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Smoke and heat control systems - Part 2: Specification for natural smoke and heat exhaust ventilators

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Smoke and heat control systems - Part 2: Specification for natural smoke and heat exhaust ventilators

Systèmes pour le contrôle des fumées et de la chaleur - Partie 2: Spécifications pour les exutoires de fumées et de chaleur naturels

Anlagen zur Kontrolle von Rauch- und Wärmeströmungen - Teil 2: Bestimmungen für natürliche Rauch- und Wärmeabzugsgeräte

This draft European Standard is submitted to the CEN members for CEN enquiry. It has been drawn up by Technical Committee CEN/TC 191 .

If this draft becomes a European Standard, 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.

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CEN

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Contents

Foreword

This Part of this European Standard has been drawn up by Technical Committee CEN/TC 191 Working Group 8 "Smoke and heat control systems and components".

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

Part 1 : Specification for smoke curtains - Requirements and test methods.

Part 2 : Specification for natural smoke and heat exhaust ventilators.

Part 3 : Specification for powered smoke and heat exhaust ventilators.

Part 4 : Natural and powered smoke and heat exhaust ventilation systems - Installation and test methods.

Part 5 : Design and calculation methods for smoke and heat exhaust ventilation systems.

Part 6 : Design and calculation methods and installation procedure for pressure differential smoke control systems.

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

a) CO2 systems (EN BCYG);
b) sprinkler systems (EN BCYH);
c) powder systems (EN 615);
d) explosion protection systems (EN 26 184);
e) foam systems (EN BKWV);
f) halon systems (EN BKWY);
g) hydrant and hose reel systems (EN 671-2);
h) semi rigid hose systems (EN 671-1);
i) water spray systems (PrEN BKWX).

Users of this European Standard are advised to consider the desirability of independent certification of product conformity with this European Standard based on testing and continuing surveillance, which may be coupled with assessment of a supplier's quality system against EN 29 001, EN 29 002 and/or EN 29 003 as appropriate.

Introduction

Smoke and heat exhaust ventilation systems create a smoke free layer above the floor by removing smoke 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. They also exhaust hot gases released by a fire in the developing stage.

The use of smoke and heat exhaust ventilation systemsto create smoke free areas beneath a buoyant smokelayer 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 smoke and heat exhaust ventilators operate fully and reliably whenever called upon to do so during their installed life. A heat and smoke exhaust ventilation system 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.

Smoke and heat exhaust ventilation systems 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;
reduce thermal effects on structural components during a fire;
reduce damage caused by thermal decomposition products and hot gases.

Natural smoke and heat exhaust ventilators are devices fitted into the roof and/or upper walls of a construction work to allow smoke and fire gases to be exhausted from the construction work when driven by thermal buoyancy inherent in those gases. It is essential that they are able to open, and/or to remain open in the event of a fire in that construction work and to fulfil their function even when climatic and weather conditions are unfavourable.
The performance of the natural smoke and heat exhaust ventilation systems depends on

- the temperature of the smoke;
- the aerodynamic free area of the ventilators;
- the wind influence;
  size, geometry and location of the inlet air openings;
- the time of actuation;
- the location and conditions of system (for example arrangements and dimensions of the building).

Smoke and heat exhaust ventilation systems are used in buildings or construction works where the particular (large) dimensions, shape or configuration make smoke control necessary.

Typical examples are

- single and multistorey shopping malls;
  single and multistorey industrial buildings and warehouses;
- atria and complex buildings;
- enclosed car parks;
- stairways;
- tunnels;
- theatres.

Depending on differing circumstances and the building's or construction work's situation whichcan effect their performance powered or natural smoke and heat exhaust ventilation systems may be used.

It is specified in Parts 4 and 5 of this European Standard that powered and natural exhaust ventilators shall not be used to extract smoke and hot gases from the same smoke reservoir.

Special conditions apply where gas extinguishing systems (e.g. according to prEN BCYG or prEN BKWY) are used, (see Parts 4 and 5).

1 Scope

This Part of this European Standard specifies requirements and gives test methods for natural smoke and heat exhaust ventilators which are intended to be installed as a component of a natural smoke and heat exhaust system conforming to prEN BKXF-4 and prEN BKXF-5.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

EN 29001 1987
Quality systems. Model for quality assurance in design/development, production, installation and servicing

EN 29002 1987
Quality systems. Model for quality assurance in production and installation

EN 29003 1989
Quality systems. Model for quality assurance in final inspection and test

EN 45001 1989
General criteria for the operation of testing laboratories

EN 45020 1991
Glossary of terms for standardization and related activities

prEN BKXF-1
Specifications for smoke curtains. Requirements and test methods

prEN BKXF-3
Specifications for powered smoke and heat exhaust ventilators.

prEN BKXF-4
Natural and powered smoke and heat exhaust ventilation systems. Installation and test methods.prEN BKXF-5
Design and calculation methods for smoke and heat exhaust ventilation systems.

prEN BKWY-6
Design and calculation methods and installation procedure for pressure differential smoke and control systems

ISO 834 1975
Fire-resistance tests. Elements of building construction

3 Definitions, symbols and units

3.1 Definitions For the purposes of this European Standard, the following definitions apply :

3.1.1 smoke and heat control system : Arrangement of components installed in a construction work to limit the effects of smoke and heat from a fire.

3.1.2 smoke and heat exhaust system : Smoke control system which exhausts smoke and heat from a fire in a construction work or part of a construction work.

3.1.3 smoke and heat exhaust ventilation system :
Arrangement of components installed in a construction work to exhaust smoke and heat from a fire in order to establish a buoyant layer of warm gases above cooler, cleaner air.

3.1.4 natural ventilation : Ventilation caused by buoyancy forces due to differences in density of the gases because of temperature differences.

3.1.5 powered ventilation : Ventilation caused by the positive displacement of gases through a ventilator.

NOTE : Fans are usually used.

3.1.6 ventilator : Device for the movement of gases into or out of a construction work.

3.1.7 exhaust ventilator : Device for the movement of gases out of the construction work.

3.1.8 smoke and heat exhaust ventilator : Device specially designed to move smoke and hot gases out of a construction work under conditions of fire.

3.1.9 dual purpose ventilator : smoke and heat exhaust ventilator which has provision to allow its use for comfort (i.e. day to day) ventilation.

3.1.10 permanently open natural smoke and heat exhaust ventilator : Smoke and heat exhaust ventilator without devices for closing.

3.1.11 manually opened smoke and heat exhaust ventilator :
Smoke and heat exhaust ventilator which can only be opened by a manual control or release device.

3.1.12 manually initiated powered smoke and heat exhaust ventilator : Powered smoke and heat exhaust ventilator which may be initiated only by human action.

3.1.13 automatic natural smoke and heat exhaust ventilator :
Smoke and heat exhaust ventilator which is designed to open automatically after the outbreak of fire if called upon to do so.

NOTE : Automatic natural smoke and heat exhaust ventilators may also be fitted with a manual control or release device.

3.1.14 automatically initiated powered smoke and heat exhaust ventilator : Powered smoke and heat exhaust ventilator which operates automatically after the outbreak of fire if called upon to do so.

3.1.15 smoke reservoir : Region within a building bordered by smoke curtains or structural elements so as to retain a thermally buoyant smoke layer in the event of a fire.

3.1.16 installation : The act of installing.

NOTE : To avoid confusion, the noun form of the word "installation" will not be used in this standard.

3.1.17 geometric area (A_v) : Area of the opening through a ventilator, measured in the plane defined by the surface of the construction work, where it contacts the structure of the ventilator. No reduction is made for controls, louvres or other obstructions (see Fig. B.1).

3.1.18 coefficient of discharge (C_v) : Ratio of actual flow rate, determined under specified conditions, to the theoretical flow rate through the ventilator as defined in annex G.

NOTE : The coefficient takes into account any obstructions in the ventilator such as controls, louvres, vanes, etc. A coefficient of discharge is determined without external sidewind (C_{vo}) or with external sidewind (Cvw).

3.1.19 aerodynamic free area (A_a) : Product of the geometric area multiplied by the coefficient of discharge ($A_a = A_v \times C_v$).

3.1.20 throat area : Smallest cross sectional area of the flow path through the ventilator.

3.1.21 projection area : Cross sectional area of the ventilator above the plane of the roof, at a right angle to the sidewind flow.

3.1.22 opening mechanism : Mechanical device which operates the ventilator to the fire open position.

3.1.23 thermal device : Temperature sensitive device of the ventilator which responds to initiate a subsequent action.

3.1.24 rated temperature : Temperature at which a thermal device responds to a very slow temperature rise.

3.1.25 opening time : Period between the information to open being received by the ventilator, to achieving the fire open position of the ventilator.

3.1.26 initiation device : Device which activates the opening mechanism of the ventilator (e.g. on receipt of information from a fire detection system or thermal device).

3.1.27 range of ventilators : Ventilators of various sizes having the same method of construction (identical number of hinges on a louvre blade or flap, identical materials and thicknesses, etc) and the identical number and type of opening devices.

3.1.28 fire open position : Configuration of the ventilator specified by its designer to be achieved and sustained while venting smoke and heat.

3.1.29 aspect ratio : Ratio of length to width.

3.1.30 gas container : Vessel containing gas in a compressed form, the energy of which, when released, will open the ventilator.

3.2 Symbols and units

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

Symbol	Quantity	Units
A_a	aerodynamic free area of a smoke exhaust ventilator	(in m^2)
A_v	geometric area of smoke exhaust ventilator	(in m^2)
A_{sc}	horizontal cross section area of the settling chamber	(in m^2)
A_m	nozzle exit area of a smoke exhaust ventilator	(in m^2)
A_{pr}	projection area for the side wind flow	(in m^2)
B_m	width of nozzle exit	(in m)
B_v	maximum width of the smoke exhaust ventilator in the fire open position above the upper surface of the settling chamber	(in m)
C_v	coefficient of discharge	dimensionless
C_v	coefficient of discharge without sidewind influence	dimensionless
C_v	coefficient of discharge with sidewind influence	dimensionless
H_m	height of nozzle exit area in metres (in m)	
H_v	maximum height of the exhaust ventilator in the fire open position above the upper surface of the settling chamber	(in m)
m_{ing}	mass flow rate entering the settling chamber	(in kg/s)
P_{amb}	ambient pressure	(in Pa)
P_d	wind stagnation pressure	(in Pa)

V_∞	sidewind velocity	(in m/s)
V_m	mean velocity	(in m/s)
V_n	mean nozzle velocity	(in m/s)
W_s	snow load	(in Pa)
W_w	windload	(in Pa)
W_{wd}	design wind load	(in Pa)
α	opening angle of the smoke exhaust ventilator	(in °)
β_{crit}	incidence angle at which the smallest value of C is obtained with sidewind	(in °)
Δ_P	pressure difference	(in Pa)
Δ_{Pint}	pressure difference between the static pressure in the settling chamber and the ambient pressure	(in Pa)
P_{air}	density of air	(in kg/m^3)

4. Design requirements

4.1. Initiation device.

4.1.1 General
The ventilator shall be fitted with one or more of the following :

a) a manually operated initiation device;
b) a thermal initiation device conforming to 4.1.2.;
c) an initiation device activated by an electrical signal from a remote source, e.g. a smoke and heat detector system, the interruption of electrical supply, a manually actuated “fire override” switch, etc.
d) a pneumatic initiation device, e.g. a pneumatic signal, a loss of compressed air, etc.
e) an initiation device able to respond to other types of release signals.

4.1.2 Thermal initiation device
Any thermal initiation device shall be mounted in the throat of the ventilator.

When fitted into the ventilator the mechanical forces applied to the thermal device shall not exceed the supplier's recommendations.

4.2 Opening mechanism

4.2.1 General
The ventilator shall be provided with the following :

a) a manually operated opening mechanism; and/or
b) an opening mechanism with energy within the ventilator

NOTE : opening mechanisms dependent on an external energy source for example pneumatic motor, electricity from an external source, may be used only in addition.

4.2.2. Integral gas containers
Any gas container forming an integral part of the ventilator shall be equipped with a pressure release device to prevent an explosion if the container overheats.

4.3. Ventilator for life safety applications
A ventilator for life safety applications shall be fitted with means to permit remote opening and closing for test purposes.

4.4. Aspect ratio of the geometric area
The aspect ratio of the geometric area shall not exceed 5:1.

5. General testing procedures

For type approval testing, tests shall be carried out in the sequence specified in Annex A (para. A.1).

For each test, a test report shall be prepared in accordance with Annex A (para. A.2).