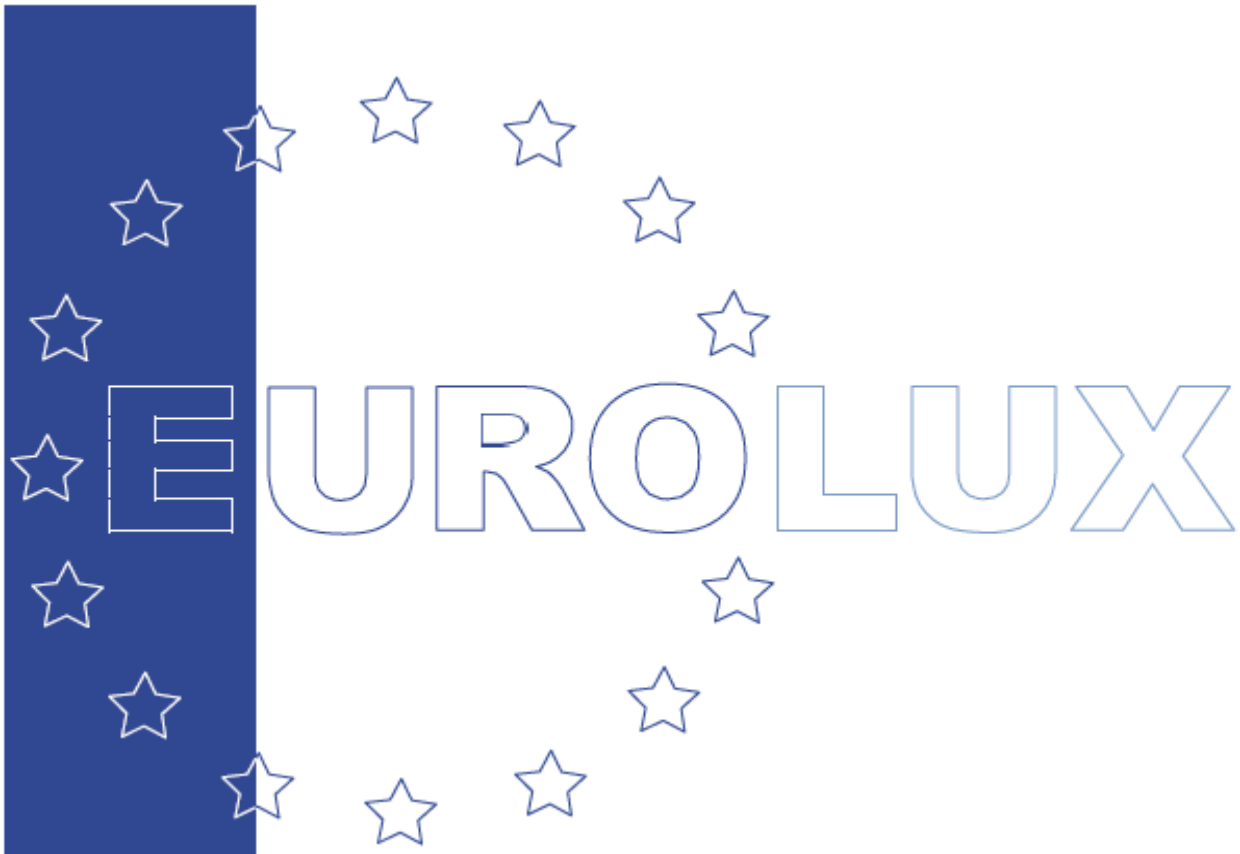

GUIDELINE 02

Maintenance of Natural Smoke and Heat Exhaust Ventilation Systems (NSHEVS)

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EUROLUX

Maintenance of Natural Smoke and Heat Exhaust Ventilation Systems (NSHEVS)

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Contents

Foreword

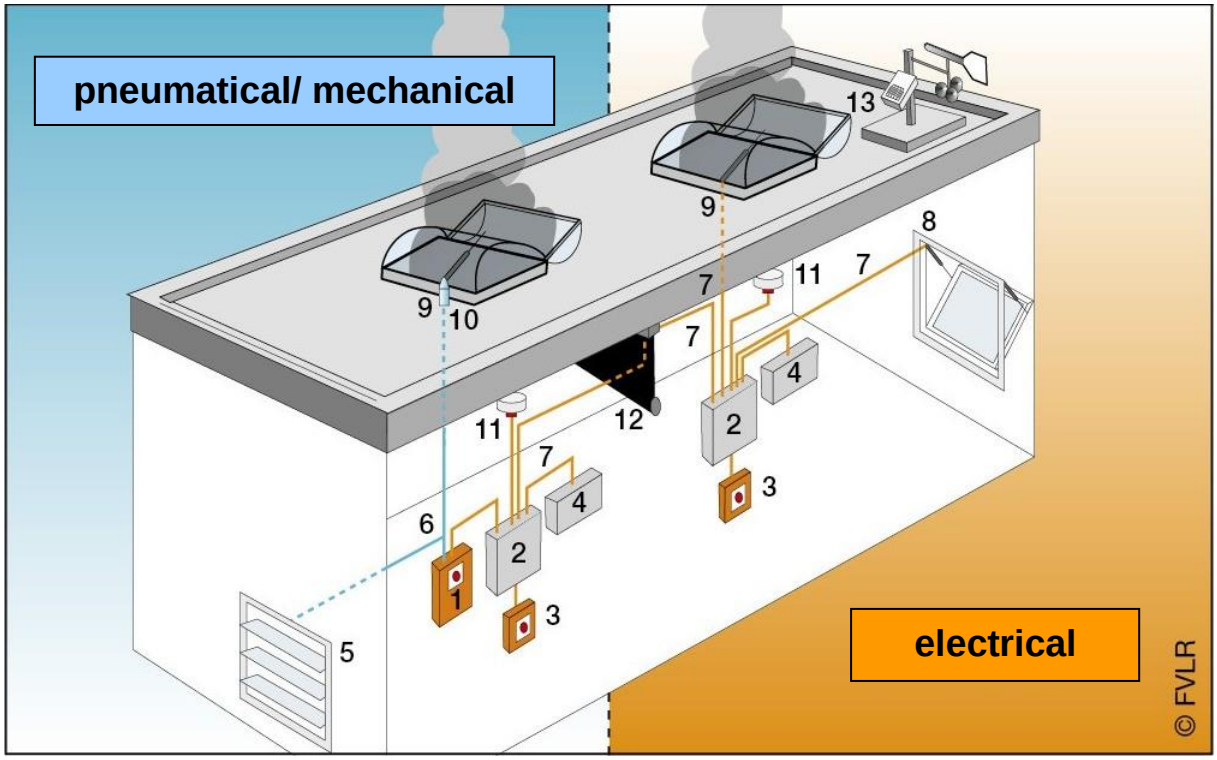
A Natural Smoke and Heat Exhaust Ventilation System (NSHEVS) is a system of safety equipment, intended to perform a positive role in the event of a fire, which creates and maintains a smoke free layer above the floor by exhausting smoke and hot gases to the outside.
Their value in assisting in the evacuation of people from buildings and other construction works, reducing fire damage and financial loss by preventing smoke damage, facilitating access for fire fighting 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 NSHEVS operate correctly and reliably whenever called upon to do so during the working life.
This objective requires:

- NSHEVS designed and installed in accordance with standards and regulations,
- A regular and proper control and maintenance of this sleeping installed safety system.

The responsibility of these two requirements is a duty of the owner, occupier and/or operator in accordance with the relevant laws, regulations, policies and clauses.
When these requirements are neglected, the owner, occupier and/or operator risks the danger of fines and plant closure with the possibility of prosecution after a possible fire incident caused by the failure of the NSHEVS.
The sole lack of maintenance and/or improper operations can also cause the loss of warranty and increase the responsibility of the owner, occupier and/or operator.
EUROLUX has prepared this guideline to present all relevant issues based on the latest experience of the main European companies operating in this field.

The essential components of NSHEVS are listed in the following table for two example solutions (see Figure 1).

System overview: NSHEVS



Key:

1	Pneumatic control unit with manual activation and compressed gas container (CO_2) or Mechanical control unit with manual activation unit (winch) or Emergency Release Box or Manual Control Device
2	Electric control unit with back-up power supply
3	Manual initiation device, electronic (emergency release switch)
4	External control or transmission of information (optional)
5	Air inlet, pneumatic, electric or manual (optionally operated automatically)
6	Control line (pneumatic) or cable control line (mechanical)
7	Control line (electric)
8	Air inlet, operated by an electric or pneumatic motor (optionally automatically)
9	NSHEVS, pneumatic drive or electric drive/motor and/or instored energy
10	Fire detection device, pneumatic (thermal release link) with compressed gas container (CO_2)
11	Electronic fire detection device (smoke detector)
12	Smoke barrier (if required retractable version)
13	Wind and rain detector

Figure 1: System diagram NSHEVS (left pneumatic/mechanical system, right electric system)

1 Scope

This guideline sets requirements and detailed instructions for the operation, control and maintenance of an installed NSHEV Systems:

- Document references
- Frequency of surveillance, routine control, preventive and corrective maintenance,
- Operating instructions
- Suitable spare parts
- Competence of the maintenance organization and staff.

All information is independent of systems and manufacturers.

2 Normative References

EN 1873, Prefabricated accessories for roofing - Individual rooflights of plastics - Product specification and test methods

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

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

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

EN 14963, Roof coverings - Continuous rooflights of plastics with or without upstands - Classification, requirements and test methods

CEA 4020 (en), Natural Smoke and Heat Exhaust Ventilation Systems (NSHEVS), Planning and Installation

3 Definitions and Abbreviations

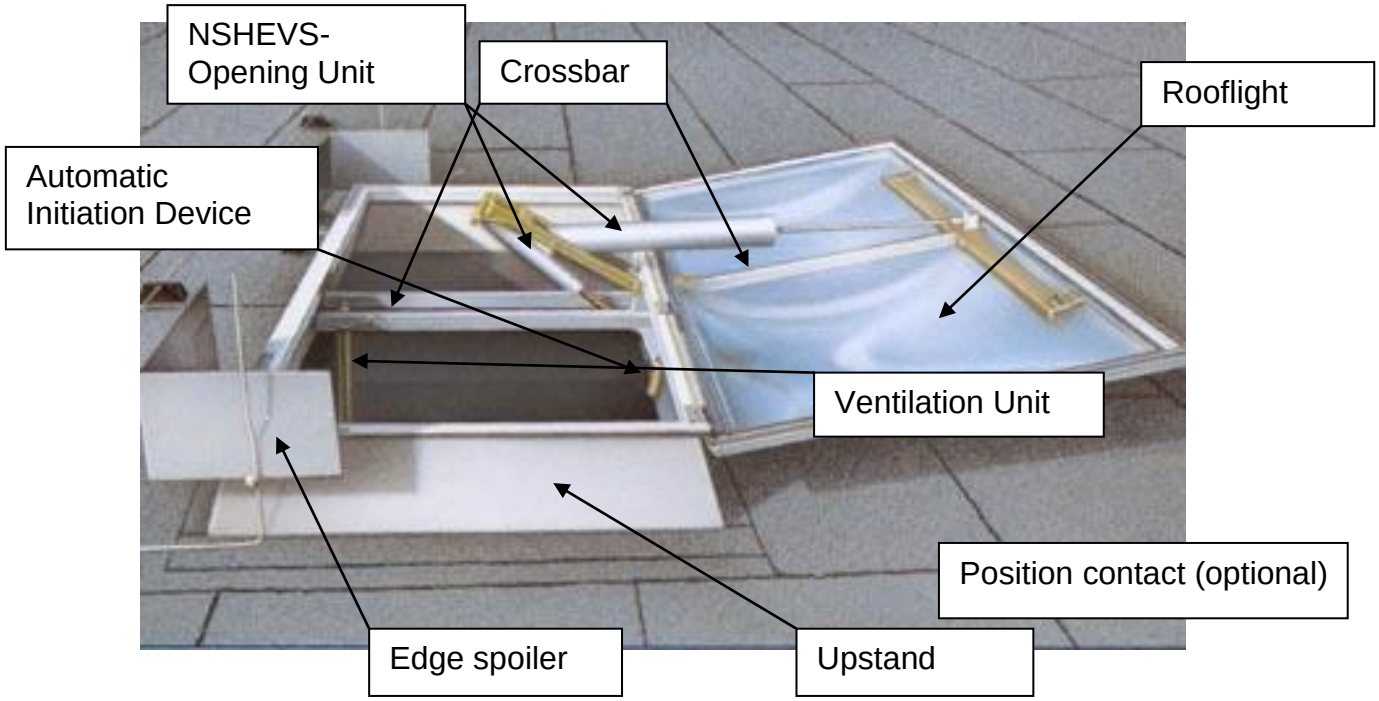


Figure 2: Exemplary exposition for a NSHEVS integrated into an individual rooflight

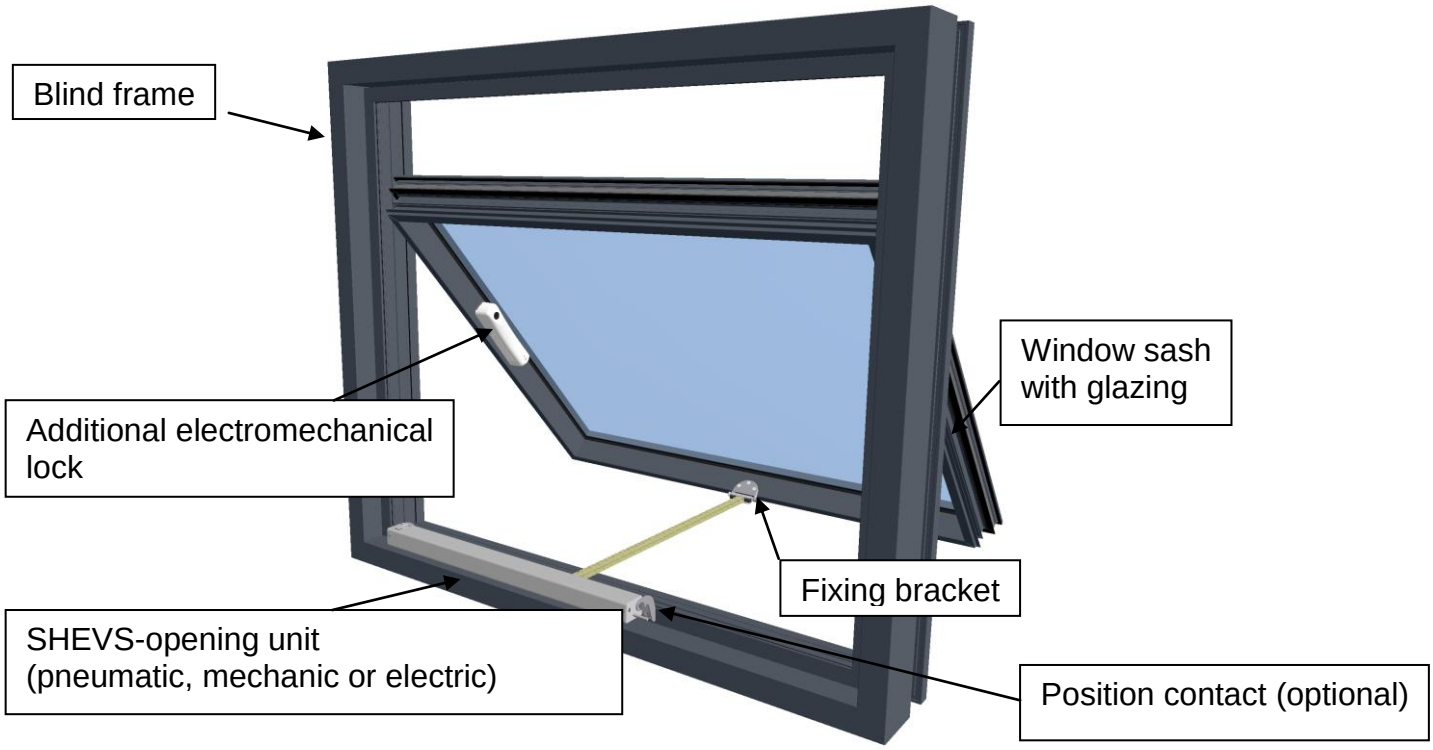


Figure 3: Exemplary exposition for a NSHEVS integrated into a window

3.1 Fixed element of the NSHEVS

The fixed element of the NSHEVS may be upstand and/or frame necessary for the connection to the building (roof or wall)

3.2 Upstand

element, part of the NSHEV, which can be single or multi-walled or composite with vertical and/or pitched walls; with or without thermal insulation and having the dual purpose of providing an area for fixing the NSHEV and for connection to the substructure, the roof covering or the roof sealing. The upstand transmits the loads acting upon NSHEVS into the substructure.

Upstands acting as a support for waterproofing membranes are usually built in galvanized steel sheets or protected against corrosion. Different materials (PVC, wood, …) can be used if in accordance with the CE marked product.

Upstands have to be interdependent with ribbed steel sheets.

3.3 Movable element/s of the NSHEVS

Flap/s linked to the fixed element by hinges to close the NSHEVS in the waiting position and able to open into the fire open position or into the day to day ventilation position as required.

3.4 Opening mechanism

Mechanical device which operates the NSHEVS to the fire open position.

This device can be oleo pneumatic, pneumatic, mechanical (spiral spring) or electric.
Opening mechanism includes crossbar, console, actuators (cylinder, electric motor), springs, valves, etc. necessary to connect the fixed element to movable element of the NSHEVS.

3.5 Accessories

- Wind deflectors (edge spoilers or smoke-shield plates) improving the aerodynamic performance,
- additional actuators (usually electric motors) used for day to day ventilation,
- any other additional device, if included in the CE marked product.

Accessories can't be added to or eliminated from the CE marked NSHEVS without a new assessment by the manufacturer.

3.6 Automatic Initiation Device

Device which automatically activates the operation of the NSHEVS on detection of a threshold value being exceeded (e. g. smoke gas concentration or temperature).
The signal may come from a fire detection system (smoke or heat detector) or thermal device
Thermal devices installed within the NSHEVS can be:

- a thermo-fuse and a CO_2-container,
- a graded eutectic fuse.

3.7 Fixing Bracket

Component to lock the NSHEVS opening mechanism in the waiting position.

3.8 Operator

The person that is authorized to operate the NSHEVS in accordance with this guideline.

3.9 Instructed technician

The instructed technician is a person trained on:
- Technical details of the specific components constituting the natural smoke exhaust installation he works on.
- Regulation requirements that the building is subjected to.

Also, he shall have the competence to appreciate consequences of his actions on the installation or the components he works on. This technician is qualified and authorized by his employer.

3.10 Lock

Locking device electromechanically, pneumatically or mechanically controlled retaining the NSHEVS in the waiting position of safety.

3.11 Surveillance

Visual inspection suitable to verify that the components and NSHEVS under the normal operational conditions, are unobstructed and in full working order through visual examination.
The Surveillance can normally be carried out by the personnel occupying the premises after having received suitable instructions.

3.12 Routine control/functional test

A regular test to ensure that the product and/or system works with the same level of performance as the time of its installation.

3.13 Preventive maintenance

Maintenance operations executed at specified periods or condition-based in order to reduce the probability of failure or deterioration during the functioning of a system.

3.14 Corrective maintenance

Maintenance operations executed after detection of a failure in order to return conditions to a fully functioning system.

3.15 Manual trigger

Unit to activate a NSHEVS manually in case of fire.

Also called
- alarm box,
- control panel,
- emergency release station or

- emergency release box.

Usually the manual trigger consists of a body, in which a power supply (e. g. in terms of a CO_2-cylinder) and a verification mechanism to activate the NSHEVS is stored.
This mechanism can be released by a steel cable, electrically or pneumatically.

NSHEVS that belong to the same group can be activated group wise by a manual trigger.
The location of the manual trigger is clearly marked (see annex for indicator plate) and access for service is constantly kept free.

3.16 Ventilation Unit

It is an optional device in the natural smoke exhaust installation to allow ventilation of parts of the building using the NSHEV installation. It can be with a cable and a crank, electric or pneumatic. The fire function always has priority to this comfort option.

3.17 NSHEVS

Abbreviation for Natural Smoke and Heat Exhaust Ventilation System

3.18 NSHEV

Abbreviation for Natural Smoke and Heat Exhaust Ventilation

3.19 NSHEV-Opening Unit

Power-operated device for opening the outer cover or shutter blades or similar of a NSHEV; usually pneumatic cylinders (with and without end position locking) or electric motors (24 V, 48 V or 230 V, partly self-locking latch through the drive) are used.

3.20 Smoke Barrier

Component installed in the ceiling to form a smoke reservoir.
Smoke barriers divide a room into different sections of smoke compartments (smoke reservoirs). Such sections should not be larger than 1.600 m². Smoke barriers can technically be built by architectural structures (e. g. on-site binders, girders, beams) or by roll-off blinds. If it is movable, it shall conform to the EN 12101-1.

NOTE: Smoke Barriers may also be referred to as smoke curtains, smoke blinds or smoke screens.

3.21 SHEVS

Abbreviation for Smoke and Heat Exhaust Ventilation System

3.22 Transmission/ Communication Path

Pipes, electric wires, steel cables or other connections used for power transmission, function monitoring or controlling of components of a NSHEVS.

3.23 HEVS

Abbreviation for Heat Exhaust Ventilation System

3.24 Servicing

All measures to maintain or return the NSHEVS in full operational condition.

3.25 Air inlet

Opening, either fixed or operable, connected to outside air to allow the inlet of air from outside the building.

Air inlets are necessary for the correct operation of the natural heat and smoke exhaust system and shall be arranged in the lower outer wall of a building or a room. It can be achieved by opening systems within the façade or the outer doors of the building.

3.26 NHEVS condition

3.26.1 Standby condition

Status of the NSHEVS and control system under normal conditions when there is no fire indication, fault or damage recorded.

3.26.2 Fire position

Status of the NSHEVS to be reached after the detection of the fire and maintained while the NSHEVS is venting smoke and heat.

3.26.3 Fault condition

Status of the NSHEVS indicated by the control system requiring the intervention of the operator or qualified technician to clear or repair the fault and return the system to standby condition.

3.26.4 Damage condition

Status of the NSHEVS identified when undertaking surveillance or routine control which will require maintenance/repair.

4 Principles

4.1 Structure of a NSHEVS

4.2 General

All components of a NSHEVS shall be controlled, tested and maintained regularly.

Frequency of visits and routine maintenance requirements are defined by the manufacturers Operation and Maintenance Manuals. The frequency of visits will not be more than one year.

A biannual correct functioning test is recommended by the authors of this guideline.

All components of a natural smoke and heat exhaust ventilation system shall be tested together.

Recommended intervals are indicated in par. 4.4.
Operation and maintenance shall follow the national regulations.

4.3 Principles of maintenance

For proper maintenance, the following principles shall be observed:

a) NSHEV

- Inspection of all units belonging to the NSHEV for problems, security, obvious damage or defects.
- Check on possibility to reach the fire position with conditions defined by the manufacturer (absence of obstruction, reduction of the opening stroke…).
- Operation of the visual and audible, normal operating and fault indications.
- Respect of the control and maintenance frequency.

b) Control lines

- The condition of control lines and their connections shall be examined (mountings, corrosion, leaks, protection, security, etc.).

c) Manual trigger

- Functional tests shall be undertaken with the designed actuation system. In the case of systems with single-use CO_2-cylinders, they will have to be renewed with identical CO_2-replacement-cylinders.
- In the case of remote control, the system has to be tested from the central control panel (CMSI).
- Signalling and access to manual triggers must be kept clear by the building owner or user at all times.

d) Smoke barriers

e) Air inlet

f) Global smoke exhaust system

a. General principles

1. All NSHEV installations including the opening units, the power sup-ply, control system and accessories shall all be serviced and tested in accordance with the manufacturer's instructions to ensure correct and reliable operation at least once a year. Any repairs identified should be carried out at the same time.

2. For particularly dirty, dusty sites or with corrosive/aggressive atmospheres the maintenance intervals should be reduced accordingly.

3. All operations (control and maintenance) can only be performed by qualified technicians having preventive maintenance task list to follow and a stock of spare parts for corrective maintenance.

4. The replacement of damaged parts has to be done with identical correctly sourced parts

5. Since maintenance is usually performed on the roof or at high level, the relevant safety precautions to comply with the relevant working at height regulations shall be observed.

b. Traceability

1. When the qualified technician takes over responsibility for an installation, he has to verify that the installation is in accordance with its Operation and Maintenance manual.

2. Keep a record of any work done and actions to do in an activity log book and, if it exists, on a safety log book.

3. Any modification of an existing installation must be recorded as an alteration in the Operation and Maintenance manual.

4.4 Phases and periodicity

Phase	Frequency and Circumstances	Qualification
Initial verification	At the handover of the maintenance of a NSHEVS by a new servicer	Competent and instructed body
Surveillance	Always by the owner of the NSHEVS	
Routine control	Max 6 months	Competent and instructed body
Preventive maintenance	Max 12 months	Competent and instructed body
Corrective maintenance	When required	Competent and instructed body

NOTE: In case of modification of the activity a general verification carried out in accordance with the operations of the initial verification and of the periodical control allows the evaluation of any adjustments necessary. The same procedure can be used for restoring a NSHEVS after a fire.

Table 1: Maintenance planning

4.5 NSHEVS documentation

Any NSHEVS shall have an Operation and Maintenance Manual with at least the following information:

- as-built drawing including a list of the NSHEVs,
- data sheet for all components (NSHEV, smoke barriers, air inlets, control panels, power supplies, etc.),
- Activity log book to record the test results and all maintenance operations.

5 Maintenance

The activities listed here represent a basic overview. For individual cases, it is the responsibility of the manufacturer and installer to provide this information.

Action	Task	Intervention type	
		Routine control	Preventive maintenance
Natural smoke and heat exhaust ventilation systems (NSHEVS)			
Plant identification and Documentation			
Observation	Identification, marking, label, certification mark Check if correct and present	X	X
Observation	Check if relevant manufacturer's requirements for maintenance are available	X	X
Action	Maintenance book (check and complete)		X
Common measures for all NSHEVs			
Observation	NSHEVs and translucent part integrity	X	X
Observation	Absence of obstruction during opening and closing	X	X
Observation	General condition of the support	X	X
Observation	Mounting of components	X	X
Visual inspection	General condition of the NSHEVs	X	X
Visual inspection	Settings, hinges, seals of the NSHEVs		X
Visual inspection	Automatic Initiation Device (input and heat-sensitive device)		X
Tests	Functioning and validation of the available	X	X
Tests	Security after closing	X	X
Action	Cleaning to optimize functioning		X
Action	Lubrication of movable components		X
Particular measures for NSHEVs with stored energy			
Visual inspection	Condition and mounting way of gas springs		X
Visual inspection	Condition of return pulleys	X	X

Action	Task	Intervention type	
		Routine control	Pre-ventive mainte nance
Wind deflector/edge spoiler			
Observation	Presence	**X**	
Observation	Absence of obstruction for opening and closing	**X**	
Action	Retighten connections		**X**
Control line			
Common measures for all control lines			
Observation	Integrity		**X**
Observation	Good condition		**X**
Observation	Integrity of existing mechanical protections		**X**
Observation	Bending of pneumatic connections, corrosion, settings, cables, pulleys, tightening of cable clamps, presence of mechanical protections for access level 0		**X**
Particular measures for mechanical control lines			
Visual inspec-tion	Protections, settings, implementation heights, cables lengths, pulleys number, etc.	**X**	
Observation	Appropriateness between the cable and pulleys	**X**	
Visual inspec-tion	Cable not damaged, cut or frayed	**X**	
Particular measures for pneumatic control lines			
Action	Tightness test of network		**X**
Inspection	Components: tubes, connections		**X**
Particular measures for electric control lines			
Inspection	Connections		**X**
Inspection	Type and quality of conductors: absence of oxidation trace on connections, condition of cables insulation, marks		**X**
Common measures for all control units and adapted control devices			
Test	Control units shall be tested over a full operational cycle	**X**	
Observation	Integrity of control device and adapted control device		**X**

Action	Task	Intervention type	
		Routine control	Pre-ventive mainte nance
Observation	Accessibility of all control units/devices	**X**	
Observation	Good general condition of supports		**X**
Observation	Good settings of components		**X**
Test	Functioning of control units after triggering	**X**	
Visual inspec-tion	General conditions (corrosion, setting, positioning, me-chanical protection, etc.)	**X**	
Action	Maintenance and servicing operation in accordance with the specification sheets from the manufacturer		**X**
Common measures for all adapted control devices, manual control devices, grouped manual control devices			
Visual inspec-tion	Integrity of seal and check sticker, if existing, with using of information		**X**
Test	Manual triggering	**X**	
Common measures for all adapted control devices			
Test	Control / remote. If possible, tests to coordinate with cen-tral control panel (CMSI) tests	**X**	
Observation	Presence of manufacturer's labels		**X**
Action	Removing of dust, cleaning of electromagnetic trigger's plates in accordance with the manufacturer's instructions		**X**
Test	Rearming	**X**	
Particular measures for all mechanical adapted control devices, mechanical manual control de-vices			
Observation	Cables correctly rolled up	**X**	
Particular measures for all pneumatic adapted control devices, manual control devices and grouped manual control devices			
Observation	Nominal pressures declared between control device and NSHEVS	**X**	
Observation	Correct functioning of exhaust in case of pneumatic rearm-ing and/or operation of comfort ventilation	**X**	
Observation	Integrity of percussion needle		**X**

Action	**Task**	**Intervention type**	
		Routine control	**Pre-ventive mainte nance**
Test	Comfort ventilation functions if present Position check to ensure that it cannot be overridden closed when activated to the fire position	**X**	
Observation	Adequacy between CO_2 containers spare parts and instal-lation specifications	**X**	**X**
Action	Every 10 years eventually test the whole system in ac-cordance with the manufacturer's instructions		**X**
Particular measures for all electric adapted control devices, manual control devices and grouped manual control devices			
Visual inspec-tion	Conditions of cables and connections		**X**
Test	Measurement of control voltage (output of source)		**X**
Test	Validation of input voltages : power supply, command input for adapted control devices	**X**	
Test	Transfers of position controls for control devices with sig-nalling	**X**	
Test	Comfort ventilation functions if provided.	**X**	
Test	Operation to fire position with batteries / backup	**X**	
Measures for emergency power supplies			
Common measures for all electrical back up power supplies			
Action	Batteries shall be replaced like for like after a maximum of 4 years after commissioning		**X**
Observation	Right battery voltage during charging	**X**	
Observation	Right battery voltage with the charger disconnected and after 1 hour of discharge	**X**	
Observation	Battery condition (distortion, corrosion, electrolyte, leaks, etc.)	**X**	
Inspection	Fuses and circuit breakers	**X**	
Inspection	Loose connections	**X**	

Action	Task	Intervention type	
		Routine control	Pre-ventive mainte nance
Common measures for all pneumatic power supplies			
Inspection	Characteristics and correct calibration of back-up devices during triggering / supply of NSHEVS or corresponding pneumatic backup supplies		**X**
Observation	Links / connections inside the building or well-protected against frost	**X**	**X**
Observation	Existence and conditions of mechanical protections with access level 0	**X**	
Observation	Conditions of mechanical links (impacts, chemical reaction, etc.)		
Particular measures for single-use pneumatic emergency power supplies			
Observation	Pressures for emergency operation and consistency of results with pressures calculated during commissioning	**X**	
Test	NSHEVS and single-use pneumatic emergency supplies have the same weight as when new	**X**	
Observation	Correct weight of CO_2 containers in the vent and any spares in stock (CO_2 mass shall not be less than 90% of original net mass)	**X**	
Action	Replacement of single-use pneumatic back up power sup-plies older than 10 years		
Particular measures for permanent-use pneumatic back up power supplies			
Observation	Pressure (between value and maximum assigned)	**X**	
Observation	Capacity remaining in the reservoir is sufficient to operate the system	**X**	
Observation	Correct functioning of signalling unit	**X**	
Observation	Switching between normal supply and back up supply	**X**	
Action	Drain all filters to clear the system of any water and/or oil		**X**
Particular measures for limited-use pneumatic back-up power supplies			
Observation	Pressure (between value and maximum assigned)	**X**	
Observation	Capacity remaining in the reservoir is sufficient to operate the system	**X**	
Observation	Correct local signalling of supply condition	**X**	

Action	Task	Intervention type	
		Routine control	Pre-ventive mainte nance
Action	Capacity remaining in the reservoir is sufficient to operate the system to the fire position 3 times, including intermediate resetting if necessary.		X
Smoke barriers			
	Check operation by all methods of activation (manual, automatically, foreign, etc.)	X	
	Check for dirt, damage, corrosion and fastening from the outside (body, cloth)	X	
	Fixing of the cloth on the roll shaft and behaviour when unrolling	X	
	Clamping force	X	
	Extreme position and end strip	X	
	Check electrical wiring to the drive motors, etc. for damage.	X	
Common measures for all air inlets			
Observation	integrity	X	X
Observation	Absence of obstructions for the air flow	X	X
Observation	Absence of obstructions during opening and closing		
Visual inspection	General condition of the air inlets	X	X
Visual inspection	Settings, hinges,		X
Visual inspection	Automatic Initiation Device if relevant		X
Tests	Operation and proof of reaching the fire position	X	X
Action	Clean to maintain reliable operation		X
Action	Lubrication of movable components		X

6 Qualification of Maintenance Staff

For works, in which the safety of the buildings relies on the particular knowledge of the company employed, the maintenance contractor with responsibility for the NSHEVS has to be cer-

tified by a recognized organization to prove their suitability to the building authority if requested. In addition to maintenance this also applies to the repair of a NSHEVS.

Therefore these works should only be carried out by companies which have the necessary know-how

- the tools and competences (sometimes specific), that are necessary to undertake the particular works
- that the staff are trained and therefore authorized in this field
- a minimum stock of spare parts

Note: Qualification of the maintenance company should be performed through a voluntary assessment procedure

7 Documentation

To check, whether structural changes, that could influence the function of the NSHEVS, have been carried out since the last completed maintenance, in particular as-built drawing with a listed NSHEVS is essential.

This requires that the NSHEVS is documented by the client at the time of acceptance (if necessary, the executing company can create it) and that this documentation is noted in a system log book, in which further testing results and maintenance actions are also recorded.

8 Maintenance Agreement

It is recommended that the building owner/operator with the NSHEVS should service and if necessary repair them using a recognized company specialized for NSHEVS within an annual maintenance agreement.

With the completion of a maintenance agreement the person in charge can reduce the impact of damage and his own liability in case of fire. Furthermore he can prove to a third party (e.g. the building authority, at controls according to the checking regulations, the insurance etc.) that he fulfilled his duty to keep the NSHEVS ready and operative constantly.

The completion of a maintenance agreement with a qualified and specialised company for NSHEVS offers the following advantages:

- the safety level of of the whole installation is maintained,
- dates of routine inspections are managed and guaranteed,
- the own complexity of control is reduced,
- costs become transparent and controllable,
- the manufacturer and installer regulations are being observed complied with,
- the correct replacement and spare parts are being used,
- compliance with the requirements of local authorities and insurance companies is maintained,
- competent help is available in emergencies.

9 Deadline

It is necessary to check the NSHEVS at least once a year through the maintenance agreement with a certified company.

10 Difficult atmosphere

For particularly aggressive environments (dusty, corrosive, wet, etc.) the maintenance intervals should be reduced accordingly.

With feedback from recorded faults on components in the installation, the maintenance company will be able to define an anticipated plan to replace components with reduced life expectancy (pneumatic system, pneumatic drive, springs, fusible links, percussion needle, cables, glazing, etc.).