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Smoke and heat control systems - Part 1: Specification for smoke barriers

Rauch- und Wärmefreihaltung - Teil 1: Bestimmungen für Rauchschürzen

Systemes pour le contrôle des fumées et de la chaleur - Partie 1: Spécifications relatives aux écrans de cantonnement de fumée

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This European Standard was approved by CEN on 16 January 2004.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

CEN members are the national standards bodies of 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.

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Foreword

This European Standard (EN 12101-1:2005) has been prepared by Technical Committee CEN/TC 191 “Fixed firefighting systems”, 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of an identical text or by endorsement, at the latest by February 2006, and conflicting national standards shall be withdrawn at the latest by August 2008.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive 89/106/EEC.

For relationship with EU Directive(s), see informative Annex ZA, which is an integral part of this document.

This European Standard is one part of the European Standard EN 12101, which has the general title “Smoke and heat control systems” and consists of the following separate parts:

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.

Part 4: Fire and smoke control installations — Kits.

Part 5: Guidelines on functional recommendations and calculation methods for smoke and heat exhaust ventilation systems (published as CR 12101-5)

Part 6: Specification for pressure differential systems — Kits.

Part 7: Smoke control ducts.

Part 8: Specification for smoke control dampers.

Part 9: Control panels.

Part 10: Specification for power supplies.

EN 12101 is included in a series of European Standards planned also to cover:

a) CO2 systems (EN 12094 & EN ISO 14520);

b) sprinkler systems (EN 12259);

c) powder systems (EN 12416);

d) explosion protection systems (EN 26184);

e) foam systems (EN 13565);

f) hose reel systems (EN 671);

g) water spray systems.

Annexes A to D are normative.

Annex E is informative.

This document includes a Bibliography.

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.

0 Introduction

0.1 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. For these benefits to be obtained 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.

Components for smoke and heat exhaust systems should 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 European Standard, 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 will 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 will provide essential smoke containment and channelling.

This European Standard applies to smoke barriers used within smoke and heat control systems, which include other equipment e.g. natural smoke and heat exhaust ventilators (EN 12101-2) and powered smoke and heat exhaust ventilators (EN 12101-3). Smoke barriers perform within specific time/temperature ranges.

0.2 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 have the ability to 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;

— to channel smoke in a pre-determined direction;

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

0.3 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 should be noted that, within the scope of this standard, smoke barriers can contain smoke and gases in excess of 600 °C but are not intended to perform the same function as fire barriers, smoke control doors which show conformity with (or are tested against) EN 1634-1 and –3, unless they meet the additional temperature requirements found in Table 2. Typical applications for smoke barriers are:

— smoke reservoir boundaries;

— channelling screens;

— void edge screens;

— void sealing screens;

— corridor containment;

— shop unit containment;

— escalator containment;

— stairwell containment;

— elevator well containment.

0.4 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 standard.

This European Standard applies to the following types of smoke barriers:

— static smoke barriers: (SSB),

— active smoke barriers: (ASB).

A wide range of different materials may 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 the 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 4.

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.

1 Scope

This part of EN 12101 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 standard provides the test methods for, and evaluation of conformity of, the smoke barrier systems.

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, *Fire resistance tests — Part 1: General requirements*.

EN 1363–2, *Fire resistance tests — Part 2: Alternative and additional procedures*.

EN 1634–3, *Fire resistance tests for door and shutter assemblies - Part 3: Smoke control doors and shutters*.

prCEN/TR 12101–4, *Smoke and heat control systems — Part 4: Installed SHEVS systems for smoke and heat ventilation.*

EN ISO 9001, *Quality management systems — Requirements (ISO 9001:2000)*.

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

3 Terms, definitions and symbols

3.1 General terms and definitions

For the purposes of this European Standard, the terms and definitions given in EN ISO 13943:2000 and the following apply.

3.1.1
active smoke barrier
smoke barrier which moves from its retracted position into its fire operational position automatically when called upon to do so

3.1.2
barrier movement
travel distance (e.g. height, drop) of an active barrier from its retracted position to its fire operational position

3.1.3
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

3.1.4
consumable power supplies
any form of power that when not available will prevent an active smoke barrier moving to the required fire operational position

3.1.5
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

3.1.6
fail-safe
designed to return to a safe condition in the event of a failure or malfunction etc.

3.1.7
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

3.1.8
fitness for purpose
ability of a product, process or service to serve a defined purpose under specific conditions

3.1.9
free area
total area of all designed openings and clearance gaps in and/or around the perimeter of a smoke barrier

3.1.10
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

3.1.11
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

3.1.12
response time
time taken for an active smoke barrier to move to its fire operational position after initiation

3.1.13
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

3.1.14
smoke and heat control system
arrangement of components installed in a construction works to limit the effects of smoke and heat from a fire

3.1.15
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, Smoke Screens.

3.1.16
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

3.1.17
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

3.1.18
static smoke barrier
smoke barrier permanently fixed in its fire operational position

3.1.19
void edge screen
smoke barrier deployed beneath the edge of a balcony or projecting canopy. Void edge screens can either be used 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

3.1.20
void sealing screen
smoke barrier deployed across a void to create a smoke reservoir beneath the smoke barrier

3.2 Symbols

A_g	Area of the gaps between smoke barriers, or between barrier and structure (m^2)
d_C	Horizontal deflection of a smoke barrier, measured at its bottom bar (m)
d_0	Height of opening
D	Distance of movement (drop) of smoke barrier (mm)
D_1	Design depth of a smoke layer in a reservoir (m)
G	Acceleration due to gravity (m/s^2)
h_b	Height of rise of a thermal line plume from an opening or balcony edge to the smoke layer (m)
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 (m)
L_C	Length of the smoke barrier from top to bottom bar, measured along the fabric (m)
M_b	Mass per metre length of the barrier's bottom bar (kg/m)
M_C	Mass per m^2 of the barrier fabric (kg/m^2)
M_B	Mass flow rate under a balcony (kg/s)
M_p	Mass of gas flowing into the gas layer in a protected area, having leaked through gaps in smoke barriers (kg/s)
$N_{1...3}$	Number of each type of gap in smoke barrier
t	Time in minutes
T	Absolute temperature of gases (K)
T_l	Absolute temperature of gas layer in a reservoir (K)
θ_l	Temperature rise above ambient of smoky gases in a reservoir (°C)
ρ_o	Density of ambient air (kg/m^3)
W	Width of smoke barrier (mm)

4 Product requirements

4.1 General

NOTE The smoke barrier requirements are intended to provide the SHEVS designers with smoke barriers which fulfil the system design requirements. Compliance with EN 12101-1 does not necessarily, by itself, ensure fitness for purpose for an application, as defined in ISO/IEC Guide 2:1996.

The system design parameters will dictate the minimum classification and performance of smoke barriers which 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.

4.2 Barrier types

4.2.1 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.

4.2.2 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 additional to the elements of the construction works which could act as permanent static smoke barriers.

4.2.3 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 1 Active smoke barriers are used as alternatives and/or additional to elements of the construction works which could act as permanent static smoke barriers.

Active smoke barriers shall be categorized as follows:

ASB1: Smoke barriers which 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 5.4) 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 which 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 5.4) 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, which can be deployed to any height (see 5.4).

ASB4: Smoke barriers conforming to ASB2, which can be deployed to any height (see 5.4).

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.

NOTE 2 ASB1 and ASB3 do not require fire rated cables or cable systems.

NOTE 3 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 accordance with prCEN/TR 12101-4.

NOTE 4 In certain applications smoke barriers are used for life safety applications where types ASB1 and ASB3 may be more fit for purpose.

4.3 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.

4.4 Smoke (fire effluent) leakage

4.4.1 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 5.5.

Deflection of a smoke barrier may occur due to pressure differences or air movement. This may increase edge gaps or reduce effective smoke reservoir depth. The system design shall take this into consideration (see 5.5.2).

NOTE 1 Care should be taken to ensure that any adjacent surfaces which form part of the barrier to smoke, e.g. false ceilings or fittings, have at least equivalent properties as the smoke barrier e.g. resistance to temperature and permeability (see prCEN/TR 12101-4).

NOTE 2 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.

4.4.2 Permeability of materials

The smoke barrier shall be manufactured from materials which restrict the passage of smoke (see Annex C and 5.5.5).

Where a specific system leakage rate is required, a complete product shall be tested to EN 1634–3 (see 5.5.5).

4.5 Reliability

The reliability of smoke barriers shall be determined in accordance with 5.3.

4.6 Response time

The response time of active smoke barriers shall conform to 5.4.

5 Performance requirements and classifications

5.1 General

Smoke barriers shall be tested in the orientation and use intended by the manufacturer for their application and installation.

5.2 Temperature/time classification

The temperature/time classifications of all smoke barriers shall be determined in accordance with the test methods in Annex D.

Smoke barriers shall be classified in accordance with the classification categories in Table 1.

Table 1 — Standard classification categories

Classification	Temperature (°C)	Time (min)
D 30	600	30
D 60	600	60
D 90	600	90
D 120	600	120
DA	600	Actual time reached above 120

The heat exposure at 600°C, designated D, represents the constant temperature of the smoke barrier test. The designations 30, 60, 90, 120 represent the period of the smoke barrier test. A smoke barrier which meets the requirements of D 60 also meets the requirements of D 30; equally, a D 90, or D120, smoke barrier also meets the requirements of D 60 and D 30, and D90, respectively. A DA smoke barrier meets all D requirements.

If smoke barriers are to operate at higher time/temperature ranges, they shall be classified in accordance with the classification categories in Table 2. The testing shall meet the time temperature requirements of EN 1363-1.