types. Size increase is permitted only for: 50 % height; 50 % width; 50 % area.
Steel single skin folding shutter doorsets (uninsulated)	Unlimited size reduction is permitted. Size increase is not permitted.	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.
Other sliding/folding (insulated) doorsets	Unlimited size reduction is permitted for all types except insulated metal doors where a reduction to 50 % width and 75 % height of the tested specimen is the limit of variation. Size increase is not permitted.	Unlimited size reduction is permitted for all types except insulated metal doors where a reduction to 50 % width and 75 % height of the tested specimen is the limit of variation. Size increase is permitted only for: 15 % height; 15 % width; 20 % area.
Rolling shutter doorsets	Unlimited size reduction is permitted. Size increase is not permitted.	Unlimited size reduction is permitted. Size increase is permitted only for: 30 % height; 10 % width.
Operable fabric curtains	Unlimited size reduction is permitted. Size increase is not permitted.	Unlimited size reduction is permitted. Size increase is permitted only for: 10 % height; 10 % width.

EXAMPLE For a double leaf doorset with Category B overrun time, the tested overall door leaf width 1 600 mm can be increased for the door leaves by +15 % to overall 1 840 mm. Each leaf could be increased equally by 15 % up to 920 mm. For an insulated hinged/pivoted doorset, one leaf could be increased by 15 % up to 920 mm whilst the other leaf could be decreased by 50 % to 400 mm.

NOTE In this latter case, the full extended width of 1 840 mm could not be achieved.

If these relationships, particularly the latter one for unequal leaves, are still not sufficient to cover a manufacturer's needs, then an asymmetrical test specimen could be tested following which, with a Category B overrun, the increase and decrease rules could be applied individually to each leaf in turn.

For all asymmetrical size variations, the 50 % reduction will apply to both insulated and non-insulated products.

Annex C
(informative)

Background to field of direct application statements for asymmetric 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 doorset from only one direction and in 13.5 on the field of application of some types of doorset when mounted in different types of construction from which they were tested.

For the purposes of this annex, two generic types of doorset 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 (e.g. 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 (e.g. steel and aluminium).

Doorsets made from other 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 doorsets (e.g. calcium silicate, vermiculite, fibre cement based boards) and plastics based doors (e.g. glass reinforced polyester, PVC). For doorsets constructed from such materials, asymmetrical test specimens will always need to be tested from both sides (i.e. a minimum of two test 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 doorset in a rigid standard supporting construction will have been carried out with appropriate fixings for that doorset in rigid constructions. If the result is applicable to a flexible construction then appropriate fixings for that doorset mounted in a flexible construction should be used.

C.2 Hinged doorsets

C.2.1 General

For the purposes of this annex, three generic types of hinged or pivoted doorsets 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 doorset is considered separately with respect to both integrity and insulation performance. The influences of supporting constructions are also considered. Figure 34 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 34.

If the door leaf 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 gasses 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 doorset.

C.2.2.1.2 Supporting construction

A rigid supporting construction such as 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 doorsets 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 versus flexible supporting constructions is 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 described 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. Metal 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.

If the door leaf 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 gasses 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 doorset.

For doorsets with a transom, the temperature of the transom will be higher with a door leaf 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. Therefore it follows that for timber door leaves hung in metal frames the most onerous direction is with the leaf opening into the furnace with the doorset 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 doorset 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 doorset often fails insulation by virtue of failing integrity, in addition to failing insulation independently.

A test with the doorset 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 leaf 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 gasses 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 leaf opens towards the fire, then as described above, the top and bottom leading edge corners of the leaf will attempt to bow away from the fire and towards the door stop which aids the performance of the doorset.

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 doorset 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 doorset 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 doorset, a test 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 but this only applies to doors without insulation in the core and with a movement restrictor at approximately mid height on the hanging edge.

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 doorset, a test specimen opening in each direction will need to be tested.

A test with the doorset 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 type of construction.

C.3 Pivot hung doorsets

C.3.1 General

In this context only pivot hung doorsets with offset pivots are considered, since centrally pivoted doorssets 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 doorsets.

The essential difference with offset pivot hung doorsets 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 doorsets 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 door leaf to drop onto the sill.

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 doorsets 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 doorsets 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 doorsets

C.4.1 Integrity performance

There are several aspects of the performance of rolling shutters (e.g. 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 (e.g. the barrel, axle and bearing supports). For these components the worst case is with them mounted inside the 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 doorsets, the arguments for determining the weaker side are not so conclusive. In addition the guide supporting metalwork 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 doorset, 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 test specimen needs to be tested in that configuration.

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

C.5 Sliding/folding doorsets

C.5.1 General

There are several aspects of the performance of sliding/folding doorsets that are similar to those of rolling shutters (e.g. loadbearing components exposed to fire). There are also several aspects of the performance of sliding/folding doorsets that are similar to those of hinged/pivoted doorsets (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 doorset exposed to the highest temperatures and therefore these parts should be mounted within the furnace.

C.5.3 Insulation performance

As with rolling shutter doorsets discussed in C.4, the more of the frame and other components of the doorset 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 test specimen to dissipate heat away from the non-fire side.

C.5.4 Conclusion

For evaluating a sliding/folding doorset, 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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