



SLOVENSKI STANDARD
SIST-TP CEN/TR 12101-4:2007
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Sistemi za nadzor dima in toplote - 4. del: Vgrajeni sistemi »SHEVS« za odvod dima in toplote s prezračevanjem

Smoke and heat control systems - Part 4: Installed SHEVS systems for smoke and heat ventilation

Rauch- und Wärmefreihaltung - Teil 4: Anlagen zur Rauch- und Wärmefreihaltung im eingebauten Zustand

Systemes pour le contrôle des fumées et de la chaleur - Partie 4: Systemes SEFCV installés pour l'évacuation de fumées et de chaleur par ventilation

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**Smoke and heat control systems - Part 4: Installed SHEVS
systems for smoke and heat ventilation**

Systèmes pour le contrôle des fumées et de la chaleur -
Partie 4: Systèmes SEFCV installés pour l'évacuation de
fumées et de chaleur par ventilation

Rauch- und Wärmefreihaltung - Teil 4: Anlagen zur Rauch-
und Wärmefreihaltung im eingebauten Zustand

This Technical Report was approved by CEN on 1 August 2006. It has been drawn up by the Technical Committee CEN/TC 191.

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CEN/TR 12101-4:2006 (E)**Foreword**

This document (CEN/TR 12101-4:2006) has been prepared by Technical Committee CEN/TC 191 "Fixed firefighting systems", the secretariat of which is held by BSI.

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 European document (Technical Report) has the general title "*Smoke and heat control systems*" and consists of the following separate parts:

- *Part 1: Specifications 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: Installed SHEVS systems for smoke and heat ventilation.*
- *Part 5: Guidelines on functional recommendations and calculation methods for smoke and heat exhaust ventilation systems (published as CEN/TR 12101-5)*
- *Part 6: Specification for pressure differential systems - Kits*
- *Part 7: Smoke control ducts*
- *Part 8: Smoke control dampers*
- *Part 9: Control panels*
- *Part 10: Power supplies*

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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. It contributes to the protection of property and permits 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.

Components for smoke and heat exhaust ventilation systems should be installed as part of a properly designed smoke and heat exhaust ventilation 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 damages caused by thermal decomposition products and hot gases.

A powered smoke exhaust system can also be used for the realisation of the following purposes:

- creation of a negative pressure differential facing the direction of escape for the prevention of the spread of smoke;
- local dilution of smoke within occupied zones.

Natural smoke and heat exhaust ventilators are devices fitted into the roof and /or upper walls of a construction works to allow smoke and fire gases to be exhausted from the construction works 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 and to fulfil their function even when climatic and weather conditions are unfavourable.

Depending on the building geometry and siting of the building with regard to neighbouring buildings, and design criteria, natural smoke and heat exhaust ventilators can be used instead of powered smoke and heat ventilators.

This Technical Report sets down the testing requirements for the system when installed to ensure that it operates in a safe and reliable manner. Commissioning, periodic maintenance and servicing requirements are stated as well as the users' responsibilities for ensuring that the system is always for use in case of fire.

Components of the SHEVS should be designed or chosen to meet the specific performance requirement of the system.

Without proper installation of all of its components, the SHEVS could not operate correctly nor meet the performance targets for which it has been designed.

Commissioning is necessary to check the SHEVS operates in accordance with its design. The system has to be permanently available for operation. This can only be achieved when checked and maintained.

CEN/TR 12101-4:2006 (E)**1 Scope**

This Technical Report applies to SHEVS when installed in a building. This Technical Report specifies the ability of the system to meet the required performances of the SHEVS as specified by the design of the system. This Technical Report requires that a detailed engineering design of the system exists but this standard does not state how the design is made. This Technical Report also covers requirements on components and compatibility between components to ensure that the requirements on the installed system will be met. This Technical report includes requirements for the assembly, installation, commissioning, function testing, maintenance, periodic servicing and routine testing of SHEVS.

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 12101-1, *Smoke and heat control systems — Part 1: Specification for smoke barriers*

EN 12101-2, *Smoke and heat control systems — Part 2: Specification for natural smoke and heat exhaust ventilators*

EN 12101-3, *Smoke and heat control systems — Part 3: Specification for powered smoke and heat exhaust ventilators*

EN 12101-6, *Smoke and heat control systems — Part 6: Specification for pressure differential systems_ - kits*

prEN 12101-9, *Smoke and heat control systems — Part 9: Control panels*

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

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EN 1366-8, *Fire resistance tests for service installations — Part 8: Smoke extraction ducts*

prEN 1366-9, *Fire resistance tests for service installations — Part 9: Single compartment smoke extraction ducts*

prEN 1366-10, *Fire resistance tests for service installations — Part 10: Smoke control dampers*

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

EN 13501-2, *Fire classification of construction products and building elements — Part 2: Classification using data from fire resistance tests, excluding ventilation services*

EN 13501-3, *Fire classification of construction products and building elements — Part 3: Classification using data from fire resistance tests on products and elements used in building service installations: fire resisting ducts and fire dampers*

prEN 13501-4, *Fire classification of construction products and building elements — Part 4: Classification using data from fire resistance tests on components of smoke control systems*

EN 60529, *Specification for degrees of protection provided by enclosures (IP code) — Safety signs directive (92/58/EEC)*

EN ISO 5167-1, *Measurement of fluid flow by means of pressure differential devices inserted in circular cross-section conduits running full - Part 1: General principles and requirements (ISO 5167-1:2003)*

ISO 2408, *Steel wire ropes for general purposes – Minimum requirements*

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

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

ISO 5168, *Measurement of fluid flow -- Procedures for the evaluation of uncertainties*

3 Definitions

For the purposes of this Technical Report, the following definitions apply (see also Annex C with drawings).

3.1

access level

level of restriction for qualified persons of the access to specific equipment of a component

3.2

air inlet

device connected to outside air to allow the inlet of air from outside the construction works

3.3

automatic activation

initiation of operation of the smoke and heat venting installation without manual action

3.4

automatic and manual activation

initiation of operation of the smoke and heat venting installation, which can be both automatic and manual

3.5

commissioning

the act of ensuring that all components and the system are installed and operating in accordance with this standard

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3.6

component

component of a SHEVS is a complete product which is part of the SHEVS : ventilator, air inlet, electric cable, silencer, etc.

3.7

control panel

device containing control and/or release devices, manual and/or automatic, used to operate the system

3.8

detailed engineering plan (DEP)

document produced by the SHEVS designer giving technical specifications of the system, from which, by means of a detailed engineering plan, the specifications for the system may be derived. It includes details of controls, mode tables of how the system is to operate with particular design fires and the siting of components (see Annex D)

3.9

fire compartment

enclosed space, comprising one or more separate spaces, bounded by elements of construction having a specified fire resistance and intended to prevent the spread of fire (in either direction) for a given period of time

NOTE "Fire compartment" often has regulatory connotations. The term should not be confused with "room of origin" or "fire cell".

CEN/TR 12101-4:2006 (E)**3.10****fire position, fire open position (where appropriate)**

position of a component to be reached and maintained while the SHEVS is venting smoke and heat

3.11**geometric area (A_v)**

area of the opening through a ventilator, measured in the plane defined by the surface of the construction works, where it contacts the structure of the ventilator. No reduction will be made for controls, louvres or other obstructions (see Annex C, Figure C.1)

3.12**initiation device**

device which activates the operating mechanism of the component (e.g. of a smoke control damper or ventilator) on receipt of information from a fire or smoke detection system or thermal device

3.13**input/output characteristics**

characteristics of a component of a SHEVS at the interface with other components of the SHEVS, such as voltage, current, frequency, impedance, power, pressure, speed, diameter or flow rate

3.14**manually initiated smoke and heat exhaust ventilation system**

smoke and heat exhaust ventilation system which is initiated by human actions only after the outbreak of fire (e.g. by pressing a button or pulling a handle) leading to a sequence of automatic actions in the operation of the SHEVS

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3.15**natural ventilation**

ventilation caused by buoyancy forces due to differences in density of the gases because of temperature differences (see Annex C, Figure C.2)

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3.16**operating time**

maximum period between the signal to operate being received by the SHEVS and the achievement of the fire position by the smoke zone of the SHEVS with the most unfavourable route

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3.17**powered ventilation**

ventilation caused by the positive displacement of gases through a ventilator

NOTE Fans are usually used.

3.18**response time**

period between the signal to operate being received by the component (e.g. a control panel, ventilator or smoke control damper) and the achievement of the fire position by the component

3.19**secondary power supply**

power supply to operate the system when the normal power supply has failed

3.20**smoke and heat control system**

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

3.21**smoke and heat exhaust system**

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

3.22**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 gases above cooler, cleaner air

3.23**smoke and heat exhaust ventilator (SHEV)**

device specially designed to move smoke and hot gases out of a construction works under conditions of fire

3.24**smoke control damper**

device which may be opened or closed to control the flow of smoke and hot gases. It may have the following positions:

- Fire position: open (to exhaust smoke from fire compartment);
closed (to avoid spreading of smoke in other zones).
- Standby position: closed.

3.25**smoke and heat exhaust duct**

products used to channel the gases to and from the smoke and heat exhaust ventilator

3.26**smoke layer**

layer of smoke which stabilizes underneath the roof due to the affect of temperature gradient

3.27**smoke reservoir**

volume within a construction works limited or bordered by the ceiling and smoke barriers or structural elements so as to retain a thermally buoyant smoke layer in the event of a fire (see Figure C2, Annex C)

3.28**smoke zone**

room or a division of a room of a construction works for the extraction of smoke and hot gases. Each zone is served by a SHEVS, (or sub system of a SHEVS), which is initiated by a signal from a single device or group of initiation devices associated with the zone. A zone contains at least one smoke reservoir

3.29**stand by position**

state of a component ready for operation

3.30**thermal device**

temperature sensitive device which responds to initiate a subsequent action

4 Description of the principles of operation for smoke and heat control systems

There are three principles for smoke control in construction Works:

CEN/TR 12101-4:2006 (E)**4.1 Smoke and heat control system which rely on the principle of the creation of a smoke layer****4.1.1 Smoke layers exhausted by natural vents**

The needed area of vents is measured by the free area for each zone. For efficiency of the SHEVS, the maximum area of a smoke zone shall not exceed 1600 m².

Air inlets have to be provided to allow for the replacement of smoke by fresh air:

— with opening in roofs

The efficiency of the vents is measured by their aerodynamic free area: A_w m²

There shall be at least one ventilator for 200 m² of floor area.

— with opening in side-wall

The efficiency of the vents is measured by their aerodynamic free area: A_w m²

Wall mounted ventilators have to be installed on at least two different sides of the building and be monitored by wind direction control system.

4.1.2 Layers of smoke exhausted by powered vents

Smoke and heat exhaust systems in buildings provide the possibility to remove the design amount of fire gases from the building by applying an under pressure within the smoke compartments.

The efficiency of the powered vents is measured by the capacity of the vents measured in m³/s

The number of exhaust openings needed is determined as a function of the location and its geometry

Supply of air has to be provided to allow for the replacement of smoke by fresh air. The supply air has to be provided at a speed in accordance with the DEP and to match the needs of the largest smoke zone.

4.2 Smoke free areas by differential pressure systems

This system is taken care of by EN 12101-6, therefore, it is only given for information and not taken care of by this Technical Report.

4.3 Air renewal of the room with fresh air by dilution of smoke

The efficiency of the system is measured by its capacity in m³/s.

NOTE This type of principle has to be considered to fight smoke and heat.

Nevertheless it is not an installed system, it is brought to the place in case of a fire, therefore it is not within the scope of this standard which describes only fixed installed systems.

5 Description of the combination of products for construction of SHEVS

5.1 General

The basic input to define the SHEVS, which will be used to determine the combination of products for construction of a SHEV, is the “detailed engineering plan” . The purpose and the content of the Detailed engineering plan are described in Annex D .

This is valid for any principle of smoke ventilation.

The detailed engineering plan (DEP) has to be approved by the jurisdiction having authority.

5.2 General requirements

The three principles of smoke control described in 4.1 to 4.3 shall not be mixed within one room.

In the case of the layer system, natural extraction shall not be mixed with powered extraction in one smoke zone.

Before installation, there shall be a detailed engineering plan prepared in accordance with the design requirements and regulations valid in the place of use of the SHEVS.

The performance, the position of the components, the height of the smoke barriers and of the air inlets in regard to the level of the smoke layer are important factors, they shall be in accordance with the DEP.

A failure of a component shall only affect the operation of that component.

Any use of the smoke and heat ventilation system for a purpose other than the ventilation of heat and smoke under fire conditions shall not prevent the smoke and heat exhaust ventilation system from performing its design function when required. The ventilation of heat and smoke under fire conditions shall have priority on any other use of the system.

It shall only be possible to reset a component from the fire position to the standby position by a manual operation.

Where one or more devices form part of the control system, components shall only be controlled by signals coming from that control system.

All components covered by a Part of EN 12101 shall be in accordance with the relevant Part. Smoke barriers, natural or powered smoke and heat ventilators, dampers, ducts, control panels and power supplies shall be in accordance with EN 12101 Parts 1 and 2, EN 12101-3 and EN 12101 Parts 7, 8, 9 and 10 respectively. The classes shall be selected from these standards in accordance with the DEP.

The SHEVS shall have a maximum operating time of 120 seconds.

NOTE 1 For automatic smoke barriers deeper than 8 meters, it may take more than 120 seconds to reach the fully deployed position. They shall have at least dropped by 8 meters within the 120 seconds.

NOTE 2 It is recommended that automatic smoke barriers to be controlled at least by smoke detection.

If a component is fitted with more than one initiation device (ie: smoke detection, local push button, thermal device, etc), a defective device shall not prevent the operation to the fire position of the component by any other initiation device.

The sizing of components, including power supplies and lines, shall be calculated such as to meet the needs of the detailed engineering plan and the operating characteristics of the components

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The compatibility of all components of a SHEVS which interact has to be checked, especially input and output characteristics. The effect of lines on input / output characteristics shall be taken into account

Power Supplies shall be rated to meet power needs as defined in the DEP to operate the components of the SHEVS driven from the power supply. This shall include both peak energy supply rate and capacity.

For manual initiation, the power to move the component into the fire position shall not be provided by the operator physically.

A secondary supply shall be provided if the external power moves the component into the fire position. No secondary supply is required if the purpose of the supply is only to reset the system, to hold the system in the standby position or to recharge an internal power supply.

NOTE Nevertheless, a secondary supply may be advisable in any case to avoid nuisance operation of SHEVS components in case of power failure.

5.3 Requirements for smoke layer systems with natural ventilators

Air inlets for natural ventilators shall only be natural. The aerodynamic air inlet area shall be at least 50% more than the aerodynamic free area of the largest smoke zone of the room.

Air inlets have to be installed outside the smoke layer, near the floor.

When installed, reduction of geometric area due to side walls and/or ceiling have to be taken into account.

The installer has to check that no obstacle can affect the operation and the performance of the ventilator into the fire position (curtains, blinds, etc). Instructions shall be given not to install obstacles. Provisions shall be taken not to install obstacles (protection, marking, etc see chapter 8 of this document)

Same applies to natural air inlets with wall mounted ventilators

Systems with wall mounted ventilators shall have the ventilators mounted on at least 2 walls and be equipped with wind direction sensor. In that case, the air inlets shall be also on 2 walls.

When the wind speed is more than 1m/s, only the units on the wall opposite to the incoming wind shall be opened at a time, which implies control of wind direction. See Annex C

Wall mounted ventilators shall not be equipped with thermo devices.

NOTE Therefore smoke detection should be considered.

5.4 Requirements for smoke layer systems with powered ventilators**5.4.1 Requirements for power supplies for powered smoke and heat exhaust ventilation systems**

Each power supply shall provide the power requirements of the highest power rated group of ventilators able to operate together at design duty under ambient conditions.

The power supply to the powered ventilators and to the other components shall be available for the time of fire resistance of the powered ventilators.

Electrical power can be provided either:

- by 2 separate electrical public utility supplies, or
- by electrical public utility and backup power supply (generating plant).

NOTE The safety level to be applied depends on the application of the SHEVS and will be stated by national legislation or the local authorities on a case by case basis.

The electrical power supply to the smoke exhaust ventilation system shall be independent of the supply to the remainder of the construction works from the point of entry into the construction works.

5.4.2 Requirements for powered smoke and heat exhaust systems

Air inlets for powered ventilators can be powered or natural. The incoming airflow rate has to be calculated in relation to the largest smoke zone of the room.

Air inlets have to be installed outside the smoke layer, near the floor.

5.5 Requirements for smoke free area systems by differential pressure

The subject is covered by EN 12101-6

5.6 Requirements for smoke control by air renewal of the room with fresh air by dilution of smoke

These systems are not covered by this standard as these systems are not fixed installed systems.

6 Air Inlet

6.1 General requirements

The type, size, air flow characteristics, location and number of air inlets shall be provided in accordance with the requirements of the DEP

Air inlets may be of the following types:

- a) permanently open inlet openings;
- b) purpose provided inlets;
- c) doors and windows;
- d) natural ventilators in other smoke zones;
- e) a combination of any of a) to d);
- f) Powered inlets.

Replacement air shall not be provided by both natural and powered air inlets in the same room.

Air inlets shall be permanently open or be opened by the initiating devices associated with the SHEVS.

The time from receiving an active or passive signal until the actuator has moved the air inlet to the fire position shall be 60 seconds or less. The air inlet after operation shall remain in the fire position until reset at technical access level.

The manufacturer shall supply with the air inlet, when appropriate:

- installation instructions;
- instructions for use;
- maintenance instructions;