



BSI Standards Publication

Smoke and heat control systems

Part 2: Natural smoke and heat exhaust
ventilators

National foreword

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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of an identical text or by endorsement, at the latest by September 2017, and conflicting national standards shall be withdrawn at the latest by December 2018.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.*

According to the CEN/CENELEC Internal Regulations, the national standards organisations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

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)
$I_{u, h_{US}}$	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 thermal initiation device;
- 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;
- a pneumatic initiation device, e.g. a pneumatic signal or a loss of compressed air;
- 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.

- 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.

4.1.1.2 Automatic initiation or release device

Any automatic initiation or release device shall be within the NSHEV and shall be exposed to the hot gas entering the closed NSHEV.

There are two exceptions to this requirement, where an automatic thermal initiation or release device shall not be fitted to the NSHEV.

- a) If the NSHEV is to be installed as a wall mounted NSHEV:

Adverse wind conditions may cause a NSHEV which has been opened by the automatic initiation device to inlet and not remove heat and smoke.

- b) In specific design cases where it is suitable that the NSHEV shall only be manually initiated.

The response behaviour of thermal automatic initiation devices shall be in accordance with the requirements of EN 54-5:2017, 5.4.2 and tested six times under an increasing temperature rate 20 K/min.

The specimen shall be installed in a heat tunnel in its most unfavourable position. The release behaviour for each test shall conform to $(Y + 37) / 0,35 \geq X$ where Y is the nominal operating temperature of the thermal element and X is the release time (s). The static response behaviour of the thermal device shall be measured three times in accordance with the requirements of EN 54-5:2017, 5.3. The nominal release temperature for each test shall not vary by more than -3K to +8K.

Smoke detectors shall comply with the requirements of EN 54-7 and heat detectors with EN 54-5.

4.1.2 Opening mechanism

4.1.2.1 General

The NSHEV shall be provided with an opening mechanism with energy within the NSHEV, (e.g. gas containers, spring systems, electrical power supply) and/or with an external energy source. For the external links the manufacturer of the NSHEV shall specify the operating requirements for the initiation device and the opening mechanism, e.g. voltage, energy.

4.1.2.2 Integral gas containers

Any gas container forming an integral part of the NSHEV shall be equipped with a pressure release device to prevent an explosion if the container overheats. The energy supply shall comply with EN 12101-10.

4.1.3 Inputs and outputs

If the NSHEV is intended to operate with an external energy source it shall be equipped with inputs and/or outputs to allow connection of the NSHEV to the control panel and power supplies in accordance with EN 12101-10.

4.2 Response delay (response time)

4.2.1 Reliability

The NSHEV shall when tested in accordance with Annex C open, i.e. reach its fire open position, within 60 s after actuation.

4.2.2 Opening under (snow/wind) load

Roof mounted NSHEV shall open, reach its fire open position not more than 60 s after actuation and remain in position without an external energy supply (until reset), when tested under the snow load appropriate to its classification and under the specified side wind in accordance with Annex D.

After testing the NSHEV in accordance with Annex F it shall open into the fire open position within 60 s after actuation.

4.2.3 Low ambient temperature

When tested in accordance with Annex E the NSHEV shall open into to the fire open position within 60 s after actuation.

4.2.4 Opening under heat

The NSHEV shall when tested in accordance with Annex G open, i.e. reach its fire open position within 60 s under exposure to heat and to remain in the fire open position with not more than 10 % reduction of the throat area.

4.3 Operational reliability

The NSHEV shall when tested in accordance with Annex C open, i.e. reach its fire open position, within 60 s after actuation without damage and remain in its fire open position without an external energy supply (until reset).

4.4 Effectiveness of smoke/hot gas extraction (aerodynamic free area)

The aerodynamic free area A_a of the NSHEV shall be determined in accordance with Annex B.

Roof mounted NSHEV shall be tested without and with side wind, wall mounted NSHEV may be tested without side wind only.

In order to prevent air from flowing through the NSHEV into the fire room the aerodynamic free area A_a shall be larger than 0 m².

Wind deflectors subjected to atmospheric wind when the NSHEV is in the closed position and forming an integral part of the NSHEV to ensure the determined aerodynamic free area A_a shall be tested in accordance with 4.6.4.

Devices having influence on the aerodynamic performance are integral parts of the NSHEV and shall be installed in accordance with the manufacturer's instructions and shall be tested in accordance with Annex B, whether they are fixed to the NSHEV itself or to the surrounding construction.

When using the simple assessment procedure to determine the aerodynamic free area, see B.1, the side length shall not exceed 2,5 m and the aspect ratio of the geometric area shall not exceed 5:1.

Large area NSHEV may lead to plug holing, i.e. exhaust flows where smoke from the smoke layer and room air are mixed and removed and therefore the removal of smoke is decreased.

4.5 Performance parameters under fire conditions

4.5.1 Resistance to heat

The NSHEV shall open within 60 s under exposure to heat and remain in the fire open position without an external energy supply with not more than 10 % reduction of the throat area when tested in accordance with Annex G.

If the NSHEV shall be installed in a building it shall have – according to national requirements – a minimum class B₃₀₀30.

For NSHEV larger than the largest NSHEV tested in accordance with Annex G an assessment of the heat exposure effect shall be made by the testing station, to ensure that the performance is not negatively affected.

NOTE At present, maximum dimensions of the test apparatus for the heat exposure test are in the range of 4 m.

4.5.2 Mechanical stability

The reduction of the throat area shall not be more than 10 % reduction when tested in accordance with Annex G.

No part or component of the NSHEV shall fall from the NSHEV during the first 6 min of the test.

Devices having influence on the aerodynamic performance are integral parts of the NSHEV and shall be installed in accordance with the manufacturer's instructions and shall be tested in accordance with Annex G whether they are fixed to the NSHEV itself or to the surrounding construction.

4.5.3 Reaction to fire

The reaction to fire shall be classified in accordance with A.5 and tested in accordance with Annex H.

4.6 Performance under environmental conditions

4.6.1 Opening under load

To simulate the side wind influence roof mounted NSHEV shall be subjected, in the most unfavourable wind direction, to a side wind of 10 m/s velocity when tested in accordance with Annex D.

Roof mounted NSHEV shall open, reach its fire open position within not more than 60 s after actuation and remain in position without an external energy supply (until reset), when tested under the snow load appropriate to its classification and under the specified side wind in accordance with Annex D.

For NSHEV fitted with wind deflectors, the deflectors shall not be fitted in such a way to encourage snow or ice to collect to the detriment of the operation of the NSHEV.

4.6.2 Low ambient temperature

When tested in accordance with Annex E the NSHEV shall open into to the fire open position within 60 s after actuation. No such test is necessary for NSHEV classified T(05), see A.6.

Tests shall be conducted with simulated snow load with the classification in accordance with A.6.

4.6.3 Stability under wind load

The NSHEV shall not open at the opening side(s) more than 50 mm (measured at the location of the actuator) under the wind load appropriate to its classification, see A.6, and shall not suffer permanent deformation when tested in accordance with Annex F and following this test shall open into the fire open position within 60 s after actuation.

4.6.4 Resistance to wind-induced vibration

If wind deflectors form an integral part of the NSHEV, their natural frequency of vibration shall be higher than 10 Hz with a logarithmic decrement of damping greater than 0,1 when tested in accordance with F.5.2.

4.6.5 Resistance to heat

The NSHEV shall open within 60 s under exposure to heat and remain in the fire open position with not more than 10 % reduction of the throat area when tested in accordance with Annex G.

If the NSHEV shall be installed in a building it shall have – according to national requirements – a minimum class B₃₀₀30.

4.7 Durability

4.7.1 Response delay (response time)

The durability of NSHEV considering response delay is fulfilled if the fire open position is reached within 60 s after being tested at least 49 times in accordance with Annex C.

4.7.2 Operational reliability

The durability of NSHEV considering operational reliability is fulfilled if the fire open position is reached after being tested at least 49 times in accordance with Annex C.

4.7.3 Performance parameters under fire conditions

The NSHEV is regarded to be durable if after the test in accordance with Annex G the throat area is not reduced by more than 10 % and all parts relevant for the aerodynamic performance of the NSHEV, e. g. filling, wind deflectors and flaps and all structural parts remain in place.

5 Testing, assessment and sampling methods

Test of NSHEV shall be carried out in accordance with Annexes B, C, D, E, F, G and H.

For each test, a test report shall be prepared.

The methods for testing, assessing and sampling for the essential requirements of Clause 4 are:

- For the “nominal activation condition/sensitivity” the presence of the initiation device according to 4.1.1, the “opening mechanism” according to 4.1.2 and “inputs and outputs” according to 4.1.3 shall be checked as present.
- The “response delay (response time)” to be ≤ 60 s shall be tested for reliability according to Annex C, for opening under (snow/wind) load according to Annex D and F, for low ambient temperature according to Annex E and for opening under heat according to Annex G and assessed in accordance with Annex A. The sampling methods are given in the Annexes C, D, E, F, and G.
- The operational reliability shall be tested in accordance with Annex C and assessed in accordance with Annex A. The sampling method is given in Annex C.

Table 1

Reliability classes	No. of Openings into the fire open position
Re 50	50
Re 500	500
Re 1000	1 000
Re A	A

- The effectiveness of smoke/heat gas extraction – aerodynamic free area shall be tested and assessed in accordance with Annex B. The aerodynamic free area A_a shall be larger than 0 m². The sampling method is given in Annex B.
- The performance parameters under fire conditions, resistance to heat and mechanical stability shall be tested and assessed in accordance with Annexes G and A as:

B₃₀₀ 30,

$B_{600}30$,

B_A30 .

and reaction to fire in accordance with Annexes H and A as:

class

The sampling methods are given in Annexes G and H.

- The performance under environmental conditions shall be tested and assessed for the performance under load in accordance with Annexes D and A as:

Table 2

Snow load	Load [Pa]
SL 500	500
SL 1000	1 000
SL 1500	1 500
SL A	A

for the stability under wind load in accordance with Annexes F and A as:

Table 3

Wind load	Load [Pa]
WL 1500	1 500
WL 3000	3 000
WL A	A

for the low ambient temperature in accordance with Annexes E and A as:

T(-25),

T(-15),

T(-05),

T(05),

T A.

and for the resistance to wind induced vibrations in accordance with Annexes F and A as:

natural frequency of vibration ω_0 : > 10 Hz

logarithmic decrement of damping δ : > 0,1

The sampling methods are given in Annexes D, E, and F.

Tests for reliability conducted in accordance to Annex C and for resistance to heat in accordance to Annex G are considered to satisfy the requirements of durability as specified in 4.7.1, 4.7.2 and 4.7.3.

6 Assessment and verification of constancy of performance - AVCP

6.1 General

The compliance of the natural smoke and heat exhaust ventilators (NSHEV) with the requirements of this standard and with the performances declared by the manufacturer in the DoP shall be demonstrated by:

- determination of the product type;
- factory production control by the manufacturer, including product assessment.

The manufacturer shall always retain the overall control and shall have the necessary means to take responsibility for the conformity of the product with its declared performance(s).

6.2 Type Testing

6.2.1 General

All performances related to characteristics included in this standard shall be determined when the manufacturer intends to declare the respective performances unless the standard gives provisions (e.g. use of previously existing data, CWFT and conventionally accepted performance) for declaring them without performing tests.

Assessment previously performed in accordance with the provision of this standard may be taken into account providing that they were made to the same or a more rigorous test method under the same AVCP system on the same product or products of similar design, construction and functionality, such that the results are applicable to the product in question.

NOTE Same AVCP system means testing by an independent third party under the responsibility of a product certification body.

For the purpose of assessment the manufacturer's products may be grouped into families where it is considered that the results for one or more characteristics from any one NSHEV within the family are representative for that same characteristics for all the NSHEV within that family.

Products may be in different families for different characteristics.

Reference to the assessment method standards should be made to allow the selection of a suitable representative sample.

In addition, the determination of the product shall be performed for all characteristics included in the standard for which the manufacturer declares performances:

- at the beginning of the production of a new or modified natural smoke and heat exhaust ventilator (NSHEV) (unless a member of the same family), or
- at the beginning of a new or modified method of production (where this may affect the stated properties); or

they shall be repeated for the appropriate characteristic(s), whenever a change occurs in the natural smoke and heat exhaust ventilator (NSHEV) design, in the raw material or in the supplier of the components, or in the production process (subject to the definition of a family), which would affect significantly one or more of the characteristics.

Where components are used whose characteristics have already been determined by the component manufacturer on the basis of assessment methods of other product standards, these characteristics need not be re-assessed. The specifications of these components shall be documented.

Products bearing regulatory marking in accordance with appropriate harmonized European specifications may be presumed to have the performances declared in the DoP, although this does not replace the responsibility on the NSHEV manufacturer to ensure that the NSHEV is correctly manufactured and its component products have the declared performance values.

6.2.2 Test samples, testing and compliance criteria

The number of samples of NSHEV to be tested / assessed shall be in accordance with Table 4.

Table 4 — Number of samples to be tested and compliance criteria

Characteristic	Requirement	Assessment method	No. of samples	Compliance criteria
Nominal activation conditions/sensitivity, as:				
- Initiation device	4.1.1			4.1.1
- Opening mechanism	4.1.2			4.1.2
- Inputs and outputs	4.1.3			4.1.3
Response delay (response time), as:				
- Reliability	4.2.1	Annex C	cf. Annex C	4.2.1
- Opening under (snow, wind) load	4.2.2	Annex D	cf. Annex D	4.2.2
- Low ambient temperature	4.2.3	Annex E	cf. Annex E	4.2.3
- Opening under heat	4.2.4	Annex G	cf. Annex G	4.2.4
Operational reliability	4.3	Annex C	cf. Annex C	4.3
Effectiveness of smoke/hot gas extraction – aerodynamic free area	4.4	Annex B	cf. Annex B	4.4
Performance parameters under fire conditions, as:				
- Resistance to heat	4.5.1	Annex G	cf. Annex G	4.5.1
- Mechanical stability	4.5.2	Annex G	cf. Annex G	4.5.2
- Reaction to fire	4.5.3	Annex H	cf. Annex H	4.5.3
Performance under environmental conditions, as:				
- Performance under load	4.6.1	Annex D	cf. Annex D	4.6.1
- Low ambient temperature	4.6.2	Annex E	cf. Annex E	4.6.2
- Stability under wind load	4.6.3	Annex F	cf. Annex F	4.6.3
- Resistance to wind-induced vibration	4.6.4	Annex F	cf. Annex F	4.6.4
- Resistance to heat	4.6.5	Annex G	cf. Annex G	4.6.5
Durability, as:				
- Response delay (response time)	4.7.1	Annex C		4.7.1
- Operational reliability	4.7.2	Annex C		4.7.2
- Performance parameters under fire conditions	4.7.3	Annex G		4.7.3

6.2.3 Test sequence

For type testing the sequence of the tests is free except for tests in accordance with Annexes C and D which shall be conducted with the same test specimen in the sequence first C then D.

6.2.4 Test reports

The results of the determination of the product type shall be documented in test reports. All test reports shall be retained by the manufacturer for at least 10 years after the last date of production of the NSHEV to which they relate.

6.2.5 Cascading determination of the product type results

For some construction products, there are companies (often called “system houses”) which supply or ensure the supply of, on the basis of an agreement¹⁾, some or all of the components (e.g. in case of windows: profiles, gaskets, weather strips)²⁾ to an assembler who then manufactures the finished product (referred to below as the “assembler”) in his factory.

Provided that the activities for which such a system house is legally established include manufacturing/assembling of products as the assembled one, the system house may take the responsibility for the determination of the product type regarding one or several essential characteristics of an end product which is subsequently manufactured and/or assembled by other firms in their own factory.

When doing so, the system house shall submit an “assembled product” using components manufactured by it or by others, to the determination of the product type and then make the determination of the product type report available to the assemblers, i.e. the actual manufacturer of the product placed on the market.

To take into account such a situation, the concept of cascading determination of the product type might be taken into consideration in the technical specification, provided that this concerns characteristics for which either a notified product certification body or a notified test laboratory intervene, as presented below.

The determination of the product type report that the system house has obtained with regard to tests carried out by a notified body, and which is supplied to the assemblers, may be used for the regulatory marking purposes without the assembler having to involve again a notified body to undertake the determination of the product type of the essential characteristic(s) that were already tested, provided that:

- the assembler manufactures a product which uses the same combination of components (components with the same characteristics), and in the same way, as that for which the system house has obtained the determination of the product type report. If this report is based on a combination of components not representing the final product as to be placed on the market, and/or is not assembled in accordance with the system house’s instruction for assembling the components, the assembler needs to submit his finished product to the determination of the product type;
- the system house has notified to the manufacturer the instructions for manufacturing/assembling the product and installation guidance;
- the assembler (manufacturer) assumes the responsibility for the correct assembly of the product in accordance with the instructions for manufacturing/assembling the product and installation guidance notified to him by the system house;

1) This can be, for instance, a contract, license or whatever kind of written agreement, which should also contain clear provisions with regard to responsibility and liability of the component producer (system house, on the one hand, and the assembler of the finished product, on the other hand).

2) These companies may produce components but they are not required to do so.

- the instructions for manufacturing/assembling the product and installation guidance notified to the assembler (manufacturer) by the system house are an integral part of the assembler's Factory Production Control system and are referred to in the determination of the product type report;
- the assembler is able to provide documented evidence that the combination of components he is using, and his way of manufacturing, correspond to the one for which the system house has obtained the determination of the product type report (he needs to keep a copy of the system house's determination of the product type report);
- regardless the possibility of referring, on the basis of the agreement signed with the system house, to the latter's responsibility and liability under private law, the assembler remains responsible for the product being in compliance with the declared performances, including both the design and the manufacture of the product, which is given when he affixes the regulatory marking on his product.

6.3 Factory production control

6.3.1 General

The manufacturer shall establish, document and maintain an FPC system to ensure that the NSHEV placed on the market comply with the declared performance of the essential characteristics.

The FPC system shall consist of procedures, regular inspections and tests and/or assessments and the use of the results to control raw and other incoming materials or components, equipment, the production process and the product.

All the elements, requirements and provisions adopted by the manufacturer shall be documented in a systematic manner in the form of written policies and procedures. This factory production control system documentation shall ensure a common understanding of evaluation of the constancy of performance and enable the achievement of the required product performances and the effective operation of the production control system to be checked.

Factory production control therefore brings together operational techniques and all measures allowing maintenance and control of the compliance of the product with the declared performances of the essential characteristics.

In case the manufacturer has used cascading product type results, the FPC shall also include the appropriate documentation as foreseen in 6.2.5.

6.3.2 Requirements

6.3.2.1 General

The manufacturer is responsible for organizing the effective implementation of the factory production control system in line with the content of this product standard. Tasks and responsibilities in the production control organization shall be documented and this documentation shall be kept up-to-date.

The responsibility, authority and the relationship between personnel that manages, performs or verifies work affecting product constancy, shall be defined. This applies in particular to personnel that need to initiate actions preventing product non-conformities from occurring, actions in case of non-conformities and to identify and register product constancy problems. Personnel performing work affecting the constancy of performance of the product shall be competent on the basis of appropriate education, training, skills and experience for which records shall be maintained.

In each factory the manufacturer may delegate the action to a person having the necessary authority to:

- identify procedures to demonstrate conformity of the product at appropriate stages;
- identify and record any instance of non-conformity;

- identify procedures to correct instances of non-conformity.

The manufacturer shall draw up and keep up-to-date documents defining the factory production control. The manufacturer's documentation and procedures should be appropriate to the product and manufacturing process. All FPC systems should achieve an appropriate level of confidence in the constancy of the product. This involves:

- a) the preparation of documented procedures and instructions relating to factory production control operations, in accordance with the requirements of the technical specification to which reference is made;
- b) the effective implementation of these procedures and instructions;
- c) the recording of these operations and their results;
- d) the use of these results to correct any deviations, to repair the effects of such deviations, to treat any resulting instances of non-conformity and, if necessary, to revise the FPC to rectify the cause of non-constancy of performance.

Where subcontracting takes place, the manufacturer shall retain the overall control of the product and ensure that he receives all the information that is necessary to fulfil his responsibilities in accordance with this European Standard.

If the manufacturer has part of the product designed, manufactured, assembled, packed, processed and/or labelled by subcontracting, the FPC of the subcontractor may be taken into account, where appropriate for the product in question. The manufacturer who subcontracts all of his activities may in no circumstances pass these responsibilities on to a subcontractor.

NOTE Manufacturers having a FPC system, which complies with EN ISO 9001 and which addresses the provisions of this European standard are recognized as satisfying the FPC requirements of Regulation (EU) No 305/201.

6.3.2.2 Equipment

6.3.2.2.1 Testing

All weighing, measuring, and testing equipment shall be calibrated and regularly inspected in accordance with documented procedures, frequencies and criteria.

6.3.2.2.2 Manufacturing

All equipment used in the manufacturing process shall be regularly inspected and maintained to ensure use, wear, or failure does not cause inconsistency in the manufacturing process. Inspections and maintenance shall be carried out and recorded in accordance with the manufacturer's written procedures and the records retained for the period defined in the manufacturer's FPC procedures.

6.3.2.3 Raw materials and components

The specifications of all incoming raw materials and components shall be documented, as shall the inspection scheme for ensuring their compliance. In case supplied kit components are used, the constancy of performance system of the component shall be that given in the appropriate harmonized technical specification for that component.

6.3.2.4 Traceability and marking

The NSHEV shall be identifiable and traceable with regard to their production origin. The manufacturer shall have written procedures ensuring that processes related to affixing traceability codes and/or markings are inspected regularly.

6.3.2.5 Controls during manufacturing process

The manufacturer shall plan and carry out production under controlled conditions.

The factory production control system shall document the various stages in the production of products; identify the checking procedure and those individuals responsible for all stages of production.

During the production process itself, a record shall be kept of all checks, their results, and any corrective actions taken. This record shall be sufficiently detailed and accurate to demonstrate that all stages of the production phase, and all checks, have been carried out satisfactorily.

6.3.2.6 Product testing and evaluation

The manufacturer shall establish procedures to ensure that the stated values of the characteristics he declares are maintained.

6.3.2.7 Non-complying products

The manufacturer shall have written procedures which specify how non-complying products shall be dealt with. Any such events shall be recorded as they occur and these records shall be kept for the period defined in the manufacturer's written procedures.

Where the product fails to satisfy the acceptance criteria, the provisions for non-complying products shall apply, the necessary corrective action(s) shall immediately be taken and the products or batches not complying shall be isolated and properly identified.

Once the fault has been corrected, the test or verification in question shall be repeated.

The results of controls and tests shall be properly recorded. The product description, date of manufacture, test method adopted, test results and acceptance criteria shall be entered in the records under the signature of the person responsible for the control/test.

With regard to any control result not meeting the requirements of this European standard, the corrective measures taken to rectify the situation (e.g. a further test carried out, modification of manufacturing process, throwing away or putting right of product) shall be indicated in the records.

6.3.2.8 Corrective action

The manufacturer shall have documented procedures that instigate action to eliminate the cause of non-conformities in order to prevent recurrence.

6.3.2.9 Handling, storage and packaging

The manufacturer shall have procedures providing methods of product handling and shall provide suitable storage areas preventing damage or deterioration.

6.3.3 NSHEV specific requirements

The FPC system shall address this European Standard and ensure that the NSHEV placed on the market comply with the declaration of performance.

The FPC system shall include a product specific FPC, which identifies procedures to demonstrate compliance of the NSHEV at appropriate stages, i.e.:

- a) the controls and tests to be carried out prior to and/or during manufacture according to a frequency laid down in the FPC test plan, and/or
- b) the verifications and tests to be carried out on finished NSHEV according to a frequency laid down in the FPC test plan.

If the manufacturer uses only finished products, the operations under b) shall lead to an equivalent level of compliance of the product as if FPC had been carried out during the production.

If the manufacturer carries out parts of the production himself, the operations under b) may be reduced and partly replaced by operations under a). Generally, the more parts of the production that are carried out by the manufacturer, the more operations under b) may be replaced by operations under a).

In any case the operation shall lead to an equivalent level of compliance of the product as if FPC had been carried out during the production.

NOTE Depending on the specific case, it can be necessary to carry out the operations referred to under a) and b), only the operations under a) or only those under b).

The operations under a) refer to the intermediate states of the product as on manufacturing machines and their adjustment, and measuring equipment, etc. These controls and tests and their frequency shall be chosen based on product type and composition, the manufacturing process and its complexity, the sensitivity of product features to variations in manufacturing parameters, etc.

The manufacturer shall establish and maintain records that provide evidence that the production has been sampled and tested. The product description, date of manufacture, test method adopted, test results and acceptance criteria shall be entered in the records under the signature of the person responsible for the control/test. These records shall show clearly whether the production has satisfied the defined acceptance criteria and shall be available for at least three years.

6.3.4 Initial inspection of factory and FPC

Initial inspection of factory and of FPC shall be carried out when the production process has been finalized and in operation. The factory and FPC documentation shall be assessed to verify that the requirements of 6.3.2 and 6.3.3 are fulfilled.

In the inspection it shall be verified:

- a) that all resources necessary for the achievement of the NSHEV characteristics included in this European Standard are in place and correctly implemented, and
- b) that the FPC-procedures in accordance with the FPC documentation are followed in practice, and
- c) that the NSHEV complies with the product type samples, for which compliance of the performance to the DoP has been verified.

All locations where final assembly or at least final testing of the relevant product is performed shall be assessed to verify that the above conditions a) to c) are in place and implemented. One visit may cover one or more NSHEV, production lines and/or production processes.

If the FPC system covers more than one product, production line or production process, and it is verified that the general requirements are fulfilled when assessing one product, production line or production process, then the assessment of the general requirements does not need to be repeated when assessing the FPC for another product, production line or production process.

All assessments and their results shall be documented in the initial inspection report.

6.3.5 Continuous surveillance of FPC

Surveillance of the FPC shall be undertaken once a year.

The surveillance of the FPC shall include a review of the test plan(s) and production processes for each product to determine if any changes have been made since the last assessment or surveillance and the significance of any changes shall be assessed.