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Smoke and heat control systems —

Part 3: Specification for powered smoke and heat exhaust ventilators

Systèmes de contrôle de fumée et de chaleur —
Partie 3: Spécifications pour les ventilateurs mécaniques d'évacuation des fumées et de la chaleur

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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 21927-3 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*

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 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 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.

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

Depending on the design of the system and the ventilator, powered or natural smoke and heat ventilators can be used in a smoke- and heat-control system. Powered smoke- and heat-exhaust ventilators can be installed in the roof or upper part of walls of buildings or in a ducted system with the ventilator inside or outside the smoke reservoir or in a plant room.

It is important that powered smoke- and heat-exhaust ventilation systems operate based on powered ventilators. The performance of a powered smoke- and heat-exhaust system depends on

— the temperature of the smoke,

— size, number and location of the exhaust openings,

— the wind influence,

— size, geometry and location of the inlet air openings,

— the time of actuation,

— the location and conditions of the 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 multi-storey shopping malls,

— single and multi-storey industrial buildings and warehouses,

— atria and complex buildings,

— enclosed car parks,

— stairways,

— tunnels,

— theatres.

Depending on differing circumstances and the situation of the building or construction works that can affect their performance, powered or natural smoke- and heat-exhaust ventilation systems can be used.

It is important that powered and natural exhaust ventilators not be used to extract smoke and hot gases from the same smoke reservoir.

Special conditions apply where gas extinguishing systems (e.g. in accordance with ISO 14520-1) are used.

Smoke and heat control systems —

Part 3:
Specification for powered smoke and heat exhaust ventilators

1 Scope

This part of ISO 21927 specifies requirements and gives methods for testing powered smoke- and heat-exhaust ventilators that are intended to be installed as part of a powered smoke- and heat-exhaust ventilation system. It also provides a procedure for approving a range of powered smoke- and heat-exhaust ventilators and their motors, from a limited number of tests.

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 5167 (all parts), *Measurement of fluid flow by means of pressure differential devices inserted in circular cross-section conduits running full*

ISO 5221, *Air distribution and air diffusion — Rules to methods of measuring air flow rate in an air handling duct*

ISO 5801, *Industrial fans — Performance testing using standardized airways*

ISO 10294-1, *Fire resistance tests — Fire dampers for air distribution systems — Part 1: Test method*

ISO 13943, *Fire safety — Vocabulary*

ISO 21927-2:2004, *Smoke and heat control systems — Part 2: Specification for natural smoke and heat exhaust ventilators*

IEC 60034-1, *Rotating electrical machines — Part 1: Rating and performance*

IEC 60034-2, *Rotating electrical machines — Part 2: Methods for determining losses and efficiency of rotating electrical machinery from tests (excluding machines for traction vehicles)*

3 Terms and definitions

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

3.1
smoke- and heat-control system
arrangement of components installed in a construction work to limit the effects of smoke and heat from a fire

3.2
smoke- and heat-exhaust system
smoke-control system that exhausts smoke and heat from a fire in a construction work or part of a construction work

3.3
smoke- and heat-exhaust ventilation system
SHEVS
components jointly selected to exhaust smoke and heat to establish a buoyant layer of warm gases above cooler, cleaner air

3.4
natural ventilation
ventilation caused by buoyancy forces due to differences in density of the gases because of temperature differences

3.5
powered ventilation
ventilation caused by the positive displacement of gases through a ventilator

NOTE Fans are usually used.

3.6
ventilator
device for enabling the movement of gases into or out of a construction work

3.7
exhaust ventilator
device for the movement of gases out of the construction work

3.8
insulated motor
motor thermally insulated from the environment which generally includes a motor casing

3.9
smoke- and heat-exhaust ventilator
SHEV
device specially designed to move smoke and hot gases out of the construction work under conditions of fire

3.10
dual purpose ventilator
smoke- and heat-exhaust ventilator that has provision to allow its use for comfort (i.e. day-to-day) ventilation

3.11
emergency ventilator
smoke- and heat-exhaust ventilator that is not used for comfort (i. e. day-to-day) ventilation

3.12
automatically initiated powered smoke- and heat-exhaust ventilator
powered smoke- and heat-exhaust ventilator that operates automatically after the outbreak of fire if called upon to do so

3.13
smoke reservoir
region within a building limited or bordered by smoke curtains or structural elements and which, in the event of a fire, retains a thermally buoyant smoke layer

3.14
hot-gas fan
fan that is suitable for handling hot gases for a specified time/temperature profile

3.15
powered smoke- and heat-exhaust ventilator
hot-gas fan that is suitable for handling hot gases for a limited period only

3.16
powered roof ventilator
partition fan designed for mounting on a roof and having exterior weather protection

3.17
insulated ventilator
ventilator insulated to limit the external surface temperature to reduce the danger of injury to persons or damage to materials

3.18
smoke-reservoir ventilator
ventilator suitable for operation fully immersed in a smoke reservoir

3.19
non-smoke-reservoir ventilator
ventilator not suitable for operation fully immersed in a smoke reservoir

3.20
powered ventilator product range
physically similar ventilators using the same form of construction and materials throughout, with the same methods of impeller construction and motor mounting and construction, and electrical connection in which the following can vary across the range:

— overall dimensions of the units;

— impeller diameter and width, hub size, blade length and number of blades of the impeller;

— size of the motor

3.21
powered ventilator motor range
motors that are physically similar, using the same form of construction, i.e. same materials and manufacturing method for carcase, cooling impeller, when fitted, and end covers; same insulation specification that includes sheet insulation used for coil separation and slot insulation, winding-impregnation material (varnish or resin, etc.), lead insulation, terminal blocks and any other materials that can affect the integrity of the insulation; same bearing type, class of fit, lubricant and arrangement, with motor windings based on the same maximum winding temperature and class of insulation, in which the following can vary across the range:

— frame size;

— rotational speed;

— electrical windings, including multi-speed;

— form of mounting, e.g. foot, flange, pad, clamp, etc.

3.22
motor rating
maximum power that the motor delivers continuously without exceeding the allowable temperature rise

3.23
fire position
position of a component to be reached and maintained while venting smoke and heat

4 Design requirements

4.1 Application classes

A powered ventilator shall be classified into one or more of the following application classes:

— insulated or uninsulated;

— smoke reservoir or non-smoke reservoir;

— dual purpose or emergency only use;

— ducted cooling air required.

4.2 Motor rating

4.2.1 The motors shall be selected for continuous operation at the power required for normal ambient temperature, not just for operation at high temperature.

4.2.2 Motor ratings shall be limited either by the temperature rise for one class lower than the insulation class of the motor, as defined in IEC 60034-1 and as given in Table 1 of this part of ISO 21927, or for motors with class B or class F insulation to the motor rated output power being 15 % above the absorbed power at a density of 1,2 kg/m^3.

Table 1 — Motor temperature ratings

Motor insulation	Temperature rise at ambient
Class H or C	Class F
Class F	Class B
Class B	Class E

4.3 Motor specification

Motors shall comply with the requirements of IEC 60034-1.

4.4 Hot-gas fan

The time/temperature profile that a hot-gas fan is required to operate under, can be “continuous” or more specific to the application. Special materials may be incorporated in the fan that can have a direct or indirect drive. The motor may be in the air-stream on a direct-drive fan or separated from it by a bifurcation tunnel. Indirect drive fans may incorporate a means of cooling belts, bearings or other drive components.

5 General testing procedures

For type approval, tests shall be carried out in accordance with Annexes A, B, C, D and E. For each test, a test report shall be prepared in accordance with Annexes C and/or D.

For different directions of the motor axis, a separate test shall be done for either direction (horizontal and/or vertical).

NOTE A direct field of application for the direction of the motor axis (horizontal and/or vertical) is under consideration as of the date of publication of this part of ISO 21927.

6 Performance requirements and classification

6.1 Temperature/time classification

6.1.1 A ventilator shall be classified (see Table 2) as

a) F200;

b) F300;

c) F400;

d) F600;

e) F842;

f) Not classified.

6.1.2 For products intended to be installed within a building, there shall be no significant leakage of smoke from the furnace coming from the housing of the ventilator during the entire test period.

6.1.3 At the appropriate temperature given in Table 2, a ventilator shall function for not less than the appropriate minimum time and shall re-start when tested in accordance with Annex C.

Table 2 — Test temperature and functioning time according to classification

Class	Temperature °C	Minimum functioning period minutes
F200	200	120
F300	300	60
F400	400	120
F600	600	60
F842	842	30
Not classified	as specified by sponsor	as specified by sponsor

6.2 Flow and pressure

When tested in accordance with Annex C, at the appropriate temperature and for the appropriate time given in Table 2, the volume flow shall not change by more than 10 % or the static pressure shall not change by more than 20 % of that measured at the end of the warm-up period of the test.

6.3 Outer surface temperature and cooling air temperature of insulated ventilators

When the ventilator is tested in accordance with Annex C, at the temperature and for the time appropriate to the product temperature/time category:

— the outer surface temperature of an insulated ventilator shall not increase by more than 180 °C in accordance with ISO 834-1 for any individual value;

— the cooling air expelled from the unit shall not exhibit an increase of temperature of more than 180 °C from the initial room temperature.

NOTE Increases above the specified temperature can increase the fire risk.

6.4 Wind load

If the ventilator is designed to be installed at the atmospheric termination of a system and is fitted with flaps or louvres and these project above the wind deflectors (cowl or wind shield), the flaps or louvres shall open in less than 30 s against of a load of 200 Pa, when the ventilator is tested in accordance with Annex E.

6.5 Snow load

6.5.1 If the ventilator is designed to be installed at the atmospheric termination of a system, the ventilator shall be classified as one of the following:

— SL 0;

— SL 125;

— SL 250;

— SL 500;

— SL 1 000;

— SL *A*.

The designations 0, 125, 250, 500, 1 000 and "*A*" represent the test snow load, expressed in pascal, applied when the ventilator is tested in accordance with Annex E. The "*A*" in "SL *A*" will be replaced by the test snow load when this exceeds 1 000, or by the test load if one of the four defined values is not used.

Where the minimum angle of installation (combining roof pitch and ventilator pitch) recommended by the supplier exceeds 45°, the ventilator takes the classification SL 1 000 without a test; except where the snow is prevented from slipping from the ventilator, e.g. by wind deflectors.

If the ventilator is fitted with deflectors, the snow-load classification, SL, shall not be less than 2 000d, where d is the depth of snow, in metres, that can be contained with the confines of the deflectors.

6.5.2 The ventilator shall open to its fire-open position in not more than 30 s after actuation when tested under the snow load appropriate to its classification in accordance with Annex E.

The following types of ventilators can be suitable for use on heated buildings without a snow-load classification test:

a) vertical discharge units without flaps or dampers;

b) vertical discharge units with uninsulated metal flaps or dampers.

6.6 Operation at low temperature

A powered ventilator with a separate device for the operation of the dampers, flaps or louvres that does not use the air pressure from the fan shall conform to ISO 21927-2:2004, 8.3, when tested in accordance with ISO 21927-2:2004, Annex E.

6.7 Reliability

A powered ventilator with dampers, flaps or louvres or a separate device for the operation of the dampers, flaps or louvres that does not use the air pressure from the fan shall conform to ISO 21927-2:2004, 8.1, when tested in accordance with ISO 21927-2:2004, Annex C.