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Smoke and heat control systems —

Part 1: Specification for smoke barriers

Systèmes pour le contrôle des fumées et de la chaleur —

Partie 1: Spécifications des écrans de fumée

Reference number
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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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

ISO 21927-1 was prepared by Technical Committee ISO/TC 21, *Equipment for fire protection and fire fighting*, Subcommittee SC 11, *Smoke and heat control systems and components*.

ISO 21927 consists of the following parts, under the general title *Smoke and heat control systems*:

— *Part 1: Specification for smoke barriers*

— *Part 2: Specification for natural smoke and heat exhaust ventilators*

— *Part 3: Specification for powered smoke and heat exhaust ventilators*

A Part 4, dealing with specifications for smoke ducts, a Part 5, dealing with specifications for smoke dampers, a Part 6, dealing with specifications for control panels and a part 7, dealing with specifications or guidelines for power supplies are planned.

Introduction

General

Smoke and heat exhaust ventilation systems (SHEVS) create a smoke-free layer above the floor by removing smoke and heat and thus improve the conditions for the safe escape and/or rescue of people and animals and the protection of property and permit the fire to be fought while still in its early stages.

The use of smoke and heat exhaust ventilation systems to create smoke-free areas beneath a buoyant smoke layer has become widespread. Their value in assisting in the evacuation of people from construction works, reducing fire damage and financial loss by preventing smoke logging, facilitating fire fighting, reducing roof temperatures and retarding the lateral spread of fire is firmly established. To obtain these benefits, it is essential that SHEVS operate fully and reliably whenever called upon to do so during their installed life. A SHEVS is a scheme of safety equipment intended to perform a positive role in a fire emergency.

It is important that the components for smoke and heat exhaust systems be installed as part of a properly designed smoke and heat exhaust system.

SHEVS help to

— keep the escape and access routes free from smoke,

— facilitate fire fighting operations by creating a smoke-free layer,

— delay and/or prevent flashover and thus full development of the fire,

— protect equipment and furnishings and contents,

— reduce thermal effects on structural components during a fire,

— reduce damage caused by thermal decomposition products and hot gases.

For the purpose of this part of ISO 21927, a smoke barrier is deemed to be any form of barrier to the movement of fire effluent.

Smoke barriers control the movement of fire effluent within a construction works in the event of fire. Smoke barriers, when used within a smoke and heat control system, become a critical element of that system. If smoke barriers are not in their fire-operational position, the system does not perform as designed. However, even in the event that other elements of the SHEVS do not function, smoke barriers in the fire operational position provide essential smoke containment and channelling.

This part of ISO 21927 applies to smoke barriers used within smoke and heat control systems, which include other equipment, e. g. natural smoke and heat exhaust ventilators (ISO 21927-2) and powered smoke and heat exhaust ventilators (ISO 21927-3). Smoke barriers perform within specific time/temperature ranges.

Function of smoke barriers

The function of smoke barriers is to control the movement of fire effluent within construction works by forming a barrier. The functions of active or manually deployed smoke barriers are identical to those of static smoke barriers, but they also can be retracted and concealed when not in use.

Typical functions of smoke barriers are to

— create a smoke reservoir by containing and limiting the travel of the smoke;

— channel smoke in a pre-determined direction;

— prevent or retard smoke entry to another area or void.

Applications of smoke barriers

The primary applications of smoke barriers are listed below. However, as their application becomes more widespread, it is inevitable they will be put to a wider variety of uses. It is important to note that, within the scope of this part of ISO 21927, smoke barriers can contain smoke and gases in excess of 600 °C but are not intended to perform the same function as fire doors and shutters tested in accordance with ISO 3008 or smoke-control doors tested in accordance with ISO 5925-1.

Typical applications for smoke barriers are as

— smoke reservoir boundaries,

— channelling screens,

— void edge screens,

— void sealing screens,

— corridor containment,

— shop unit containment,

— escalator containment,

— stairwell containment,

— elevator well containment.

Types of smoke barrier

Construction-works elements can be used to create static smoke barriers and they can be augmented by smoke barriers covered by this part of ISO 21927.

This part of ISO 21927 applies to the following types of smoke barriers:

— **s**tatic **s**moke **b**arriers (SSB),

— **a**ctive **s**moke **b**arriers (ASB).

A wide range of different materials can be used to create smoke barriers. Typical materials used for static smoke barriers include fabric, glass, metal, fire-resisting board, fibreglass and mineral wool or any impermeable material capable of resisting smoke at temperatures required by the design.

Typical examples of active smoke barriers include roller, pleated, folding, hinged or sliding, using the types of material as described for static smoke barriers.

Static and active smoke barriers are categorized by type and performance in Clause 5.

In addition, an ASB product is deemed to include all controlling equipment, etc. This does not include external controls, for example a fire alarm or a sprinkler flow switch.

Smoke and heat control systems —

Part 1:
Specification for smoke barriers

1 Scope

This part of ISO 21927 specifies the product performance requirements, classifications and test methods for smoke barriers, which comprise the barrier itself, with or without associated activation and drive devices, designed for use in smoke and heat control systems. It covers only barriers installed in buildings, i.e. it does not cover barriers made of part of the building's structure. This part of ISO 21927 provides the test methods for, and conformity assessment of, the smoke barrier systems.

Smoke barriers are only covered by this part of ISO 21927 when calculation methods exist for the determination of the leakage rate of smoke. This requires the smoke barriers to be sufficiently fixed and guided on any free joints between two adjacent smoke barriers. Figure E.4 illustrates a design to which this part of ISO 21927 does not apply.

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.

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

ISO 5925-1:2007 *Fire tests — Smoke-control door and shutter assemblies — Part 1: Ambient- and medium-temperature leakage tests*

ISO 13943, *Fire safety — Vocabulary*

ISO/IEC 17000, *Conformity assessment — Vocabulary and general principles*

ISO/IEC 17050-1, *Conformity assessment — Supplier's declaration of conformity — Part 1: General requirements*

ISO/IEC 17050-2, *Conformity assessment — Supplier's declaration of conformity — Part 2: Supporting documentation*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 13943 and the following apply.

3.1
active smoke barrier
smoke barrier that moves from its retracted position into its fire-operational position automatically when called upon to do so

3.2
barrier movement
travel distance (e.g. height, drop) of an active barrier from its retracted position to its fire operational position

3.3
channelling screen
smoke barrier installed beneath a balcony or projecting canopy to direct the flow of smoke and hot gases from a room opening to the spill edge

3.4
consumable power supplies
any form of power that, when not available, prevents an active smoke barrier from moving to the required fire operational position

3.5
deflection
movement of a smoke barrier when subjected to the buoyant force of the hot smoke, the movement of air, air pressure or any combination thereof

3.6
fail-safe
designed to return to a safe condition in the event of a failure or malfunction, etc.

3.7
fire operational position
final configuration of a device, e.g. a smoke barrier, specified by its designer to achieve and be sustained in the ultimate fire condition of the design

3.8
fitness for purpose
ability of a product, process or service to serve a defined purpose under specific conditions

3.9
free area
total area of all designed openings and clearance gaps in and/or around the perimeter of a smoke barrier

3.10
integrity
ability of a barrier to maintain its soundness for the purpose for which it is intended without the transmission of significant quantities of flames or hot gases to the non-exposed side

3.11
life safety application
application of the smoke and heat control system in its fire operational condition for the period of time required for the occupants of the premises to be alerted, and to be able to exit the premises, with the smoke and heat control system assisting in the protection of the means of escape

3.12
response time
time taken for an active smoke barrier to move to its fire operational position after initiation

3.13
smoke and heat exhaust ventilation system
SHEVS
set of components jointly selected to exhaust smoke and heat in order to establish a buoyant layer of warm smoke above cooler, cleaner air

3.14
smoke and heat control system
arrangement of components installed in a construction works to limit the effects of smoke and heat from a fire

3.15
smoke barrier
device to channel, contain and/or prevent the migration of smoke (fire effluent)

NOTE Smoke barriers can also be referred to as smoke curtains, smoke blinds or smoke screens.

3.16
smoke reservoir
region within a construction works limited or bordered by smoke barriers or structural elements so as to retain a thermally buoyant smoke layer in the event of a fire

3.17
spill edge
edge of a soffit beneath which a smoke layer is flowing and adjacent to a void, e.g. the edge of a balcony or canopy or the top edge of a window through which the smoke is flowing out of a room

3.18
static smoke barrier
smoke barrier permanently fixed in its fire operational position

3.19
void edge screen
smoke barrier deployed beneath the edge of a balcony or projecting canopy

NOTE Void edge screens can be used either to create a smoke reservoir beneath the balcony or canopy or to restrict the length of spill edge in order to create a more compact spill plume

3.20
void-sealing screen
smoke barrier deployed across a void to create a smoke reservoir beneath the smoke barrier

4 Symbols

$A_{g,a}$ to $A_{g,f}$	Area of the gaps between smoke barriers, or between barrier and structure, expressed in square metres
$A_{g,tot}$	Total free area of the smoke barrier system, calculated as the sum of the areas of the individual gaps between smoke barriers, or between barrier and structure, expressed in square metres
$A_{h,tot}$	Total area of the gaps in the head, obtained by summing the areas of the individual gaps, $g_{h,a}$ to $g_{h,f}$.
d_C	Horizontal deflection of a smoke barrier, measured at its bottom bar, expressed in metres
D	Distance of movement (drop) of smoke barrier, expressed in millimetres
D_l	Design depth of a smoke layer in a reservoir, expressed in metres
g	Acceleration due to gravity, expressed in metres per square second
g_e	Edge gap between the barrier and the surrounding construction, expressed in millimetres
$g_{h,a,\ldots}g_{h,f}$	Gaps the in header box, expressed in millimetres (see Figure 1)
g_j	Joint gap between adjacent barriers, expressed in millimetres
$g_{j,max}$	Maximum joint gap when barriers are in the fire operational condition, expressed in millimetres; $g_j = g_{j,max}/2$
h_B	Height of rise of a thermal line plume from an opening or balcony edge to the smoke layer, expressed in metres
h_O	Height of an opening
h_p	Height of rise of leakage gases from the base of the hot gas layer in the smoke reservoir to the ceiling in the adjacent protected area, expressed in metres
L_C	Length of the smoke barrier from top to bottom bar, measured along the fabric, expressed in metres
M_b	Mass per metre length of the barrier's bottom bar, expressed in kilograms per metre
M_B	Mass flow rate under a balcony, expressed in kilograms per second
M_C	Mass per square metre of the barrier fabric, expressed in kilograms per square metre
M_g	Mass of gas flowing through a gap, expressed in kilograms per second
M_p	Mass of gas flowing into the gas layer in a protected area after having leaked through gaps in smoke barriers, expressed in kilograms per second
t	Time, expressed in minutes
T	Absolute temperature of gases, expressed in kelvin
T_l	Absolute temperature of gas layer in a reservoir, expressed in kelvin
T_0	Absolute ambient temperature, expressed in kelvin
θ_l	Temperature rise above ambient of smoky gases in a reservoir, expressed in degrees Celsius
ρ_0	Density of ambient air, expressed in kilograms per cubic metre
W	Width of smoke barrier, expressed in millimetres

5 Product requirements

5.1 General

The smoke barrier requirements are intended to provide the SHEVS designers with smoke barriers that fulfil the system design requirements. Compliance with this part of ISO 21927 does not necessarily, by itself, ensure fitness for purpose for an application, as defined in ISO/IEC Guide 2.

The system design parameters dictate the minimum classification and performance of smoke barriers that can be used in any particular application. The criteria for the correct choice of smoke barrier shall take into account the total system, function and location requirements without hindering the means of escape or endangering the occupants.

5.2 Barrier types

5.2.1 General

Smoke barriers shall be defined as one of the following types:

— static smoke barrier: flexible material;

— static smoke barrier: rigid material;

— active smoke barrier: flexible material;

— active smoke barrier: rigid material.

5.2.2 Static smoke barriers (SSB)

Static smoke barriers shall be fixed in their fire operational position at all times and according to their design classification.

NOTE Static smoke barriers are used as alternatives and/or additions to the elements of the construction works that can act as permanent static smoke barriers.

5.2.3 Active smoke barriers (ASB)

Active smoke barriers shall move to the fire operational position upon external initiation and according to their design classification. Active smoke barriers shall be defined according to their application, e.g. life safety protection or property protection, method of operation and external initiations.

NOTE Active smoke barriers are used as alternatives and/or additions to elements of the construction works that can act as permanent static smoke barriers.

Active smoke barriers shall be categorized as follows:

— ASB1: smoke barriers that fail safe in/to the fire operational position (not lower than 2,5 m above the finished floor level or in any location hazardous to occupants or objects), in a controlled manner (see 6.4) when all consumable primary and auxiliary power sources are removed, in the event of wiring or system corruption, or any combination thereof;

— ASB2: smoke barriers that move to/stay in the fire operational position (not lower than 2,5 m above the finished floor level or in any location hazardous to occupants or objects), in a controlled manner (see 6.4) upon external initiation but requiring a consumable power source in order to move to or be maintained in the fire operational position;

— ASB3: smoke barriers, conforming to type ASB1, that can be deployed to any height (see 6.4);

— ASB4: smoke barriers conforming to ASB2, that can be deployed to any height (see 6.4).

In the majority of applications, active smoke barriers shall fail safe. But if it is necessary for the smoke barrier to remain retracted, even in the event of fail-safe, the system shall be so designed and tested.

ASB1 and ASB3 do not require fire-rated cables or cable systems.

Active smoke barriers without the fail-safe facility i.e. those requiring a power source to drive them down (ASB2 and ASB4), require fire-rated cables or cable systems.

In certain applications, smoke barriers are used for life-safety applications where types ASB1 and ASB3 may be more fit for purpose.

5.3 Auxiliary power supply

If batteries are used as the primary or auxiliary power source (types ASB2 and ASB4), batteries shall be submitted to an active battery test at intervals not exceeding 60 min. During this test, the connected load shall be at least 110 % of the normal motor current and shall be powered solely from the battery set. A fault-indicating signal shall be given as a volt-free contact and as an optical indication on the control panel upon

— battery set insufficiently charged,

— faulty battery set (e.g. short circuit),

— battery set not connected to load (e.g. open circuit).

Upon detection of a fault signal, the active smoke barrier shall move to the fire operational position.

Other stored energy systems shall have an equivalent level of monitoring and shall be capable of moving the barrier to its fire operational position upon detection of a fault signal.

Power supplies shall comply with regulatory requirements valid in the place of use.

5.4 Smoke (fire effluent) leakage

5.4.1 Openings, gaps and/or perimeter spaces

The free area through and around the complete system, materials and joints inherent in the product design shall be stated by the manufacturer.

All gaps in and around all types of smoke barrier shall be minimized to maintain the smoke-barrier containment efficiency as defined in 6.5.

Deflection of a smoke barrier can occur due to pressure differences or air movement. This can increase edge gaps or reduce the effective smoke-reservoir depth. The system design shall take this into consideration (see 6.5.2).

Care should be taken to ensure that any adjacent surfaces that form part of the barrier to smoke, e.g. false ceilings or fittings, have properties, e.g. resistance to temperature and permeability, at least equivalent to those of the smoke barrier.

NOTE The above criteria require consideration to ensure the efficiency of the smoke barrier to control the movement of fire effluent and aid the effectiveness of the SHEVS.

