
Smoke and heat control systems —
Part 4:
Natural smoke and heat exhaust
ventilators — Design, requirements
and installation

Systèmes pour le contrôle des fumées et de la chaleur —

Partie 4: Exutoires de fumées et de chaleur naturels —
Dimensionnement, exigences et mise en place





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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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html.

This document 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*.

A list of all parts in the ISO 21927 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

Smoke and heat control systems (SHCS) create and maintain smoke free areas in a construction works by controlling smoke flow 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 (SHEVS) 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 firefighting, 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 any smoke and heat control system are installed as part of a properly designed system.

Smoke and heat control systems help to:

- keep escape and access routes free from smoke;
- facilitate firefighting operations;
- delay and/or prevent flashover and thus full development of a fire;
- protect equipment and furnishings;
- reduce thermal effects on structural components during a fire;
- reduce damage due to thermal decomposition products and hot gases.

Pressure differential systems are used either to positively pressurize spaces separated from the fire or to depressurize the space containing the fire in order to limit or prevent the flow of smoke and heat into adjacent spaces. A typical use would be to pressurize an escape stair well in order to protect vertical means of escape.

Depending on the design of the system, natural or powered smoke and heat ventilators can be used in a smoke and heat control system.

Control equipment is needed in order to control all components in a SHCS, such as:

- natural ventilators;
- powered ventilators;
- smoke barriers;
- smoke dampers;
- air inlets;
- duct sections;
- dampers.

SHCS control equipment can also provide control for day-to-day ventilation and signals to other fire safety equipment under fire conditions.

SHCS control equipment can be for extra-low voltage or low voltage electrical systems or pneumatic systems or any combination thereof.

Power output devices for control equipment are dealt with in ISO 21927-10.

Smoke and heat control systems —

Part 4:

Natural smoke and heat exhaust ventilators — Design, requirements and installation

1 Scope

This document applies to the design and installation of natural smoke and heat exhaust ventilators (NSHEVs) for spaces from which smoke is extracted vertically by thermal buoyancy via the roof in the case of single-storey buildings and via the uppermost storey in the case of multi-storey buildings. It also applies to spaces in which NSHEVs are installed in external walls.

This document includes tables and calculation methods for the design of clear layers in order to comply with the requirements of various protection objectives.

This document includes information and provisions to be taken into account when applying the design rules set out herein and when installing NSHEVs.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 13943, *Fire safety — Vocabulary*

ISO 21927-1, *Smoke and heat control systems — Part 1: Specification for smoke barriers*

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

3 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <https://www.electropedia.org/>
- ISO Online browsing platform: available at <https://www.iso.org/obp>

3.1

aerodynamic free area

measure of smoke and heat exhaust area of the ventilator

Note 1 to entry: It is the geometric area multiplied by the coefficient of discharge.

3.2

automatic activation

initiation of operation without direct human intervention

3.3
coefficient of discharge
aerodynamic efficiency

C_v
ratio of actual flow rate, measured under specified conditions, to the theoretical flow rate through the ventilator

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

3.4
exhaust ventilator

device for the movement of gases out of the construction works

3.5
initiation device

device that activates the operating mechanism of the component, e.g. of a damper or a ventilator, on receipt of information from a fire detection system or thermal device

3.6
smoke and heat exhaust ventilation system
SHEVS

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

3.7
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

4 Symbols and abbreviated terms

Symbol	Definition	Unit
A_a	area of smoke exhaust opening	m^2
A_{fa}	fire area	m^2
A_{in}	area of air inlet	m^2
A_R	area of smoke reservoir	m^2
c_z	factor for determining the area of the air inlet	—
d	height of clear layer	m
h	height of space to be protected	m
H_{sb}	height of smoke barrier	m
z	height of smoke layer ($h - d$)	m

5 Design principles

5.1 General

The design of natural smoke and heat exhaust ventilation systems (see [Figure 1](#)) depends, inter alia, on:

- the rate of energy release;
- the theoretical fire area of a building or the resulting design group;
- the target height of the clear layer; and