INTERNATIONAL STANDARD 3008

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Fire-resistance tests — Door and shutter assemblies

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FOREWORD

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Draft International Standards adopted by the Technical Committees are circulated to the Member Bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 3008 was drawn up by Technical Committee ISO/TC 92, *Fire tests on building materials and structures*, and circulated to the Member Bodies in March 1973.

It has been approved by the Member Bodies of the following countries :

Australia	India	South Africa, Rep. of
Austria	Ireland	Spain
Bulgaria	Israel	Sweden
Canada	Italy	Thailand
Czechoslovakia	Korea, Rep. of	United Kingdom
Denmark	Mexico	U.S.A.
Egypt, Arab Rep. of	Norway	U.S.S.R.
Germany	New Zealand	
Hungary	Romania	

The Member Bodies of the following countries expressed disapproval of the document on technical grounds :

Belgium
France

NOTE — Annexes A and B to this International Standard provide additional information but neither annex forms a mandatory part of this standard. The procedure described in annex B may be used as an optional requirement. Laboratories are advised to gain experience with this method, particularly with the aim of increasing its sensitivity to an acceptable level so that it may be included in the main body of the standard at a future revision.

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Fire-resistance tests — Door and shutter assemblies

1 SCOPE AND FIELD OF APPLICATION

This International Standard specifies methods of testing and assessing the fire resistance of elements of construction intended for closing openings in walls.

It is applicable to door and shutter assemblies[1] with the exception of fire dampers. The procedure does not provide for a method of classification; national standards may specify the appropriate criteria for doors intended to be used in different buildings and in different positions in a building.[2]

2 REFERENCE

ISO 834, *Fire-resistance tests — Elements of building construction.*

3 PRINCIPLE

The test procedure enables the fire resistance of an element of construction to be determined on the basis of the length of time for which a specimen satisfies one or more criteria when exposed to the specified heating conditions.

The performance of a door or shutter assembly is influenced by the mechanical features of construction. The results of a fire test may not always be valid for a construction having overall dimensions larger or much smaller than those of the test specimen.

4 FURNACE

The furnace shall be capable of subjecting one side of the specimen to the heating condition specified in ISO 834, and the furnace temperatures shall be measured with respect to the specimen and controlled within the tolerances specified in ISO 834.

Means shall be provided for increasing and maintaining the pressure conditions within the furnace chamber to a positive value in relation to the pressure in the laboratory.

5 PREPARATION OF TEST SPECIMEN

5.1 Dimensions

The complete assembly to be tested shall be full size. When either of the dimensions of the full-size construction is larger than it is possible to accommodate in the furnace, the test specimen shall have the maximum size that can be accommodated; in such a case, the appropriate width or height shall be not less than the following :

- width : 2 m
- height : 2,5 m

5.2 Construction

The test shall be performed on a complete door or shutter assembly as intended to be used in practice, incorporating all hardware and other equipment.[3] The finish and form of the specimen shall be representative of the finish and form that would be used in practice.

The door or shutter shall be tested in a wall of the type in which it is intended to be used, particularly when it forms part of a prefabricated or industrialized system. When this cannot be specified, the wall may be of concrete or brick having a thickness of

- about 100 mm for a test having an anticipated duration of 2 h or less;
- about 200 mm for tests of longer duration.

The mounting of the specimen (see figure 1) shall be representative of its use in practice so that appropriate clearances between the door and the frame or the surround exist. In the case of hinged timber doors, the clearance between the door edge and frame shall be representative of that likely to be obtained in practice and, if this cannot be specified, the clearance shall be not less than 3 mm. The clearance shall be stated in the test report.

The assembly shall be fitted[4] with the frame flush with the unexposed face of the wall unless the type of door precludes such fixing or if it is likely to reduce the severity of exposure or be unrepresentative of its use in practice.

1) A complete door or shutter assembly should comprise the door panel or screen, the frame to which it is attached with the fixing and retaining mechanisms to be employed in practice.

2) Tests made in conformity with this procedure indicate the performance of the specimen during the heating period and do not determine its suitability for use after exposure to fire.

3) The term "hardware" includes such items as hinges, latches, door handles, locks, keyholes, letter plates, sliding gear, closing devices, electrical wiring and any other items which may influence the performance of the specimen being tested.

4) It may be necessary to mount sliding or rolling shutter assemblies on the exposed face of the wall to represent the most severe exposure conditions.

5.3 Conditioning

Specimens containing hygroscopic materials or other materials which can be affected by moisture shall be conditioned to equilibrium with the prevailing conditions in the laboratory, which shall be within the following limits :

- temperature (dry bulb) : 25 ± 15 °C
- relative humidity : 40 to 65 %

Doors made entirely of metal or of metal and glass do not require any conditioning. The wall containing the door shall not be constructed less than 2 weeks before the test in the case of a brick wall or less than 4 weeks in the case of a concrete wall. To minimize the effect on frame temperatures of excessive moisture in concrete walls, it may be necessary to condition them to a state of equilibrium.

6 TEST PROCEDURE

The specimen door or shutter assembly shall be exposed on one face to the heating conditions specified in ISO 834. For a full assessment, tests shall be performed on two specimens by exposing opposing faces to the furnace; this may be done simultaneously or separately, depending on the equipment available. To meet special circumstances or if exposure from one side is considered more onerous than from the other, the testing authority may decide to test a single assembly from the more onerous side only.[1)]

Measurements and observations specified in clause 7 shall be made during the test. The test shall be terminated when the door no longer satisfies the criteria under which its performance is being judged or at an earlier stage by prior agreement between the sponsor and the testing authority, even if no failure under any of the criteria has occurred.

7 MEASUREMENTS AND OBSERVATIONS

7.1 Furnace pressure

The static pressure in the furnace shall be measured, for example, by using the static pressure probe detailed in figure 2. The measurements of the static pressure shall be made at a minimum of three positions located along a vertical axis on one side of and close to the door or shutter assembly in line with the top and bottom edges of the clear opening and at one-third of the height from the sill level as shown in figure 1. The pressure shall be controlled so that a positive pressure is maintained over the upper two-thirds of the door.

7.2 Unexposed face temperature

The temperature of the unexposed face of the door or shutter assembly shall be measured by means of thermocouples as specified in ISO 834. No temperature measurements are necessary on doors or shutters constructed of sheet steel without insulation or on glass in glazed doors.

For determining the mean temperature rise, at least five thermocouples shall be fixed on the face of the door or shutter, excluding the frame, one at the centre and the others at the centre of each quarter-section. None of these five thermocouples shall be fixed on positions with through-metal connections or closer than 100 mm to the edge of the door leaf, or shutter. If insulation data are required on glazed doors or multi-leafed doors, the thermocouples shall be distributed as uniformly as possible.

The maximum temperature rise on the unexposed face shall be determined from the five thermocouples specified above plus additional thermocouples (fixed or mobile) which may be used over through-metal connections or at other points considered to be of special interest.

Temperature measurements shall also be made on the frame members on the faces parallel to the plane of the wall. Thermocouples shall be fixed at mid-height of the two vertical sides, at the centre of the head member (including the barrel enclosure of a steel rolling shutter) and at any other position where higher temperatures may be expected. The thermocouples shall be located approximately 15 mm from the edge away from the door or shutter.

7.3 Radiation from unexposed face

Radiant heat flux shall be measured from the unexposed face of the specimen, by means of a radiometer or other suitable means, along an axis normal to the centre of the door and at a known distance from the face. This distance shall be such that the field of view just covers the diagonal of the door or shutter assembly.

A description of a type of radiometer suitable for this purpose has been published[2)]. Information on the measurement technique and the type of instruments used shall be given in the report.

1) The location of thermocouples for the measurement of furnace temperatures shall be with reference to the exposed face of the wall except in the case of sliding doors fixed on the furnace side of the wall, when the exposed door face shall be used as the reference plane.

2) A wide-angle field type radiometer with provision for water cooling, similar in design to that described in *Journal of Scientific Instruments*, 1960, **37**, 128-30, has been found to be suitable for radiation measurements, provided that a screen of polished aluminium is used in conjunction with it to ensure that only the specified area of the door assembly is covered. Where high intensities of radiation are anticipated, the screen may also need to be water cooled. With radiometers having flat-type receivers, the included angle of incidence shall not exceed 50°. Improved types of instrument are being developed for this purpose by a Working Group of ISO/TC 92.

7.4 Cotton pad test

The passage of flames and gases though cracks, holes or other openings in or around a door or shutter shall be determined by applying a cotton pad to such openings at regular intervals during the test. The cotton pad shall not be in contact with the element but shall be held for not less than 10 s and not more than 30 s between 20 and 30 mm away from and centrally opposite any cracks, holes or other openings in or around the door or shutter. The pad shall not be re-used if it has absorbed any moisture or become charred during a previous application.

The cotton pad, measuring approximately 100 mm square × 20 mm thick, shall consist of new undyed and soft cotton fibres without any admixture of artificial fibres, and shall have a mass between 3 and 4 g. The pad shall be conditioned by drying in an oven at 100 °C for at least 0,5 h. The pad shall be attached by wire clips to a 100 mm × 100 mm frame of 1 mm diameter wire, to which a wire handle approximately 750 mm long is fixed. Note shall be made of the time when the first ignition of the cotton pad occurs and the position where this takes place. With doors or shutters having no, or only slight, insulation, it may not be possible to apply this test shortly after the commencement of heating; in such cases note shall be made of the time after which it is not practicable to apply this test.

7.5 Other observations

Note shall be made of the deformation of the specimen and the time when collapse of the whole or part of the specimen takes place. Note shall be made also of any flaming sustained for 10 s or more on the unexposed face and the emission of smoke. The ability of the door or shutter to be opened after the test shall be noted.

8 PERFORMANCE CRITERIA

The fire resistance of the door or shutter assembly shall be judged under one or more of the following criteria. The national standards authorities may, however, introduce acceptance levels under different criteria where none are shown, or may modify those given in this clause.

8.1 Loss of integrity (initial integrity failure)

8.1.1 *Flaming*

The time shall be noted at which flaming is sustained for 10 s or more on the unexposed face.

8.1.2 *Cotton pad test*

The time shall be noted at which the first ignition of the cotton pad occurs.

8.2 Loss of integrity (ultimate integrity failure)[1)]

The time shall be noted at which the door collapses or when excessive gaps are formed or when failure of the locking or latching mechanism takes place. In the absence of such failure, the ultimate integrity shall be taken as equal to the duration of test.

8.3 Insulation

8.3.1 *Mean unexposed face temperature — door or shutter*

The time shall be noted at which the mean unexposed face temperature of the door or shutter, as measured by the thermocouples specified in 7.2 for this purpose, exceeds the initial temperature by 140 °C.

8.3.2 *Maximum unexposed face temperature — door or shutter*

The time shall be noted at which the maximum temperature on the unexposed face exceeds the initial temperature by 180 °C. Doors or shutters incorporating glazing and doors and shutters constructed of sheet steel shall be considered to have failed to satisfy this criterion.

8.3.3 *Maximum unexposed face temperature — frame*

The time shall be noted at which the maximum temperature on the unexposed face of the frame exceeds the initial temperature by more than 180 °C.

8.3.4 *Radiation from door or shutter*

The radiation measurements from the unexposed face of the door or shutter shall be used to determine the time at which critical radiation levels exist at specified distances from the door or shutter. The specification of limits which are considered safe for the storage of materials and for personnel is the responsibility of the national standards authorities.

9 TEST REPORT

The test report shall include the following information :

a) name of testing laboratory;

b) name of sponsor;

c) date of test;

d) name of manufacturer and the trade-name (if any) of the product;

1) Laboratories may find it useful to employ the canopy test described in annex B as a means for defining "ultimate integrity failure".

e) details of construction and conditioning of the specimen and the materials used, together with drawings; these shall be lodged with the testing authority for inclusion in the report where appropriate; clearances and gaps between the door and the frame shall be fully recorded;

f) description of fixing of the test specimen to the surrounding wall and of the joint, if any, between the door assembly and the surrounding wall;

g) description of glazing, if any;

h) the side of the door or shutter exposed to heating;

i) test results :

1) furnace time/pressure chart and temperature curves;

2) time/temperature results as required by 8.3.1, 8.3.2 and 8.3.3;

3) times at which various performance criteria were no longer complied with;

j) data for establishing the effective black-body temperature of the door or shutter and for determining the distances from the unexposed face at which radiation levels exceeded specified limits;

k) any other information about the performance of the specimen during the test, including the ability of the door or shutter to be opened after cooling.

ANNEX A

EXPLANATORY NOTES ON VARIOUS CLAUSES

NOTE — So that suitable precautions to safeguard health may be taken, the attention of all concerned in fire tests is drawn to the possibility that toxic or harmful gases may be evolved in combustion of test elements.

A.0 GENERAL

These notes give additional information which could not be included in the body of this International Standard. Their main purpose is to indicate to the testing and the building authorities the limitation of various clauses, the need for caution in the application of data, and the testing aspects which may need to be revised on the availability of further data.

A.1 NOTE TO CLAUSE 1

It is not the primary purpose of this International Standard to classify doors into different categories but to provide a means for doing so. Many practical considerations have to be taken into account in a classification scheme and, depending upon the use of doors, some factors are more important than others.

The national building authorities will also have specific requirements depending upon the circumstances in different situations.

A.2 NOTE TO CLAUSE 3

Attention is drawn to the inadvisability of applying the performance data to doors of sizes much different from those examined. This is particularly so for doors of much larger sizes than tested, as an increase in size can be associated with greater tendency to deform.

Larger doors also require improvements in strength and supporting mechanisms.

A.3 NOTE TO SUB-CLAUSE 5.2

In accordance with the general philosophy of fire resistance, tests on doors should be conducted on complete assemblies fixed in the type of wall in which they are expected to be used in practice; in some cases, the behaviour of the wall may be a critical factor for the door performance. When this is not possible, walls of brick or concrete of standardized thicknesses have been proposed.

The performance of doors, particularly when made of or containing timber, is significantly influenced by the size of the gaps between the door and the frame. To ensure that the performance of timber doors is representative of their use in practice, it is necessary to ensure that unduly small gaps are not introduced into the test specimens.

Different types of door require different methods of fixing in the opening. Hinged doors can be fixed in a number of positions in the opening, whereas sliding doors have to be fixed on the face of the wall. When it is possible to mount a door in a number of positions and no other considerations are involved, it is suggested that the door should be mounted as near the unexposed face as possible. With the frame of the door flush with the unexposed face, the hot gases emitted from any gaps will flow directly to the underside of any canopy without encountering the horizontal projection of the wall openings.

A.4 NOTE TO CLAUSE 6

There are very few doors which are truly symmetrical. Therefore, the performance of a door assembly should be established by testing it with each face exposed to the fire conditions. This will necessitate two tests on identical specimens and, if the doors are not wider than 1 m and the furnace can accommodate a 3 m wide wall, the two specimens could be tested simultaneously. If the canopy test (annex B) is used, a double canopy will be necessary.

Occasionally it may be possible, on the basis of past experience, to indicate the face of the door which on exposure will represent the more severe test condition; in such cases, testing with this particular face exposed will establish the minimum performance of the door. The factors which will influence the decision are the tendency of the door to deform more in one direction than in the other, damage to consumable door-stops, direct exposure of hinges to heating and the damage to the suspension or sliding gear. The national standards authorities may wish to rationalize the situation by specifying particular requirements for different types of door.

There are also instances when a given door is expected to be exposed to severe fire conditions on one side only : in such cases, there is a justification in selecting the appropriate exposure condition.

A.5 NOTE TO SUB-CLAUSE 7.1

ISO 834 does not, at present, specify a precise method for the measurement of furnace pressure. An attempt has been made in this procedure to provide a simple system which will measure the static pressure difference between the exposed and the unexposed faces. It is intended that the upper two-thirds of a door is under positive pressure conditions, whilst the pressure below this level is neutral or negative. Most vertical furnaces have linear pressure characteristics over their height with the maximum occurring near the top. Until it is possible to introduce more precise standardization in the design of furnaces, it is not practicable to specify the precise value of the maximum overpressure at the top of the door; it is, suggested, however, that it should be as close to 1,0 mmH_2O* as possible.

A.6 NOTE TO SUB-CLAUSE 7.2

On unglazed doors, the normal surface thermocouples should be distributed as specified, omitting positions with constructional features likely to cause hot spots where additional thermocouples should be attached. It is not normally necessary to measure the temperature of the unexposed face of glazed doors except when information is required on the insulating properties of the unglazed portion. When glazing is present, the thermocouples should be distributed equitably over the solid parts. Temperature measurement on the frame is intended to provide information on the likely hazard when mounting the assembly in a different type of wall to that used in the test.

A.7 NOTE TO SUB-CLAUSE 7.3

The measurement of radiation from the face of the door is complementary to the measurement of temperatures. With uninsulated doors and with doors having glazing, the radiation measurements are likely to be more important and in some cases more practicable. The location of the radiometer and its field of view should be such that it can measure radiation flux emitted from the whole of the door. This may necessitate the use of masks in front of the radiometer having the same profile as the door. The radiometer suggested is only one type of instrument which may be used for this purpose.

Where test assemblies permit the transmission of heat by radiation, the results obtained from the radiometer will reflect both the characteristics of the test specimen and the radiating characteristics of the furnace. The latter are affected by such factors as the type of refractory lining and whether or not luminous flames are present.

The foregoing does not prevent a single laboratory from grading doors according to their relative performance, because the heat transfer characteristic of a single furnace will remain constant.

A.8 NOTE TO CLAUSE 8

The performance of the doors can be judged under the following main criteria :

Loss of integrity (initial integrity failure)

Loss of integrity (ultimate integrity failure)

Insulation

A.9 NOTE TO SUB-CLAUSE 8.1

Loss of integrity (initial integrity failure)

The cotton pad is intended, primarily, for insulated doors which may be required to provide as good a protection as a wall. The canopy test (annex B) measures the combined effect of gases emitted from the door gaps and the transfer of heat by convection and radiation from the face of the door. With insulated doors, the gap sizes are the critical factor.

* 1 mm H_2O = 9,806 65 Pa

A.10 NOTE TO SUB-CLAUSE 8.2

Loss of integrity (ultimate integrity failure)

The application of this criterion to doors raises many problems and in some instances the end-point may be difficult to define.

It has been suggested that doors are unlikely to fail this requirement without having previously failed the initial integrity criterion and that therefore it could be deleted. There are, however, types of door for which the ultimate integrity criterion may need to be retained; for example, uninsulated steel shutters will fail the insulation and the initial integrity criteria within the first 10 min of a test, but by providing a substantial barrier to the passage of flames, they have a useful role to play in buildings. They have been tested for up to 4 h without suffering collapse and, for this type of construction, ultimate integrity is considered to be a useful criterion.

A.11 NOTE TO SUB-CLAUSE 8.3

Insulation

Radiant heat emitted from the unexposed face of the door can cause the ignition of combustible materials or fixtures in the vicinity. In general, doors are not likely to have goods stored within a distance equal to their width, but with completely uninsulated types this may not be a safe distance after prolonged heating. The test data will enable an unsafe zone to be defined within which no combustible contents should be placed.

Heat radiation from doors will also affect people passing the door and the radiation levels that can be tolerated are lower. The concern with the movement of people in front of uninsulated construction is appropriate only during the early stages of a fire.