BRITISH STANDARD

BS EN 1634-3:2004
Incorporating corrigendum no. 1

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

Part 3: Smoke control test for door and shutter assemblies

The European Standard EN 1634-3:2004 has the status of a British Standard

ICS 13.220.50

BSI British Standards

National foreword

This British Standard was published by BSI. It is the UK implementation of EN 1634-3:2004, incorporating corrigendum May 2006. It supersedes BS EN 1634-3:2001 which is withdrawn.

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A list of organizations represented on FSH/22/5 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.

Compliance with a British Standard cannot confer immunity from legal obligations.

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Essais de résistance au feu des portes et fermetures - Partie 3: Portes et volets pare-fumées

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Foreword

This document (EN 1634-3:2004) 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of an identical text or by endorsement, at the latest by April 2005, and conflicting national standards shall be withdrawn at the latest by April 2005.

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

This document supersedes EN 1634-3:2001.

EN 1634 ‘*Fire resistance tests for door and shutter assemblies’* consists of the following:

Part 1: *Fire doors and shutters*,

Part 2: *Fire door hardware - Building hardware for fire resisting doorsets and openable windows (in course of preparation),*

Part 3: *Smoke control doors and shutters.*

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

Caution

The attention of all persons concerned with managing and carrying out this test is drawn to the following. Mechanical and operation hazards may arise during the construction of the test elements or structures, their testing and disposal of test residues. An assessment of all potential hazards and risks to health should be made and safety precautions should be identified and provided. Written safety instructions should 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 Part of EN 1634 specifies a method for determining the leakage of cold and warm smoke from one side of a door assembly to the other under the specified test conditions. The test can be applied to door and shutter assemblies of different types intended for purposes of controlling the passage of smoke in case of fire. This test can also be applied to lift landing doors and conveyor system doors and shutters. The principle of the test is explained briefly in annex A.

2 Normative references

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

EN 1363-1:1999, *Fire resistance tests — Part 1: General requirements*

EN 1634-1:2000, *Fire resistance tests for door and shutter assemblies — Part 1: Fire doors and shutters*

EN 13501-2:2003, *Fire classification of construction products and building elements — Part 2: Classification using data from fire resistance tests, excluding ventilation services*

prEN 14600*, Fire resisting and/or smoke control doorsets and operable windows - Requirements and classification*

EN ISO 13943:2000, *Fire safety — Vocabulary (ISO 13943:2000)*

3 Definitions, symbols and designations

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 1363-1:1999, EN 1634-1:2000 and EN ISO 13943:2000, together with the following, apply:

3.1.1
smoke control door
door assembly which has the function of restricting the passage of smoke, when in a closed position, to prescribed limits

3.1.2
ambient temperature
for the purpose of this standard ambient temperature is an air temperature of (20 ± 10) °C

3.1.3
medium temperature
for the purpose of this standard medium temperature is an air temperature of (200 ± 20) °C

3.1.4
smoke leakage Sa
ambient temperature smoke leakage classification as defined in 7.5.6.3.1 of EN 13501-2:2003

3.1.5
smoke leakage Sm
ambient plus medium temperature (200 ^{o}C) smoke leakage classification as defined in 7.5.6.3.1 of EN 13501-2:2003

3.1.6
test specimen
door or shutter assembly on which leakage measurements are to be made. It includes all the components necessary for the use of the door when installed in a building e.g. side panels and over panels

3.1.7
associated construction
specific form of construction in which the test specimen is mounted which is identical to that into which the door or shutter assembly is designed to be installed in practice. The method of sealing the joint between the test specimen and the associated construction is specific to that construction and forms part of the construction being evaluated by the test

3.1.8
supporting construction
form of construction with adequate strength and stiffness which is used to support the test specimen and to fill up the difference between the size of the test specimen and the opening in the test frame in an impermeable manner. The seal between the test specimen and the supporting construction should be impermeable and withstand the test temperature and is part of the test. The test frame may be considered to be part of the supporting construction

3.1.9
test specimen leakage rate Q_{spec}
leakage through the test specimen (3.1.6) and seal between that and the test frame or any supporting/associated construction used

3.1.10
test specimen linear leakage rate Q_l
leakage rate through the test specimen (3.1.6) and seal between and the test frame or any supporting/associated construction used, excluding any leakage at the threshold, expressed in terms of loss per linear metre of the perimeter bounded by the door frame when excluding the length of the threshold

3.1.11
aspect ratio
fixed relationship of width divided by height of a four sided constructional component

3.2 Symbols and designation

The symbols and designation listed below define those used in this standard.

Symbol	Unit	Designation
Q	m^3/h	leakage rate
Q_{app}	m^3/h	apparatus leakage rate
$Q_{sup/assoc}$	m^3/h	supporting/associated construction leakage rate
Q_{spec}	m^3/h	test specimen leakage rate
Q_t	m^3/h	total leakage rate
Q_l	$m^3/h/m$	linear leakage rate

4 Test equipment

4.1 Test apparatus

The test apparatus consists of a test chamber with an open front where the test construction is mounted to provide a sealed enclosure. The opening of the test frame shall be sufficient to accommodate the test specimen with its associated or supporting construction, in general an opening of 3 m $\times$ 3 m is sufficient for most door types.

A fan system is used to create the pressure differential and, for testing to evaluate S_m, a heating system is used to generate the temperatures specified in clause 5. The fan and the heating system shall be able to replace air at ambient and medium temperature, as required, in order to compensate for leakage rates through the test assembly.

Annex B provides an outline specification for a suitable apparatus but other designs are possible to achieve the same objectives.

4.2 Instrumentation

4.2.1 Air temperature

All thermocouples for the measurement of air temperature shall be of bare metal type with a wire diameter of 0,5 mm or steel sheathed type with the overall diameter not exceeding 1,0 mm.

For ambient temperature only leakage evaluation test to satisfy S_a, the temperature measuring equipment shall be capable of measuring temperatures up to 50 ^{o}C with an accuracy of ± 4 ^{o}C.

For ambient together with medium temperature leakage evaluation test to satisfy S_m, the temperature measuring equipment shall be capable of measuring temperatures up to 250 °C with an accuracy of ± 5 °C.

4.2.2 Pressure

A suitable instrument shall be provided to measure the static pressure difference between the inside and outside of the test chamber. The pressure measuring equipment shall be capable of measuring pressures with an accuracy of 10 % of the measured value.

4.2.3 Air flow

Instrumentation shall be provided to measure the volume, Q_t, and the temperature of air supplied to or extracted from the apparatus to compensate for the total leakage. The apparatus shall be able to measure leakage up to at least 55 m^3/h to an accuracy of 1 m^3/h.

5 Test conditions

A fan system shall be provided to create a pressure differential across the test specimen of at least 55 Pa.

When testing for ambient together with medium temperature leakage, s_m, provision shall be made to heat the circulating air to the test temperature of (200 ± 20) °C within the test duration and to control the temperature within the prescribed limits given in 10.2.2.2.

The test chamber shall be well sealed and the apparatus leakage rate together with the leakage rate through an associated/supporting construction (Q_{app} + $Q_{sup/assoc}$) shall not exceed 10 m^3/h at 50 Pa and ambient temperature.

6 Test specimen

6.1 Size

The test specimen and all its components shall be full size unless limited by the size of the front opening of the test apparatus, which will normally be 3 m × 3 m. Door assemblies which cannot be tested at full size shall be tested to the maximum size possible consistent with the use of supporting or associated constructions. If an associated construction is used, a minimum zone shall be exposed within the chamber, 200 mm wide each side and over the top of the aperture, into which the door assembly is to be fixed.

6.2 Number

Leakage tests shall be carried out from both sides for full evaluation except for doors for special applications. The number of tests shall be as given in Table 1.

Table 1 — Number of tests

Application	Temperature	Number of tests
General	Ambient	One test for each side: the same door may be used by either reversing the sample or by creating under-pressure in the test chamber
General	Medium	One test for each side: a separate specimen is required in each case
Special	Ambient/medium	One test from the specified side

6.3 Design and construction

Test specimen construction and finish shall be fully representative of that intended to be used in practice. Any seal used in the door or between the door assembly and the associated construction shall be identical to that intended for application in practice.

6.4 Verification

Where practicable, the size, thickness and material specification of the door assembly shall be determined before the test to check the construction of the door against the manufacturer's specification and to allow adequate description of the tested assembly.

All gaps through which smoke can leak shall be measured and recorded. Generally these are gaps between the edge of the door leaf/leaves and the door frame, between door leaves and at sill level.

When testing for ambient temperature only leakage to satisfy S_a classification, the gap between the bottom of the door and the sill level may be tightly sealed with an impermeable material.

A full description shall be given of the conditions prevailing at each edge of the door leaf/leaves and the presence and the nature of any seals.

7 Installation of test specimen

The test specimen shall be mounted as in practice, in an associated or supporting construction, in accordance with the manufacturer's instructions, with appropriate gaps and clearances between the fixed and moveable parts.

All gaps between the supporting or associated construction and test frame shall be tightly sealed with an impermeable material.

8 Conditioning

8.1 Moisture content

The test construction shall be conditioned in accordance with EN 1363-1. Door assemblies made entirely of non-hygroscopic materials, e.g. metal or glass, shall be left in the laboratory for at least three days before testing. Any additional conditioning requirements in the relevant product standard shall also be observed.

8.2 Mechanical conditioning

For details of the requirements on mechanical testing conditioning of the test specimen before smoke leakage testing e.g. operational test or self closing test refer to the requirement and classification standard prEN 14600.

Durability requirements are given in the relevant product standard.

9 Application of instrumentation

9.1 Thermocouples

For the ambient temperature only test to evaluate S_a, two thermocouples shall be used to monitor the temperature in the chamber. These shall be equally spaced across the chamber at mid-height of the test specimen.

For the ambient and medium temperature test to evaluate S_m, nine thermocouples shall be used to monitor and control the temperature inside the test chamber. The thermocouples shall be arranged in three horizontal rows. These thermocouples shall be spread equally across the chamber with three 150 mm from the bottom edge of the opening in the test frame, three in the centre and three at ¾ height position. The hot junctions shall be positioned (100 ± 50) mm from the exposed face of the test construction.

9.2 Pressure

The pressure measuring device head (see 4.2.2) shall be mounted in the test chamber at the centre of the test specimen (100 ± 50) mm from the inside face of the test specimen.

9.3 Air flow

The equipment described in 4.2.3 shall be installed.

10 Test procedure

10.1 Pre-test procedures

10.1.1 General

After installation of the assembly in the associated or the supporting construction, but before it is mounted in front of the test chamber, each door leaf, or moving element of a hinged door assembly, shall be opened to an angle of 30° and closed 10 times, using the automatic closing devices, if provided, to ensure the assembly operates normally. With other types of doors, such as folding, sliding or rolling shutters, the opening and closing operation shall be carried out as far as practicable to check the operation of the assembly. This procedure is not a durability test, for which special procedures are available.

10.1.2 Retention force measurements

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

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

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

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

10.1.3 Mounting

After checks and verifications, the test specimen in its associated or supporting construction shall be mounted and sealed in front of the test chamber prior to performing the air leakage test.

For ambient temperature only testing to evaluate S_a, the threshold gap may be tightly sealed using an impermeable material or may be sealed by an active drop seal or similar operational seal. Details shall be recorded in accordance with 6.4 above.

The door shall be in its final closed position, unlocked and the key, if any, removed.

10.2 Air leakage test

10.2.1 Sequence of testing

Tests shall be carried out in the following sequence:

a) determine the leakage rate through the test chamber and any supporting or associated construction at ambient temperature i.e. $Q_{app}^{(20)} + Q_{sup/assoc}^{(20)}$;

b) determine the total leakage rate at ambient temperature i.e. $Q_t^{(20)}$;

c) determine the total leakage rate at medium temperature i.e. $Q_t^{(200)}$;

d) determine the leakage rate through the apparatus and any supporting or associated construction at medium temperature 200 °C, i.e. $Q_{app}^{(200)} + Q_{sup/assoc}^{(200)}$.

When testing for ambient only leakage to satisfy S_a classification, only (a) and (b) are necessary.

NOTE The order of a) and b) is not important and may be reversed.

10.2.2 Procedure

10.2.2.1 Procedure for ambient temperature only testing to satisfy S_a classification

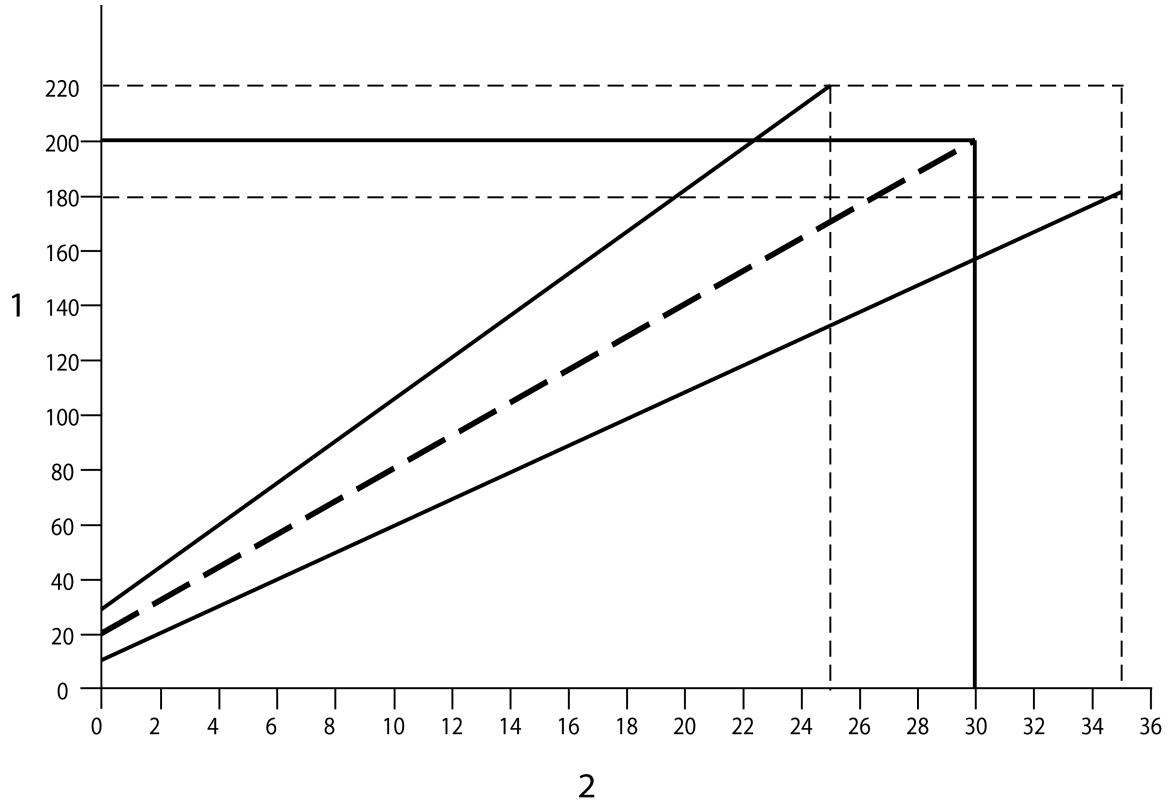
The leakage rate through the test specimen shall be measured at pressure differences of 10 Pa and 25 Pa, or for special purposes at the pressure difference specified by the sponsor. During measurement of the leakage rate the pressure difference shall be maintained for 2 min and the value of Q_t established at the end of this period using:

$$Q_{spec} = Q_t^{(20)} - (Q_{app}^{(20)} + Q_{sup/assoc}^{(20)})$$

The length of the gap between the fixed and moving components of the doorset (e.g. between the door leaf and frame as well as, where appropriate, between the moveable elements) but excluding the length of the threshold gap shall be measured and recorded.

10.2.2.2 Procedure for ambient together with medium temperature testing to satisfy S_m classification

For medium temperature tests the average air temperature close to the face of the door shall be raised from ambient temperature to the required stabilisation temperature of (200 ± 20) °C in (30 ± 5) min in such a manner that the average air temperature is maintained within the limits shown in Figure 1. The temperature distribution over the face of the door shall be controlled to (200 ± 40) °C as measured by each thermocouple. During the heating up period, neutral pressure shall be maintained in the test chamber.



Key
1 Temperature (°C)
2 Time (min)

Figure 1 — Air leakage test: rate of temperature rise and permitted limits

The leakage rate through the test specimen shall be measured at pressure differences of 10 Pa, 25 Pa and 50 Pa or for special purposes at the pressure difference specified by the sponsor. These measurements shall be taken within 10 min of achieving the test temperature. During measurement of the leakage rate, the pressure difference shall be maintained for 2 min and the value of Q_t established at the end of this period using:

$$Q_{spec} = Q_t^{(200)} - (Q_{app}^{(200)} + Q_{sup/assoc}^{(200)})$$

10.3 Observations

During the ambient and medium temperature tests any observed deformation of the door and the magnitude and position of such deformation perpendicular to the plane of the door shall be measured and recorded. The pressure and temperature at which any significant breakdown of the seals occurs shall be noted and other observations of the behaviour of the specimen shall be recorded.

After the test it shall be noted whether the specimen has been damaged as a result of the test and it shall be determined whether the door is still able to be opened manually.

11 Expression of results

11.1 Ambient temperature only test to satisfy S_a classification

The specimen leakage rate shall be calculated for each specimen and under each condition examined as follows:

$$Q_{spec}^{(20)} = Q_t^{(20)} - (Q_{app}^{(20)} + Q_{sup/assoc}^{(20)})$$

The linear leakage rate shall be calculated for each specimen and under each condition examined as follows:

$$Q_l = Q_{spec}^{(20)} / \text{“length of gap”}$$

NOTE Details relating to the length of gap can be found in 10.2.2.1.

Results of the above shall be presented in a tabular form as shown in Table 2, filling in the data for the number of tests undertaken and identifying the following product details:

— door type,

— number of door leaves, for multi-leaf door constructions,

— identification of door sides A and B,

— size of door opening.

Table 2 — Test results

No of test	Face exposed to pressure	Temperature	Total leakage rate $Q_{spec}^{(20)}$ (m^3/h) at		Linear leakage rate Q_l ($m^3/h/m$) at	
			10 Pa	25 Pa	10 Pa	25 Pa
1	Side A	Ambient				
2	Side B	Ambient				

11.2 Ambient together with medium temperature tests to satisfy S_m

The specimen leakage rate shall be calculated for each specimen and under each condition examined as follows:

$$Q_{spec}^{(200)} = Q_t^{(200)} - (Q_{app}^{(200)} + Q_{sup/assoc}^{(200)})$$

The test results shall be presented in a tabular form as shown in Table 3, filling in the data for the number of tests undertaken and identifying the following product details:

— door type,

— number of door leaves, for multi-leaf door constructions,

— identification of door sides A and B,

— size of the door opening.

If the sponsor of the test wishes to have the ambient temperature results evaluated for possible compliance with the requirements of S_a classification, this may be achieved by calculating the linear leakage rate for each specimen and under each condition examined as follows:

$$Q_l = Q_{spec}^{(20)}/\text{“length of gap”}$$

The length of gap is still as detailed in 10.2.2.1 even though the threshold gap is sealed in this case by an active drop seal or similar operational seal.

The result of the Q_l calculations may be added to the ambient temperature part of Table 3.

Table 3 — Test results

No of test	Face exposed to pressure	Temperature	Leakage rate Q_{spec} (m^3/h) at pressure difference of			Linear leakage rate Q_l ($m^3/h/m$) at pressure difference of	
			10 Pa	25 Pa	50 Pa	10pa	25pa
1	Side A	Ambient					
2	Side B	Ambient					
3	Side A	Medium					
4	Side B	Medium					

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 1634-3;

b) measured retention forces of closing devices, if any;

c) description of the associated/supporting construction used, the method of fixing and the joint between the test specimen and the associated/supporting construction;

d) leakage rate for each test specimen and for each condition examined, and for each face, as described in clause 11;

e) length of gap as described in 10.2.2.1;

f) failure of any component observed in the test and any other observations made;

g) ability to open the specimen after the medium temperature test (when included);

h) details of any deformation observed, as described in 10.3.

If a summary report is prepared it shall refer to the full report and include at least the information given in d) together with those required by EN 1363-1.

13 Field of direct application of test results

13.1 General

The field of direct application of test results is restricted to the allowable changes which a sponsor may make to the tested specimen following a successful smoke leakage test. These variations may be introduced automatically without the need for the sponsor to seek additional evaluation, calculation or approval.

The results of the leakage test continue to apply to assemblies of a different construction subject to the following:

a) The assembly is of a similar generic construction, e.g. a solid timber leaf in a timber frame or a folded sheet metal leaf in a steel frame.

b) The mode of operation is identical, e.g. single swing, double swing, roller shutter or folding leaf.

c) In the case of assemblies that only require a restriction in the leakage rate from one direction only then the direction does not vary from that tested.

d) The stiffness of the supporting construction and the method of fixing and sealing the frame to the supporting or associated construction shall not be less than that of the tested construction (this may be the specimen frame in some furnaces).

Doors tested in a flexible construction may be installed into rigid constructions but not *vice-versa*. Doors tested in a flexible construction to achieve ambient temperature classification S_a may be installed in alternative flexible constructions. The use of alternative flexible constructions for doors with S_m classification will be the subject of extended application considerations.

13.2 Construction of assembly

13.2.1 General

a) Decorative finishes such as paints may be varied.

b) The clearance gaps between components may be varied but shall not be greater than those in the tested assembly and where gaps are smaller they shall not impair the ability of the leaf/ leaves/curtain to close, especially in cases where both leaves of hinged or pivoted door assemblies are opened or closed simultaneously.

c) Threshold gaps protected by active drop seals may be varied within the movement range specified by the seal manufacturer.

13.2.2 Hinged or pivoted leaf assemblies

13.2.2.1 Timber leaves

a) The door leaf shall be constructed from similar materials (e.g. flaxboard, softwood) and stiffness equal or greater than that tested. Equal or increased stiffness may be assumed for ambient temperature use if;

   1) the leaf is thicker than that tested;

   2) the facings to the leaf are thicker than those tested;

   3) the size and density of any framing member enclosing the leaf core is not reduced;

   4) the glues and jointing procedures are not changed;

   5) for ambient temperature only, openings for glazing are not greater in dimensions or aspect ratio than any incorporated in the construction tested.

b) Variations for medium temperature uses are the subject of extended application considerations.

13.2.2.2 Metal leaves

a) The door leaf shall be constructed in an identical manner and material, i.e. pan and tray, and the method of jointing shall be identical and any stiffening is not reduced, and for ambient temperature only applications the stiffening may be increased.

   NOTE 1 For medium temperature smoke leakage rates the stiffening should not be varied as any increase in stiffness may result in higher temperature transfer and/or increased bowing.

b) The door leaf may incorporate additional insulation materials if the assembly is to resist the spread of ambient smoke but extra insulation material shall not be incorporated in door leaves designed to resist medium temperature smoke.

   NOTE 2 Extra insulation material leads to increased thermal differentials which invariably result in increased distortion.

13.2.2.3 Folding leaf door assemblies

The assembly shall be constructed from the same, or fewer, number of folding elements which shall be of the same generic detail and cross section as those tested and the method of sealing shall be maintained.

13.2.3 Rolling shutters

The number of slats forming the shutter shall not be increased. The assembly shall be constructed from the same or less number of slats of identical cross section to those of the original specimen. Any method of sealing shall be retained. The method of fixing the guides shall not be changed when fixing to other forms of associated construction.

13.3 Size and aspect ratio

13.3.1 Hinged and pivoted leaf assemblies

13.3.1.1 The leaf size shall not be increased but may be reduced providing that the number of any movement restrictors such as locks, latches and hinges is not decreased (but may be increased).

13.3.1.2 The aspect ratio of the leaf may be changed, subject to the restrictions in 13.2.2.1 and/or 13.2.2.2 and subject to the length of the leakage path not being extended.

13.3.2 Folding leaf door assemblies

a) The area of the assembly shall not be increased but may be reduced for both ambient and medium temperature smoke leakage, providing that no perimeter dimension in increased.

13.3.3 Rolling shutters

a) The area of the rolling shutter shall not be increased but may be reduced for both ambient and medium temperature smoke leakage, providing that no perimeter dimension is increased.

b) The aspect ratio of the shutter may be varied subject to the length of the perimeter of the moving curtain (sides and base) not being increased.

13.4 Glazing

a) The type of glass, providing that it has polished or floated surface finish, may be changed, e.g. toughened, laminated, wired or borosilicate, for ambient temperature smoke control situations, subject to the edge sealing system being the same. The exchange of alternative textured surface finish glass is subject to extended application evaluation.

b) The type of glass may only be changed for medium temperature smoke control applications by extended application evaluation.

c) The distance between the perimeter of the door and the perimeter of the glazing shall not be reduced.

d) The size of glazed openings may be reduced from that tested and the aspect ratio may be changed providing that no perimeter dimension is increased, and providing that for medium temperature applications the glass type is not changed.

13.5 Hardware and fittings

Elements of hardware or ironmongery and/or their fixing technique may not be changed without extended application evaluation.

The positioning of elements of hardware or ironmongery may be modified for ambient temperature smoke application but shall not be changed for medium temperature applications.

13.6 Seals

As the sealing system is a critical part of the test, no modification may be made to the system tested.

Annex A
(informative)

Test principle

The test procedure represents in a simplified way the exposure of a door to the effects of a fire when the smoke travels along various routes and comes across a door in its movement. As part of the fire safety system the door may be required to restrict the passage of smoke in order to ensure that conditions on the other side of the door do not become unacceptable. If the door is at some distance from the seat of the fire initially the smoke reaching the door would have lost much of its heat in its travel. Consequently it will be less buoyant and at low temperatures but nevertheless capable of adversely affecting the safety level due to its effect on visibility and causing smoke damage. Even where doors are not too distant from a fire the exposure conditions alter progressively.

There are two exposure situations, in relation to either the distance from the fire or the stage of development of a fire, a condition where there is no noticeable rise in temperature and a condition when the temperature has risen to a level at which ignition of combustible materials does not occur but heat damage may be caused by deformation or by failure of seals. These conditions have been termed as:

a) ambient temperature exposure conditions with air temperatures around 20 °C;

b) medium temperature exposure conditions with air temperatures around 200 °C.

In both cases it is assumed that there is no stratification of smoke.

Pressure is, however, developed on the exposed side and the pressure between the two faces forces the smoke through all available gaps and openings. Pressure differences of up to 50 Pa may be developed during this early stage which are sufficient to cause an unlatched door to be forced open.

The test procedure measures the leakage of air from one side of the door to the other. The smoke leakage rates are likely to be almost the same because smoke is particulate material transported by air.

Annex B
(informative)

Test apparatus

B.1 General

The test apparatus consists essentially of a well sealed box, termed the test chamber, which has an open side, provision for the supply of air to the inside of the chamber and a provision for heating the air to temperatures of 200 °C where medium temperature leakage is to be evaluated. A schematic arrangement of the test apparatus is shown in Figure B.1.

B.2 Test chamber

The test chamber may consist of a sheet steel construction with a layer of insulation on the inside to prevent loss of heat from the circulating air. The permissible leakage rate for the chamber is not more than 10 m^3/h. The front opening of the chamber should be designed so as to accommodate the largest size assembly on which information is required. In general a 3 m x 3 m opening will allow tests to be undertaken on the majority of constructions as this is also the recommended size for fire resistance furnaces for vertical elements. If a laboratory is only likely to be interested in testing single leaf doors of sizes found in normal buildings, a smaller opening may be feasible. As the test door has to be mounted in an associated or supporting construction, the actual size of the door that can be tested is smaller than the size of the opening. The test frame containing the test door assembly and the associated/supporting construction is fixed and sealed against the test chamber opening. The chamber should have provision for the following:

a) A fan system capable of producing a pressure differential across the specimen of up to 55 Pa and of circulating air in the chamber such that the pressure difference over the height of the door is small.

b) A piping system for the supply of air.

c) Equipment for measuring the volume of air flow supplied to the chamber to compensate for the air leakage.

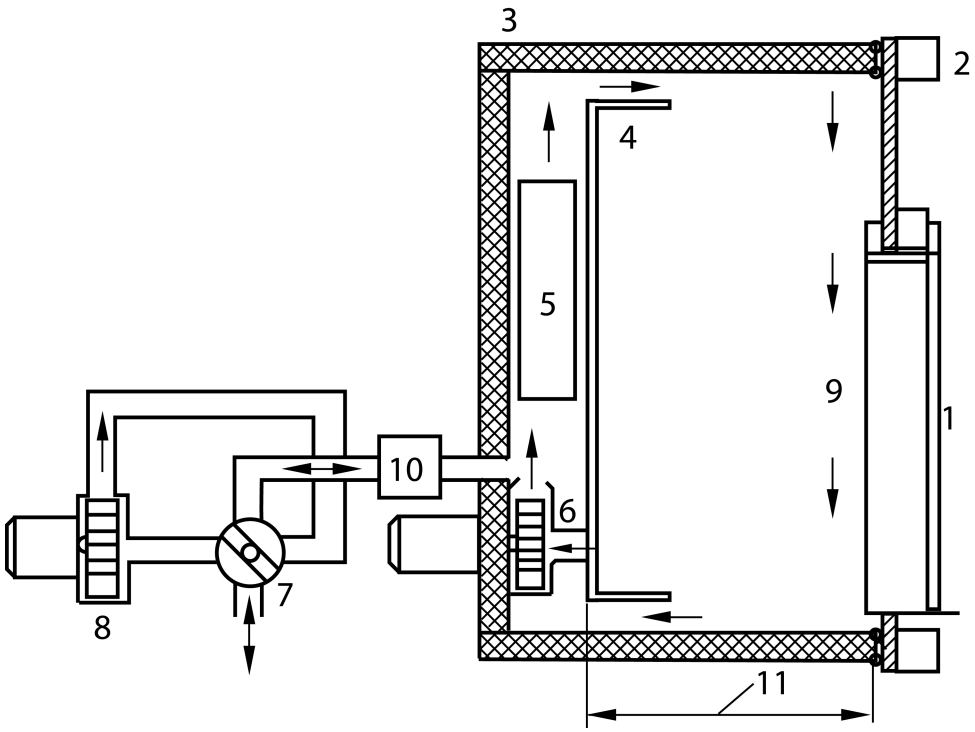
d) An air flow meter arranged in the piping system to control the amount of air flow.

e) Provision for fastening and sealing the test frame to the chamber.

f) A heat exchanger capable of heating the air supplied to the chamber for medium temperature testing.

g) Adequate insulation for the walls and the piping to minimize heat loss from the apparatus for medium temperature testing.

h) Equipment for measuring air temperature and pressure inside the chamber and air temperature close to the flow meter.



Key

1 Door or shutter assembly
2 Test frame
3 Sheet metal test chamber with insulation inside
4 Sheet metal for air conducting
5 Heat exchanger (8 kW/m^2 to 10 kW/m^2 chamber opening)
6 Air fan for circulation
7 Change-valve and volume control
8 Fan for pressure
9 Airflow direction
10 Air flow meter (2 directions)
11 Depth at least 700 mm

Figure B.1 — Schematic sketch of the test apparatus

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