TECHNICAL REPORT

ISO/TR 5925-2

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Fire tests — Smoke control door and shutter assemblies —

Part 2:
Commentary on test method and test data application

Essais au feu — Assemblages porte et volet pare-fumée —

Partie 2: Commentaires sur la méthode d'essai et l'application des données de l'essai

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Foreword

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

The main task of technical committees is to prepare International Standards, but in exceptional circumstances a technical committee may propose the publication of a Technical Report of one of the following types:

— type 1, when the required support cannot be obtained for the publication of an International Standard, despite repeated efforts;

— type 2, when the subject is still under technical development or where for any other reason there is the future but not immediate possibility of an agreement on an International Standard;

— type 3, when a technical committee has collected data of a different kind from that which is normally published as an International Standard ("state of the art", for example).

Technical Reports of types 1 and 2 are subject to review within three years of publication, to decide whether they can be transformed into International Standards. Technical Reports of type 3 do not necessarily have to be reviewed until the data they provide are considered to be no longer valid or useful.

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ISO/TR 5925-2, which is a Technical Report of type 3, was prepared jointly by Technical Committee ISO/TC 92, *Fire safety*, Subcommittee SC 2, *Fire resistance*.

ISO/TR 5925 consists of the following parts, under the general title *Fire tests — Smoke control door and shutter assemblies*:

— *Part 1: Ambient and medium temperature leakage test procedure*

— *Part 2: Commentary on test method and test data application*

Introduction

Technical Committee ISO/TC 92 *Fire safety*, has prepared a test specification for smoke control doors as follows:

ISO 5925-1, *Fire tests — Smoke control door and shutter assemblies — Part 1: Ambient and medium temperature leakage test procedure.*

In a fire the decomposition of materials results in the production of heat and fire gases containing smoke particles. The consequent expansion of gases leads to the creation of pressure differential across door faces often assisted by wind pressures, mechanical or extract systems, stack effect or a combination of these. This pressure differential induces the movement of smoke past any openings or gaps including those in a door assembly. Schemes to keep building areas free of smoke use various techniques using obstructions to its movement, exhausting, dilution, pressurization either singly or in some suitable combination. Standard tests have been designed to measure the leakage of smoke when such conditions exist. They do not deal specifically with doors installed in conjunction with smoke control methods based on pressurization but, nevertheless, information obtained from these tests is likely to be helpful in assessing the suitability of such doors.

Fire tests — Smoke control door and shutter assemblies —

Part 2:
Commentary on test method and test data application

1 Scope

This Technical Report establishes a commentary which explains the general philosophy and factors on which the test specified in ISO/DIS 5925-1 has been designed, to describe the limitations of its scope, to provide some general guidance for those who use the results of the test and to emphasize certain practical aspects of the procedure for those who carry out the test. All concerned with testing fire doors should read this commentary before initiating the test and before making use of the test results.

2 References

ISO 834:1975, *Fire-resistance tests — Elements of building construction.*

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

ISO 3008:1976, *Fire-resistance tests — Door and shutter assemblies.*

ISO/TR 3956:1975, *Principles of structural fire-engineering design with special regard to the connection between real fire exposure and the heating conditions of the standard fire-resistance test (ISO 834).*

ISO/DIS 5925-1, *Fire tests — Smoke control door and shutter assemblies — Ambient and medium temperature leakage test procedure.*

3 Definitions

For the purposes of this Technical Report, the definitions given in ISO/DIS 5925-1, together with the following, apply.

3.1 door and shutter assembly: A door and shutter assembly is an assembly comprising a fixed part (the door frame), one or more movable parts (the door leaves) and its hardware. The purpose of the door assembly is to allow or prevent access of persons and/or goods. The term hardware includes such items as hinges, latches, door handles, locks, keyholes (excluding keys), letter plates, sliding gear, closing devices, electrical wiring and any other items which may influence the performance of the assembly being tested.

3.2 fire control door: A door assembly capable of maintaining for a specified period the fire resistance criteria defined in ISO 3008.

3.3 smoke control door: A door assembly whose primary function is to restrict the passage of smoke as determined by ISO 5925 tests.

3.4 fire and smoke control door: A door assembly meeting the criteria appropriate for fire control and smoke control door assemblies.

3.5 ambient temperature: For the purpose of this standard ambient temperature is an air temperature of (25 ± 15) °C.

3.6 medium temperature: For the purpose of this standard medium temperature is an average air temperature of (200 ± 20) °C.

3.7 high temperature: A temperature representative of a standardised fully developed fire as specified in ISO 834.

4 Fire and smoke

Fire produces heat and a variety of gaseous products some of these are exhibited as smoke. Smoke may be defined as the airborne solid and liquid particulates and gases evolved on the pyrolysis and combustion of materials. Although only the particulate matter is visible, other gases are also present ranging from the slightly irritating to the highly toxic. All these with the heated air may be termed as the fire gases and create a safety problem for the occupants exposed to them.

Smoke rises with the hot fire gases until it meets an obstruction, such as a ceiling, when it will flow radially. In a small room the depth of the smoke layer can increase fairly rapidly until it spreads down to the door head level. If the door is open smoke will spread rapidly to other areas, cool down by mixing with air and become less buoyant. If the door is closed the smoke depth will continue to increase in the room, the temperature of the environment will rise and the expansion of gases could lead to an increase in air pressure relative to the outside inducing smoke leakage through the available gaps. The pressure will be highest at the ceiling level and lowest next to the floor where it may often have a negative value producing a neutral axis in the middle third of the room height. This is often confirmed by observing smoke markings after a fire along the upper parts of the door frame where leakage has taken place from the fire side. The leakage around the edges will depend upon the size of gaps, if any sealing has been used and the pressure differential between the two faces.

When a door is directly exposed to elevated temperatures, deformation and deterioration can also occur. For doors with combustible facings, pyrolysis, delamination and local generation of smoke occur at temperatures above 200 °C. As the fire becomes fully developed, the door along with other exposed elements, is subjected to high temperatures and more rapid deterioration may occur. The ability of the door to resist the passage of smoke under these conditions for a certain time is a function of the door design and the effectiveness of high temperature seals, if provided.

5 The role of doors in fire

5.1 Door usage

Fire barriers are provided in buildings to separate different risk areas and prevent the transfer of fire from one side to the other. The presence of openings in such barriers can introduce a potential weakness. Building regulations and fire codes require a door assembly used in such openings to posses the ability to resist the passage of smoke, or heat and flames, or both. The precise role of the door will vary from one location to another and the following is an example of the designations of doors in different locations:

– FIRE ZONE OR COMPARTMENT DOORS
Doors in fire walls that divide a building into fire zones or compartments. Fire zones may be provided for life safety or property protection purposes or both;

– ROOM/CORRIDOR DOORS
Doors in walls or partitions between rooms and corridors;

– HORIZONTAL EXIT DOORS
Doors in walls which provide access to a temporary refuge area or the outside of a building;

– STOREY EXIT DOORS
Doors in enclosures to vertical means of communication between storeys;

– SMOKE BARRIER DOORS
Doors in long corridors or between specified smoke compartments.

Doors specified for above locations may be required to serve a fire control or smoke control or a combined fire and smoke control function. A compartment door is often likely to be treated as a "Fire control door" only, whereas storey exit doors will be required to fulfill both functions. Other doors in a building required as part of a fire protection scheme can be treated as one of the types mentioned above by analogy. Figure 1 shows some typical examples of the usage of different doors.

5.2 Smoke compartmentation

When considering the concept of fire resistance (see ISO 834 and ISO/TR 3956) one of the basic ideas is to restrict the spread of fire to different parts of the building by providing fire compartments. In the same way, the spread of smoke in a building can also be restricted to a limited zone, thereby, facilitating limited or full evacuation of the building depending upon circumstances. The sub-division of the building for this purpose can be termed as smoke compartmentation and each zone so formed is a smoke compartment. The boundaries of smoke compartments may often be contiguous with those of fire compartments, but in many cases the former are subdivisions within the latter. The size of a smoke compartment depends upon the evacuation needs, the amount of smoke that may be generated and the facilities for smoke control.

Each smoke compartment should be surrounded by a smoke barrier i.e. a construction capable of resisting the passage of smoke. The amount of leakage to a surrounding compartment should be limited to the maximum that can be tolerated either for escape or fire fighting operations.

5.3 The function of smoke control doors

Smoke control doors are provided in fire barriers to limit the passage of smoke and other combustion products from one side to the other thereby maintaining the integrity of the barrier and giving more time for escape and fire control. Smoke control door assemblies can also be used to prevent damage to sensitive equipment such as computers and telecommunication apparatus.

It is not the purpose of this series of standard methods of test to give recommendations concerning the proper provision and installation of doors in buildings. Such matters will normally be dealt with by the national codes of practice or by regulations. Some of important factors which can be used by the authorities to formulate codes are described.

Any door, without louvres and other openings, when in the closed position has the ability to obstruct the passage of smoke and other products of combustion. However, if it has not been specially designed it may only have a limited effectiveness as a smoke barrier. The standard fire resistance test of ISO 3008 has a requirement for evaluating the passage of hot gases through any openings in or around the door. The technique used does not monitor gas flow rate as such but only the effect of such a flow on the ignition of a selected combustible material. The methods specified in ISO 5925 are more precise and are able to quantify the leakage rate.

In most cases, smoke control door assemblies need to be provided with some closer mechanism to ensure that the door is shut when not in use or closes on the occurance of a fire. A fully or partially open door will allow smoke to pass through and unless steps are taken to ensure the closure of doors the purpose of smoke control could be negated.

Smoke control door assemblies need to be considered as part of the fire barrier system. Openings for services in shafts, walls, floors and ceilings and even some partition and ceiling constructions may allow the leakage of smoke unless care is taken in their design and installation. Any requirements for smoke control doors need to take into consideration smoke leakage through all potential routes.

6 Selection of test conditions

Smoke control door assemblies will need to function in different conditions depending upon the proximity to the seat of fire, the rate of smoke production and the environmental conditions. The technical committee responsible for preparing these standards has identified three typical situations for which standard test methods would be needed.

If a fire develops in a given room with a closed door, pressure due to fire on the affected side will increase and the ensuing pressure differential will tend to push the smoke-laden air through all available gaps into the adjacent area. This will be typical of a door separating a room from a corridor (room/corridor door). Pressure across a given door is likely to be the combination of the pressure due to "normal" conditions and the pressure created by the fire. Mechanical ventilation effects may introduce a pressure difference of approximately the same magnitude. In the event that the windows to the room are open, or break by heat, a wind generated pressure difference may also become a factor. Selection of an appropriate test pressure level has to be a compromise based on probabalistic considerations.

As the temperature increases not only will the pressure differential increase but also a pressure gradient will develop over the height of the room. According to ISO/DIS 834-1 (the revision in parts of ISO 834:1975), the maximum pressure differential used in a test on a 3 m vertical element is 20 Pa. The higher pressures in the upper part will cause more leakage to occur through clearances in the upper part of the door, with either no flow at the bottom or a flow in the reverse direction if opposing pressure conditions prevail. At a later stage the increasing heat is likely to cause the door to distort, and combustible materials to decompose and char, thus increasing the gap sizes through which smoke can pass. The severity of exposure can also be an important factor for the extent to which a door may allow the passage of smoke and hot gases.

The possible range of test conditions have been divided into three recognizable ranges, the near ambient conditions, the medium temperature range and the conditions of a fully developed fire. ISO/DIS 5925–1 apparatus can be used for smoke control doors with smoke laden gases in the temperature range from the ambient to 200 °C and replaces the special test which only dealt with ambient temperature conditions. The ambient situation occurs at the beginning of a fire or when the door is remote from the fire and smoke and fire gases have cooled down by the time they reach it. In either case the temperature of gases will be low and hardly any fire generated pressure gradient will exist over the height of the door. The test has therefore been designed to be carried out at or near to the ambient temperature conditions but over a range of possible pressure differences. At the other extreme, with a fully developed fire the door will be exposed to the full severity of heat and fire generated pressure, as in the standard fire resistance test of ISO 3008. In between these two extremes a variety of intermediate conditions will exist and a choice has been made for the medium temperature test, in which the temperature selected is such as to represent partial cooling of the gases but it is still sufficiently high to cause physical distress due to distortion or surface damage.