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Sistemi za nadzor dima in toplote - 2. del: Odvod dima in toplote z naravnim prezračevanjem

Smoke and heat control systems - Part 2: Natural smoke and heat exhaust ventilators

Rauch- und Wärmefreihaltung - Teil 2: Natürliche Rauch- und Wärmeabzugsgeräte

Systèmes pour le contrôle des fumées et de la chaleur - Partie 2 : Dispositifs d'évacuation naturelle de fumées et de chaleur

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Smoke and heat control systems - Part 2: Natural smoke and heat exhaust ventilators

Systèmes pour le contrôle des fumées et de la chaleur - Partie 2 : Dispositifs d'évacuation naturelle de fumées et de chaleur

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EUROPÄISCHES KOMITEE FÜR NORMUNG

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European foreword

This document (EN 12101-2:2017) 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of an identical text or by endorsement, at the latest by September 2017, and conflicting national standards shall be withdrawn at the latest by December 2018.

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

This document supersedes EN 12101-2:2003.

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(s).

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

This European Standard is one of the parts of the European Standard EN 12101 covering smoke and heat control systems.

This European Standard has the general title *Smoke and heat control systems* and currently consists of the following parts:

— *Part 1: Specification for smoke barriers*;

— *Part 2: Natural smoke and heat exhaust ventilators* [the present document];

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

— *Part 4: Installed SHEVS systems for smoke and heat ventilation* [Technical Report CEN/TR 12101-4];

— *Part 5: Guidelines on functional recommendations and calculation methods for smoke and heat exhaust ventilation systems* [Technical Report CEN/TR 12101-5];

— *Part 6: Specification for pressure differential systems – Kits*;

— *Part 7: Smoke control sections*;

— *Part 8: Smoke control dampers*;

— *Part 10: Power supplies*.

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Introduction

In a fire situation, smoke and heat exhaust ventilation systems create and maintain a smoke free layer above the floor by removing smoke. They also serve simultaneously to exhaust hot gases released by a fire in the developing stages. The use of such systems to create smoke-free areas beneath a buoyant layer has become widespread. Their value in assisting in the evacuation of people from buildings and other construction works, reducing fire damage and financial loss by preventing smoke damage, facilitating access for firefighting by improving visibility, reducing roof temperatures and retarding the lateral spread of fire is firmly established. For these benefits to be obtained it is essential that natural smoke and heat exhaust ventilators (referred to in this standard as NSHEV) operate fully and reliably whenever called upon to do so during their installed life. A smoke and heat exhaust ventilation system (referred to in this standard as a SHEVS) is a system of safety equipment intended to perform a positive role in a fire emergency.

1 Scope

This European Standard applies to natural smoke and heat exhaust ventilators (NSHEV) operating as part of smoke and heat exhaust systems (SHEVS), placed on the market. This standard specifies requirements and gives test methods for natural smoke and heat exhaust ventilators which are intended to be installed in smoke and heat control systems in buildings.

2 Normative references

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

EN 54-5:2017, *Fire detection and fire alarm systems - Part 5: Heat detectors - Point detectors*

EN 54-7, *Fire detection and fire alarm systems - Part 7: Smoke detectors - Point detectors using scattered light, transmitted light or ionization*

EN 1363-1, *Fire resistance tests - Part 1: General Requirements*

EN 12101-10, *Smoke and heat control systems - Part 10: Power supplies*

EN 13501-1, *Fire classification of construction products and building elements — Part 1: Classification using test data from reaction to fire tests*

EN 13823, *Reaction to fire tests for building products — Building products excluding floorings exposed to the thermal attack by a single burning item*

EN 60584-1, *Thermocouples — Part 1: EMF specifications and tolerances (IEC 60584-1)*

EN ISO 1182, *Reaction to fire tests for products - Non-combustibility test (ISO 1182)*

EN ISO 1716, *Reaction to fire tests for products - Determination of the gross heat of combustion (calorific value) (ISO 1716)*

EN ISO 11925-2, *Reaction to fire tests - Ignitability of products subjected to direct impingement of flame - Part 2: Single-flame source test (ISO 11925-2)*

3 Terms, definitions, symbols and abbreviations

3.1 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1.1
aerodynamic free area
geometric area multiplied by the coefficient of discharge

3.1.2
ambient
word used to describe properties of the surroundings

3.1.3
automatic activation
initiation of operation without direct human intervention

3.1.4
aspect ratio
ratio of length to width

3.1.5
automatic natural smoke and heat exhaust ventilator
natural smoke and heat exhaust ventilator (NSHEV) which is designed to open automatically after the outbreak of fire if called upon to do so

Note 1 to entry: Automatic natural smoke and heat exhaust ventilator (NSHEV) can also be fitted with a manual control or release device.

3.1.6
comfort position
position of a NSHEV defined by the manufacturer for the purpose of comfort ventilation

3.1.7
coefficient of discharge
c_v
ratio of actual flow rate, measured under specified conditions, to the theoretical flow rate through the NSHEV, as defined in Annex B

Note 1 to entry: The coefficient takes into account any obstructions in the NSHEV such as controls, louvres and vanes and the effect of external side wind.

3.1.8
dual purpose NSHEV
NSHEV which has provision to allow its use for comfort (i.e. day to day) ventilation

3.1.9
fire open position
configuration of the NSHEV specified by its designer to be achieved and sustained while venting smoke and heat

3.1.10
gas container
vessel containing gas in a compressed form, the energy of which, when the gas is released from the vessel, will open the NSHEV

3.1.11
geometric area
A_v
area of the opening through a NSHEV, measured in the plane defined by the surface of the construction works, where it contacts the structure of the NSHEV

Note 1 to entry: No reduction is made for controls, louvres or other obstructions.

Note 2 to entry: Specific configurations are given in Figures B.1 and B.4.

3.1.12
initiation device
device which activates the operating mechanism of the NSHEV on receipt of information from a fire detection system or thermal device

3.1.13
manually opened natural smoke and heat exhaust ventilator
NSHEV that can be opened by a manual control or release device

3.1.14
mass flux
total mass of gases crossing a specified boundary per unit time

3.1.15
natural ventilation
ventilation caused by buoyancy forces due to differences in density of the gases because of temperature differences

3.1.16
opening mechanism
mechanical device which operates the NSHEV to the fire open position

3.1.17
opening time

period between the information to open being received by the NSHEV and achieving the fire open position of the NSHEV

3.1.18

projection area
cross sectional area of the movable part (e.g. flap, window) of the NSHEV:

a) above the plane of the roof, at a right angle to the side wind flow;

b) on the wall at a right angle to the side of the wall

3.1.19
range of natural smoke and heat exhaust ventilators
NSHEV of various sizes having the same method of construction and the same type of opening mechanism

3.1.20
smoke and heat control system
arrangement of components installed in a construction works to limit the effects of smoke and heat from a fire

3.1.21
smoke and heat exhaust system
smoke and heat control system which exhausts smoke and heat from a fire in a construction works or part of a construction works

3.1.22
smoke and heat exhaust ventilation system
SHEVS
components jointly selected to exhaust smoke and heat in order to establish a buoyant layer of warm gases above cooler and cleaner air

3.1.23
natural smoke and heat exhaust ventilator (NSHEV)
product specially designed to move smoke and hot gases out of a construction works naturally under conditions of fire

Note 1 to entry: In the context of this standard smoke and hot gas movement means any motion of smoke and hot gas within and out of a construction work under the influence of thermal buoyancy, e.g. exhausting and extracting smoke and hot gas, directing and guiding smoke and hot gas.

Note 2 to entry: Typical NSHEV consist of a fixed frame or upstand and of one or more flaps to be opened in case of fire by an opening mechanism initiated by a smoke or heat sensitive initiation device.

3.1.24
thermal device
temperature sensitive device which responds to initiate a subsequent action

3.1.25
throat area
smallest cross sectional area of the flow path through the NSHEV

Note 1 to entry: See Figure G.6.

3.1.26
ventilator
device for enabling the movement of gases into or out of the construction works

3.1.27
wind deflector
any part of the NSHEV guiding the wind over the open NSHEV

3.1.28
wind sensitive control system
control system designed to control two or more banks of NSHEV on separate elevations so that only the NSHEV not subject to positive wind pressures opens in case of fire

3.1.29
walls
external building surfaces with an inclination of more than 60° relative to the horizontal

3.1.30
roofs
external building surfaces with an inclination of 60° or less relative to the horizontal shed roofs, and which continuous roof-lights, independent of the inclination angle, are considered to be part of

3.2 Symbols and abbreviations

For the purposes of this standard, mathematical and physical quantities are represented by symbols, and expressed in units as follows.

Symbol	Quantity	Unit
A_a	aerodynamic free area, expressed in square metres	(m^2)
A_{ex}	area of the exit plane of NSHEV, expressed in square metres	(m^2)
A_n	nozzle exit area (for open jet facilities); test section entrance area (for closed test section facilities), expressed in square metres	(m^2)
A_{pr}	projection area of the NSHEV for the side wind flow, expressed in square metres	(m^2)
A_{sc}	horizontal cross section area of the settling chamber, expressed in square metres	(m^2)
A_{throat}	smallest geometric cross section area through which the air flows	(m^2)
A_v	geometric area of the NSHEV, expressed in square metres	(m^2)
B	width of the open hole of the settling chamber, expressed in metres	(m)
b	width of the geometric opening of a NSHEV, expressed in metres	(m)
B_n	width of nozzle exit area in open jet facilities, width of the test section in closed test section facilities, expressed in metres	(m)
B_v	maximum width of the NSHEV in the fire open position, expressed in metres above the upper surface of the settling chamber	(m)
C_v	coefficient of discharge, dimensionless	-
C_{v0}	coefficient of discharge without side wind influence, dimensionless	-
C_{vw}	coefficient of discharge with side wind influence, dimensionless	-
d_h	hydraulic diameter of the settling chamber ($d_h = (4 A_{sc})/P$), expressed in metres	(m)
$d_{h,g}$	hydraulic diameter of the geometric NSHEV area, expressed in metres	(m)
H_n	height of nozzle exit area in open jet facilities, height of the test section in closed test section facilities, expressed in metres	(m)
H_v	maximum height of the NSHEV in the fire open position above the upper surface of the settling chamber, expressed in metres	(m)

Symbol	Quantity	Unit
h_p	profile height of a wall mounted NSHEV, expressed in metres	(m)
h_{US}	height of the NSHEV upstand, expressed in metres	(m)
h_{uwd}	height of the upper edge of wind deflectors above the roof surface, expressed in metres	(m)
L	length of the open hole of the settling chamber, expressed in metres	(m)
l	length of the geometric opening of a NSHEV, expressed in metres	(m)
$I_{u, hUS}$	turbulence intensity in flow direction at height h_{US}	-
m	ratio of geometric areas (= A_{ex}/A_v), dimensionless	-
$\dot{m}_{ing}$	mass flow rate entering the settling chamber, expressed in kilograms per second	(kg/s)
NSHEV	natural smoke and heat exhaust ventilator	-
P	perimeter length of the cross section of the settling chamber, expressed in metres	(m)
p_{amb}	ambient pressure, expressed in Pascal	(Pa)
p_d	wind stagnation pressure, expressed in Pascal	(Pa)
p_{int}	internal static pressure, expressed in Pascal	(Pa)
$p_{int, v0}$	internal static pressure without side wind, expressed in Pascal	(Pa)
$p_{int, vw}$	internal static pressure with side wind, expressed in Pascal	(Pa)
T	temperature, expressed in degrees C	(°C)
U_v	length of the boundary of the geometric area of a NSHEV, expressed in metres	(m)
V_∞	side wind velocity, expressed in metres per second	(m/s)
V_l	local air speed, expressed in metres per second	(m/s)
$V_{m, sc}$	mean velocity of the settling chamber, expressed in metres per second	(m/s)
V_n	mean nozzle velocity, expressed in metres per second	(m/s)
V_{sc}	local velocities in plane above settling chamber, see Figure B.6, expressed in metres per second	(m/s)
α	opening angle of the NSHEV, expressed in degrees and referenced to the closed flap position	-
β	angle of attack, expressed in degrees	-
β_{crit}	incidence angle at which the smallest value of C_{vw} obtained with side wind, occurs, expressed in degrees	-
δ	relative wall thickness (= h_{US}/d_h), dimensionless	-

Symbol	Quantity	Unit
δ_p	relative profile thickness (= h_p/d_h) of a wall mounted NSHEV, dimensionless	-
μ	contraction coefficient (= A_a/A_{ex}), dimensionless	-
θ	angle of installation of NSHEV on a roof or in a wall, expressed in degrees	-
Δp	pressure difference, expressed in Pascal	(Pa)
Δp_{v0}	reference pressure difference between the static pressure in the settling chamber and the ambient pressure without side wind, expressed in Pascal	(Pa)
Δp_{vw}	reference pressure difference between the static pressure in the settling chamber and the ambient pressure with side wind, expressed in Pascal	(Pa)
Δp_{int}	pressure difference between the static pressure in the settling chamber and the ambient pressure, expressed in Pascal	(Pa)
ΔT	temperature difference, expressed in Kelvin	(K)
ρ_{air}	density of air, expressed in kilograms per cubic metre	(kg/m^3)

4 Requirements

4.1 Nominal activation conditions/sensitivity

4.1.1 Initiation device

4.1.1.1 General

To ensure the natural smoke and heat exhaust ventilator (NSHEV) opens in the event of a fire, it shall be fitted with one or more of the following automatic initiation devices:

a) a thermal initiation device;

b) an initiation device activated by an electrical signal from a remote source, e.g. a smoke and heat detector system, the interruption of electrical power supply;

c) a pneumatic initiation device, e.g. a pneumatic signal or a loss of compressed air;

d) an initiation device able to respond to other types of release signals.

In addition, remote initiation can take place by means of a manually operated initiation device.

e) A pneumatic non fail safe NSHEV, which does not open automatically on loss of power, shall have at least a thermal device and one power source in accordance with EN 12101-10, which is mounted directly in the NSHEV, unless the required control panel monitors the lines to the NSHEV and indicates a failure.

In some specific design cases where it is suitable to initiate the NSHEV manually only, the NSHEV may be installed without an automatic initiation device.