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Components for smoke control systems

Part 8: Code of practice for planning, design, installation, commissioning and maintenance

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Contents

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This document comprises a front cover, an inside front cover, pages i to ii, pages 1 to 50, an inside back cover and a back cover.

Foreword

Publishing information

This British Standard is published by BSI Standards Limited, under licence from The British Standards Institution, and came into effect on 31 December 2013. It was prepared by Technical Committee FSH/25, *Smoke, heat control systems and components*. A list of organizations represented on this committee can be obtained on request to its secretary.

Information about this document

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Presentational conventions

The provisions of this standard are presented in roman (i.e. upright) type. Its recommendations are expressed in sentences in which the principal auxiliary verb is "should".

Commentary, explanation and general informative material is presented in smaller italic type, and does not constitute a normative element.

The word "should" is used to express recommendations of this standard. The word "may" is used in the text to express permissibility, e.g. as an alternative to the primary recommendation of the clause. The word "can" is used to express possibility, e.g. a consequence of an action or an event.

Notes and commentaries are provided throughout the text of this standard. Notes give references and additional information that are important but do not form part of the recommendations. Commentaries give background information.

Use of this document

As a code of practice, this British Standard takes the form of guidance and recommendations. It should not be quoted as if it were a specification and particular care should be taken to ensure that claims of compliance are not misleading.

Any user claiming compliance with this British Standard is expected to be able to justify any course of action that deviates from its recommendations.

Departures from the recommendations of this British Standard are possible through consultation and discussion, and with the agreement of all interested parties (see **5.2**).

It has been assumed in the preparation of this British Standard that the execution of its provisions will be entrusted to appropriately qualified and experienced people, for whose use it has been produced.

Contractual and legal considerations

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a British Standard cannot confer immunity from legal obligations.

0 Introduction

Smoke control systems create and maintain a smoke-free layer above the floor, or help to reduce smoke and heat build-up, by removing smoke and hot gases released by a fire in the development stage. In doing this, smoke control systems help to:

a) keep escape and access routes free from smoke;

b) facilitate firefighting operations;

c) delay and/or prevent flashover and thus full development of the fire;

d) protect equipment and furnishings;

e) reduce thermal effects on structural components during a fire; and

f) reduce damage caused by thermal decomposition products and hot gases.

The use of smoke control systems has become widespread. Their value in assisting in the evacuation of buildings, 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 realized, however, it is essential that smoke control systems operate fully and reliably whenever called upon to do so during their installed life.

A smoke control system is made up of components that have generally been tested to recognized European and International standards, and needs to be installed as part of a properly designed system. The most relevant standards applicable to smoke control systems are BS EN 12101 and BS ISO 21927. Typical system implementation involves the selection of appropriate products, suitable deployment of these products and ensuring they are then interconnected and controlled in such a way as to meet the design criteria.

The recommendations for the design, planning, installation, commissioning, use and maintenance of a smoke control system are set out in the order given in Figure 1.

The first step in the design process is to assess the needs of the building for a smoke control system (see Clause **5**). When a decision is taken as to the type and purpose of the system, the planning and detailed design process begins (Clause **6**).

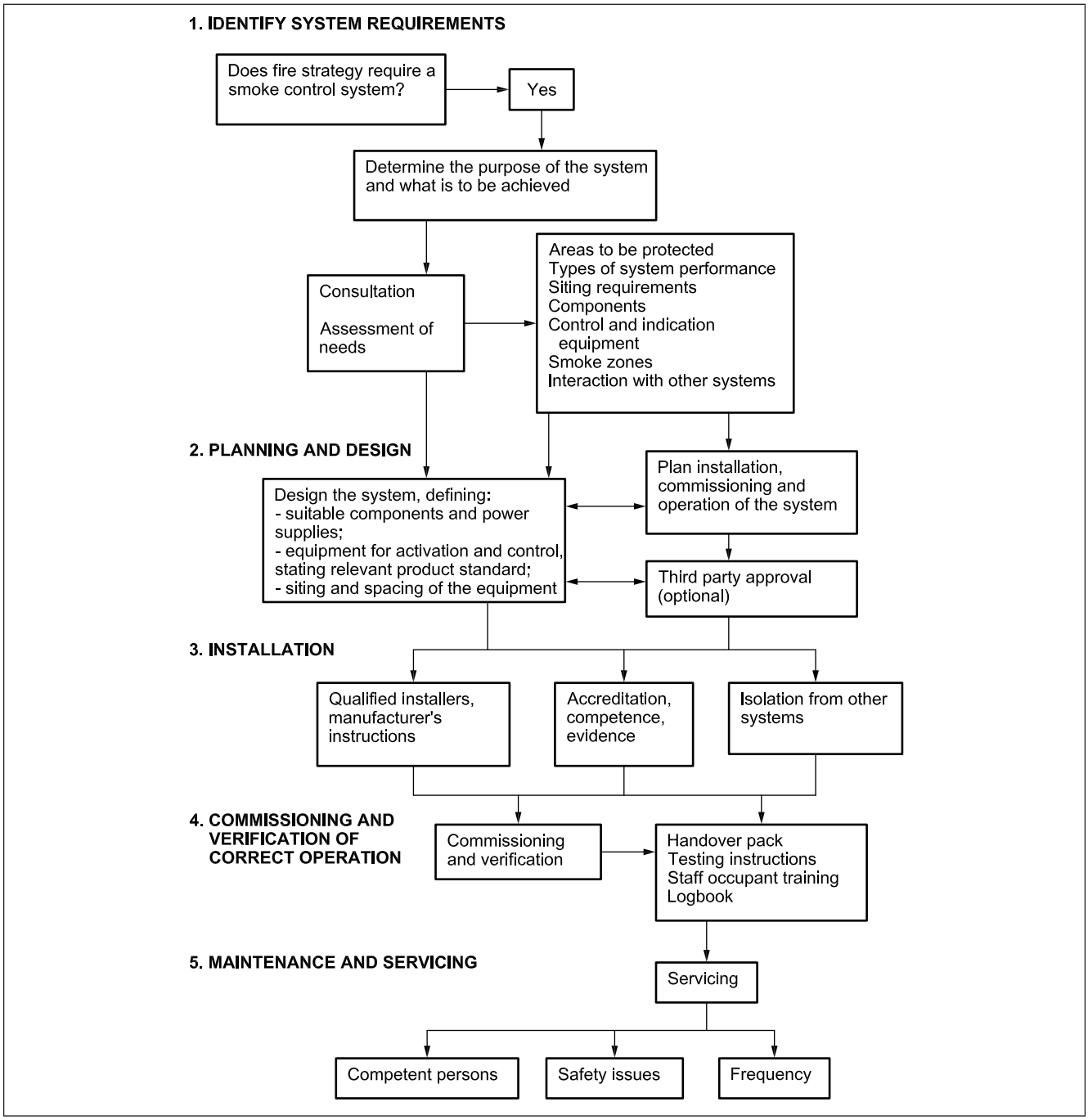
The third step is installation, which includes mounting and interconnecting the components (see Clause **7**).

The fourth step is the commissioning of the system and verification of correct operation (see Clause **8**).

Once the smoke control system is handed over to the relevant responsible person, it is important that the system is maintained and serviced to ensure it remains fully operational (Clause **9**).

The statutory responsibilities for a smoke control systems are set out in Annex A. Annex B provides model certificates for the various steps of an installation, while Annex C provides a model format of a system logbook. Annex D contains figures relating to the location of roof ventilators in areas potentially subject to positive pressures.

Figure 1 **Process for planning, designing, installing, commissioning and maintaining a smoke control system**



1 Scope

This British Standard gives recommendations for the planning, design, installation, commissioning and maintenance of smoke control systems, including smoke clearance, in and around buildings. The recommendations are applicable to systems intended for the protection of life and/or protection of property, including:

a) natural smoke ventilation;

b) mechanical smoke ventilation;

c) smoke barriers;

d) smoke and heat exhaust ducts;

e) smoke dampers, and

their controls, power supplies and interconnections.

This British Standard is not applicable to non-fire-related functions of smoke control systems.

This British Standard does not give recommendations as to whether or not to install smoke control systems in any given premises.

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.

BS 5839-1, *Fire detection and fire alarm systems for buildings – Part 1: Code of practice for design, installation, commissioning and maintenance*

BS 7346-4:2003, *Components for smoke and heat control systems – Part 4: Functional recommendations and calculation methods for smoke and heat exhaust ventilation systems, employing steady-state design fires – Code of practice*

BS 7346-5, *Components for smoke and heat control systems – Part 5: Functional recommendations and calculation methods for smoke and heat exhaust ventilation systems, employing time-dependent design fires – Code of practice*

BS 7346-7, *Components for smoke and heat control systems – Part 7: Code of practice on functional recommendations and calculation methods for smoke and heat control systems for covered car parks*

BS 7671, *Requirements for electrical installations – IET Wiring Regulations*

BS 8519:2010, *Selection and installation of fire-resistant power and control cable systems for life safety and fire-fighting applications – Code of practice*

BS 9991, *Fire safety in the design, management and use of residential buildings – Code of practice*

BS 9999:2008, *Assistive products for persons with disability – Classification and terminology*

BS EN 1366-3, *Fire resistance tests for service installations – Part 3: Penetration seals*

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

BS EN 12101-7, *Smoke and heat control systems – Part 7: Smoke duct sections*

BS EN 12101-8, *Smoke and heat control systems – Part 8: Smoke control dampers*

BS EN 12101-10:2005, *Smoke and heat control systems – Part 10: Power supplies*

BS EN 60335-2-103, *Household and similar electrical appliances – Safety – Part 2-103: Particular requirements for drives for gates, doors and windows*

BS EN 60947 (all parts), *Low-voltage switchgear and control gear*

BS ISO 21927-9, *Smoke and heat control systems – Part 9: Specification for control equipment*

3 Terms and definitions

For the purposes of this British Standard, the following terms and definitions apply.

3.1 access level
one of several states of control equipment in which selected:

- controls can be operated;
- manual operations can be carried out;
- indications are visible;
- information can be obtained

[SOURCE: BS ISO 21927-9]

3.2 aerodynamic free area
geometric area multiplied by coefficient of discharge

3.3 air inlet
device connected to outside air to admit air from outside the premises

3.4 automatic activation
initiation of operation of the smoke control system without manual action

3.5 coefficient of discharge
Cv
ratio of actual flow rate, measured under specific conditions, to the theoretical flow rate through the natural SHEV as defined in Annex B of BS EN 12101-2:2003

3.6 commissioning
act of ensuring that all components and the smoke control system are installed and operating as planned

3.7 component
complete product that is part of the smoke control system

NOTE The principal types of smoke control components are:

- *natural smoke and heat exhaust ventilators;*
- *mechanical smoke and heat exhaust ventilators (fans);*
- *smoke barriers;*
- *smoke control duct sections and ancillaries;*
- *smoke control dampers;*
- *control equipment;*
- *power supplies, including cables;*
- *air inlet.*

3.8 control equipment
element containing control and/or release devices, manual and/or automatic, used to operate the smoke control system

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

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

3.10 fire position
position of a component to be reached and maintained while the smoke control system is venting smoke and heat

3.11 geometric area
Av
area of the opening through a ventilator, measured in the plane defined by the surface of the building, where the surface of the building contacts the structure of the ventilator

NOTE No reduction is made for controls, louvres or other obstructions.

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

3.13 manually initiated smoke control system
smoke control system which is initiated by human actions after the outbreak of fire (e.g. by pressing a button or pulling a handle), leading to a sequence of automatic actions that operate the smoke control system

3.14 natural ventilation
ventilation caused by buoyancy forces arising from differences in the density of gases due to temperature differences

3.15 operating time
maximum period between the signal to operate being received by the smoke control system and the achievement of the fire position by the smoke zone of the component with the most unfavourable route

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

NOTE Powered ventilation is usually provided by fans.

3.17 premises management
persons having day-to-day control of the premises, the fire safety system(s) and implementation of the fire procedures

NOTE In large premises, management for the fire safety system and associated matters is often delegated to a single person with specialist knowledge. In small premises, a person with specialist knowledge is unlikely to be present, but management of the fire safety system can still be delegated to a specific person.

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

3.19 secondary power supply
power supply to operate the smoke control system when the primary power supply has failed

3.20 single-operation system
automatic natural smoke control system which offers no firefighting facility to change the system status after initial activation

3.21 smoke and heat exhaust system
arrangement of components that exhausts smoke and heat from a fire in a building or part of a building

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 duct
component used to channel gases to and from the smoke and heat exhaust ventilator

3.24 smoke and heat exhaust ventilator
SHEV
device specially designed to move smoke and hot gases out of a building under conditions of fire

3.25 smoke control damper
device which can be opened or closed to control the flow of smoke and hot gases

NOTE A smoke control damper can have the following positions.

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

b) Standby position: closed or open for exhaust fume ventilation.

3.26 smoke control system
arrangement of components installed in a building to limit the effects of smoke and heat from a fire

3.27 smoke layer
layer of smoke which stabilizes underneath the roof due to the effect of temperature gradients

3.28 smoke reservoir
volume within a building 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

3.29 smoke zone
geographical subdivision of the protected building served by a smoke control system (or sub-system of a smoke control system), which is initiated by a signal from a single device or group of initiation devices associated with the zone

NOTE A zone contains at least one smoke reservoir.

3.30 standby position
state of a component ready for operation

3.31 thermal device
temperature sensitive device which responds to heat by initiating a subsequent action

4 Documentation and responsibility

4.1 Documentation

Proper performance of each stage of the work should be fully documented by the person or organization taking responsibility for that stage. The documentation should include as a minimum:

a) design criteria;

b) cause and effect;

c) description of operation;

d) schematic;

e) as-built drawings;

f) operation and maintenance manuals

g) certificates;

h) logbook.

NOTE Current legislation, e.g. the Building Regulations [1, 2, 3], requires the person carrying out the work to pass on all the fire safety information about the system, as installed. This is because the building user needs to know how to safely operate and maintain any fire safety equipment. The design and installation details form the basis of any records for risk assessment purposes.

4.2 Responsibility

Responsibility for the planning, design, installation and initial performance of the installed system should be clearly defined and documented.

The design, installation and commissioning of the smoke control system may be undertaken by a single organization, or by different organizations. For example, the designer and installer may be a single, specialist smoke control contractor. Alternatively, the relevant responsible person may be responsible for the design of a smoke control system (which might be undertaken by consultants acting on behalf of the responsible person), and the design may then be communicated, by means of a specification and/or drawings, to a specialist smoke control contractor and/or to an electrical installation contractor, which would, in either case, then be responsible for installation. Responsibility for each of these activities should be agreed and documented prior to the commencement of the installation work.

Various contractual arrangements are possible, but overall responsibility for checking compliance with this standard and that the performance of the system matches the design requirements should be assumed by one organization. This responsibility should be agreed prior to the start of the installation contract.

The responsibility for provision of appropriate documentation to the relevant responsible person following completion of the system (see **8.2** and **8.3**) may rest with more than one organization and should be defined before an order for the system is placed. The type of documentation to be provided should be defined in the contract for design, supply, installation and commissioning.

NOTE The statutory responsibilities for a smoke control systems are set out in Annex A.

5 Determining requirements for a smoke control system

5.1 Assessment of requirements

The designer should determine whether a smoke control system needs to be incorporated into the overall fire safety strategy for the building and, if so, the purpose of the system (e.g. protect means of escape, facilitate firefighting access or protect property) and what is to be achieved.

An assessment may include the following.

a) Whether part or all of the building is to be protected.

b) The type of system to be installed.

The system should be designed to meet the requirements of the overall building fire safety strategy.

5.2 Consultation

Where the installation of a new smoke control system, or an extension or alteration to an existing smoke control system, is being considered for a new or existing building, the following should be consulted and, where necessary, their approval sought.

a) The building control body.

b) The fire authority.

c) The insurer(s) of the building.

The consultation should cover:

1) the purpose of the system (see **5.1**);

2) the areas to be protected;

3) selection of the correct type of system;

4) subdivision of the building into smoke zones;

5) components;

6) the siting requirements for the various parts of the building;

7) provision for control of the system and for the display of its indications;

8) provision of primary and secondary power supplies;

9) interaction with other systems, especially the interaction with fire suppression systems.

6 Planning and design

6.1 General

To ensure successful installation, commissioning and operation of the system, these processes should be carefully planned and designed, addressing the following as necessary.

a) Subdivision of the building into fire compartments and smoke zones.

b) Component selection and compatibility.

c) Siting and spacing of equipment.

d) Interactions.

e) System activation.

f) Control and indication requirements, including hierarchical operation and functionality.

g) Location of control equipment.

h) Power supply selection and performance.

i) Cable selection and performance.

j) Pneumatic pipework selection and performance.

k) Smoke control ductwork selection and performance.

6.2 Smoke zones and smoke reservoirs

6.2.1 General

The building or space within the building should, as required by the fire strategy, be divided into smoke zones arranged so that smoke from any fire can only enter one smoke zone. Fire compartmentation should not be compromised by the operation of the smoke control system.

Smoke zones should take into account the internal layout of the building space and the layout of the contents where this is fixed.

Where the fire strategy requires different smoke zone operation depending upon the fire location, the smoke zones should be interlinked with the fire detection zones to ensure correct operation.

NOTE A fire compartment within a building might require one or more smoke zones.

6.2.2 SHEVS

The dimensional limits of each smoke zone should be established in accordance with BS 7346-4 and BS 7346-5.

NOTE The recommended smoke zone area limits of 2 000 m^2 and 2 600 m^2 are not absolute maxima, but are considered small enough that the effects of cooling of the smoke layer can be neglected. If larger zones are required these ought to be justified by calculation or modelling.

6.2.3 Car parks

Where a smoke control system is recommended for a car park the dimensional limits for each zone should be determined in accordance with BS 7346-7.

NOTE There is no limit on smoke zone size for car parks. Smoke zones are, however, commonly limited to one level of the car park, and in large car parks each level may be separated into more than one smoke zone. This has the benefit of reducing the area likely to become smoke logged, and can reduce plant space and cost.

6.2.4 Single storey, multi-storey buildings and buildings with atria

Where a smoke control system is recommended the system should be designed in accordance with BS 9999, BS 9991, BS 7346-4 and/or BS 7346-5, as applicable.

6.3 Selection of components

Suitable mechanical and electrical system components should be selected to meet the intended design criteria under the defined fire conditions for the system. The system design documentation (e.g. performance specification) should reference the applicable product standards.

The components selected should be sized to ensure they have sufficient capacity or functional capability to achieve the design performance, including adequate reserve capacity. Only components that have been tested to product standards should be selected, e.g. BS EN 12101 and BS ISO 21927.

NOTE 1 The Construction Products Regulation [4] requires manufacturers to supply only fire safety products that are CE-marked as a construction product where harmonized standards exist. CE marking is not required outside the EU.

NOTE 2 BS EN 12101 and BS ISO 21927 were produced specifically for products intended for use in smoke control systems. Products assessed for fire performance only might not necessarily meet smoke control requirements.

There are many components that can be installed and interconnected to make up a smoke control system. The selection of the most appropriate type of component should be based on such factors as the following.

a) The component performance required to satisfy the system design intent, e.g. time and temperature rating of fans, airflow rates, and aerodynamic free area for ventilators.

b) Building use:

   1) high risk (e.g. warehouse containing flammable materials);

   2) low risk (e.g. office accommodation).

c) Size of area to be protected by a system. Large areas might need to be subdivided into zones by smoke barriers.

d) The building structure, location and available space.

e) Smoke control components with fire-resisting classification might be needed to ensure the correct function of the system without compromising the compartmentation of the building.

f) The complexity of the control system. Complex buildings require complex control systems containing multiple zones, automatic activation, initiation of different smoke control components, high degree of firefighter control and override, and detailed system information (e.g. zoned status indication). Manual activation only, e.g. via a manual control point, might be suitable for simple systems.

g) The need to ensure compatibility of components by ensuring that individual components:

   1) are individually fit for the purpose they are intended to perform;

   2) interact with each other to achieve the system design intent;

   3) do not adversely and disproportionately affect the operation of the system upon failure of a single component;

   4) interact with other fire protection measures where necessary to achieve the overall fire strategy.

NOTE 3 Common issues such as incompatible voltages, electrical loads and communication protocols can be avoided by considering these factors at the planning and design phase.

For systems other than single-operation, the smoke control system should be capable of maintaining functionality to serve active systems for protecting and assisting firefighters in their role for at least 60 minutes, depending on the specific firefighting application.

*NOTE 4 It is important that the system design clearly defines the performance criteria of the system during all phases of operation, including firefighting, and that those performance criteria are reasonable and achievable. Performance criteria which cannot be met by using products tested to BS EN 12101 or BS ISO 21927 need to be avoided (see **6.7.3**).*

NOTE 5 BS 8519 gives further information on fire survival time of cables for firefighting applications.

Any component of the smoke control system selected for purposes other than smoke control should not under fire conditions prevent the smoke control system from performing its emergency design function when required. The operation of the smoke control system should be given priority over non-emergency functions of the system.

6.4 Siting and spacing of equipment

6.4.1 General

Equipment should be installed in accordance with the manufacturer's instructions, and sited so that smoke and heat from any fire can be exhausted from the smoke zone without undue dilution or delay. The equipment should be sited to ensure that it does not adversely interact with other firefighting systems or that other systems do not prevent the operation of the smoke control system.

Smoke exhausts should be designed and located so that the discharged smoke is not directed at adjacent building surfaces and is unlikely to re-enter the building or adversely affect escape routes.

6.4.2 Tamper resistance

Where equipment is located in areas susceptible to inappropriate operation or tampering, sufficient measures should be taken to prevent or minimize the risk of such interference. These measures may include installing additional tamper-evident protective covers, elevated access levels or limiting control functionality to essential operation only.

6.4.3 Maintenance access

Provision should be made for access for maintenance purposes. All installed components should be capable of being safely maintained and cleaned. Access should be planned for routine maintenance tasks and plant replacement. The plant replacement strategy should be documented.

Clearance should be provided for all moving parts of the equipment to move through the designed operating range without obstruction from any other fixed or moving part of the building.

6.4.4 Climatic and environmental consideration

As any part of the smoke control system may be installed inside or outside buildings under various climatic and environmental conditions, and exposed to possible accidental or wilful mechanical damage, all the conditions under which the system is required to operate should be fully determined and any associated risks to correct electrical and mechanical operation should be reduced to acceptable levels.

Care should be taken to ensure the environment is maintained within the required temperature range and ventilation recommended by the smoke control equipment manufacturer.

The environmental conditions at each location and measures required to prevent actual or latent damage to the equipment should be identified in the system design documentation. This should include temperature, dust/moisture ingress, humidity and vibration.

Equipment should not be installed in a plant room (or similar location), unless the room is maintained in an acceptable state, including being free of dust from other trades.

NOTE Electronic equipment can fail due to dust-clogged heat sinks or fans.

6.4.5 SHEVs

Ventilators should be located as high as reasonably practicable within the roof and with a maximum spacing of 20 m. At least one ventilator should be provided for every 400 m^2 plan area of the smoke zone.

Roof ventilators should not be located:

a) within 8 m of the perimeter of a smoke zone, unless intended for edge of zone slot ventilation; or

b) in areas potentially subject to positive wind pressures (see Annex D).

6.4.6 Smoke barriers

Smoke barriers should be installed in accordance with BS EN 12101-1, ensuring they are located in positions not subject to wind or other significant variable air currents.

Active smoke barriers can deflect or bellow in use under pressure. Barriers and adjacent structure should therefore be arranged so that the deflection does not increase any edge gaps, unless the increased edge gaps can be accommodated within the overall smoke control system design.

6.4.7 Impulse fans

Any impulse fan should be located so that:

a) the initial jet from the fan is not interrupted by:

   1) down stand beams;

   2) high-level services;

   3) columns or walls; and

b) the risk of interruption by parked vehicles is minimized.

6.4.8 Inlet ventilators or grilles

Air inlets should be located and sized so that the inlet air velocity does not:

a) risk fanning the flames;

b) cause the smoke plume to lean or be otherwise disturbed;

c) disturb the smoke layer boundary.

NOTE 1 This can normally be achieved by ensuring that the inlet air velocity does not exceed 1 m/s at any point where it can interact with the fire or smoke plume and that the top of the inlet is at least 1 m below the design smoke layer interface.

Air inlets should be sized so that the inlet velocity through any door opened for escape does not exceed 5 m/s.

NOTE 2 These restrictions do not apply in the case of a compartment fire at the boundary between the compartment and a large space (mall or atrium) into which smoke is spilled before being exhausted from the building.

Inlet air should be taken from locations unlikely to be affected by smoke.

6.4.9 Shaft systems

In addition to the recommendations/guidance given in BS 9999 and BS 9991 the following recommendations should be followed.

a) Shafts should be located as close as possible to the space being ventilated. Where a natural shaft is used the shaft vent should open directly into the shaft or via a short straight stub duct. Where this is not possible the vent and connecting duct should be designed and sized to be no more resistive to flow than a shaft vent of the specified size alone.

NOTE The duct and vent need to be oversized to achieve this.

b) The shaft vent should be located as high as possible within the ventilated space. The top should be no lower than the top of the door to the stair.

c) Where the shaft system is being used to permit an extended travel distance for persons evacuating the building, the air inlet and smoke discharge should be as close to the opposite ends of the corridor as possible, and should in any case not leave more than 5 m between the vent and the furthest door beyond the vent. The direction of airflow should, as far as is practicable, move smoke away from the stair door.

d) The stair vent and the termination of any smoke shaft should be located as far as practicable so that:

1) they are not subjected to positive wind pressures;

2) smoke does not re-enter the building through the stair vent.

6.4.10 Smoke control dampers

6.4.10.1 Single compartment

6.4.10.1.1 General

NOTE 1 Single compartment smoke control dampers have classifications at 600 °C. They are suitable for use at all temperatures below 600 °C.

Smoke control dampers should as a minimum be classified to BS EN 12101-8 as single compartment smoke control dampers (multi-compartment smoke control dampers are allowed in their place).

As they are for single compartment applications, any smoke control dampers should not be used to protect a fire compartment barrier. Sufficiently large openings should be allowed at any wall to permit the smoke control dampers to be installed if they are to be within the boundary. Alternatively, the dampers should be mounted in series with, or on the surface of, the single compartment smoke control duct.

NOTE 2 Further information is given in the ASFP Blue Book European version [5].

6.4.10.1.2 With automatic activation

If the system:

a) automatically starts on the receipt of a fire or smoke alarm; and

b) the smoke control dampers move immediately to their required position; and

c) there is no override required at any point,

then single compartment smoke control dampers classified to BS EN 12101-8 as suitable for automatic activation should be used. If an override is required for smoke clearance, but only after the event, this should be allowed, but it should be noted that any dampers that are closed might remain closed as they have not been proven to open again after exposure to elevated temperatures.

NOTE Dampers used for make-up air in the fabric of the building might not need to be classified if it is proven that they will not be affected by the fire itself and they do not have any requirement for containment at any point.

6.4.10.1.3 With manual intervention

If the system waits for the Fire and Rescue Service to arrive before it is activated or allows inputs to change how the smoke is to be controlled during an event, then single compartment smoke control dampers classified to BS EN 12101-8 as suitable for manual intervention should be used. In this instance they should also be considered for make-up air applications.

6.4.10.2 Multi-compartment

6.4.10.2.1 General

NOTE 1 Multi-compartment smoke control dampers have a classification as fire resisting and can be used to protect and cross compartment barriers. They are suitable for all applications and may be used in single compartment applications.

Smoke control dampers used should as a minimum be classified to BS EN 12101-8 as multi-compartment smoke control dampers.

Sufficiently large openings should be allowed at any wall to permit the smoke control dampers to be installed if they are to be within the boundary. Alternatively, they should be mounted in series with, or on the surface of, the multi-compartment smoke control duct.

NOTE 2 Further information is given in the ASFP Blue Book European version [5].

6.4.10.2.2 With automatic activation

If the system:

a) automatically starts on the receipt of a fire or smoke alarm; and

b) the smoke control dampers move immediately to their required position; and

c) there is no override required at any point,

then multi-compartment smoke control dampers classified to BS EN 12101-8 as suitable for automatic activation should be used. If an override is required for smoke clearance, but only after the event, this should be allowed, but it should be noted that any dampers that are closed might remain closed as they have not been proven to open again after exposure to elevated temperatures.

6.4.10.2.3 With manual intervention

If the system waits for the Fire and Rescue Service to arrive before it is activated or the system allows inputs to change how the smoke is to be controlled during an event, then multi-compartment smoke control dampers classified to BS EN 12101-8 as suitable for manual intervention should be used.

6.5 Interaction with other fire protection systems and building systems

6.5.1 General

The designer should consider all interactions between the smoke control system and other systems to ensure that the smoke control system meets its intended design performance when required to do so in an emergency. Where a smoke control system interacts with other systems:

a) any interaction in a fire situation should not compromise the operation and effectiveness of the smoke control system; and

b) the smoke control system should work with other fire protection systems as defined by the fire strategy.

NOTE The designer might have to consider the specific performance of individual manufacturers' systems and equipment, and take this into account in the design of the smoke control system.

6.5.2 Building systems

6.5.2.1 HVAC systems

6.5.2.1.1 Separate systems for day-to-day environmental control and smoke control

The designer should ensure that the interaction between the smoke control system and the HVAC system:

a) does not adversely affect the smoke control strategy;

b) prevents smoke penetrating other interconnected spaces, e.g. fans shutting down and dampers (ES classification for smoke leakage) isolating ductwork.

NOTE The designer might need to consider leakage from the HVAC system and its effect on the smoke ventilation system, and ensure the appropriate dampers are selected.

6.5.2.1.2 A combined system for day-to-day environmental control, but which functions as a smoke control system in the event of a fire

The system should be designed as a smoke control system in accordance with the recommendations of BS 7346-4 or BS 7346-5.

Special consideration should be given to HVAC systems providing pressurization to spaces such as computer suites or medical facilities that are pressurized for reasons other than fire.

6.5.2.2 Building management system (BMS)

All emergency operation control inputs that activate the smoke control system should be independent of the BMS. If the designer chooses to use the BMS to initiate the smoke control system, then the system design should be robust and all inputs meet the same standards as if they were being provided within a stand-alone smoke control system or were part of a fire detection and fire alarm system.

Sufficient safeguards should be designed into any interfaces between the smoke control system and the BMS to ensure that failure of the BMS does not compromise the operation of the smoke control system.

6.5.2.3 Sun shading systems

Where retractable shading could interfere with the opening of a ventilator, the shading should automatically retract upon receipt of a fire signal, overriding any other control signal. Opening of the ventilator might need a delay to allow this to occur, but the maximum system operating time of 90 s should not be exceeded.

Where shading could interfere with the ventilation path through a ventilator, either the shading should automatically retract upon receipt of a fire signal, overriding any other control signal, or the additional resistance of the shading system should be taken into account in the design of the smoke control system.

6.5.3 Fire systems

6.5.3.1 Fire detection

Once a fire has been detected and the smoke control system has activated to its emergency operation, any subsequent signals from the fire detection system should not change the operating status of the smoke control system, unless specifically designed to do so.

6.5.3.2 Fire and voice alarms

The required levels of audibility for fire and voice alarms should be determined in accordance with BS 5839-1. Messages from voice alarm systems should be clearly audible above the sound of the operating smoke control system.

6.5.3.3 Fire suppression systems

The interactions of SHEVSs with fire suppression systems should be designed in accordance with BS 7346-4:2003, **4.2.2** (see also BS 7346-4:2003, Annex K).

When early suppression fast response (ESFR) sprinklers are to be installed, any smoke control system should be manually operated.

Where a mist system is intended to be used, the interaction of the smoke control system and the mist system should be subject to a fire engineering assessment.

NOTE Mist systems can be vulnerable to excess air velocity disturbing the mist pattern.

6.5.3.4 Firefighting lifts

Pressurization air inlet openings into a lift shaft should be positioned and sized so the airflow does not impair the operation of the lift (BS EN 12101-6). Particular care should be taken to avoid vibration of lift cables.

6.5.3.5 Active fire curtain barrier assemblies

Barrier assemblies should be designed to deploy in accordance with the fire strategy.

The barriers should be sequenced with the smoke control system to ensure they operate correctly and are not affected by pressure differences and airflows caused by the smoke control system.

NOTE 1 Excess pressure differences and airflows could cause barriers to jam during operation.

NOTE 2 Active fire curtain barrier assemblies are covered by BS 8524-1 and BS 8524-2.

6.5.4 Interactions between smoke control systems

6.5.4.1 Pressure differential systems (PDSs) and smoke and heat exhaust ventilation systems (SHEVSs)

PDSs and SHEVSs should not be provided in the same space.

If a space is equipped with a SHEVS, the designs of both the PDS and the SHEVS should not conflict and the design parameters of both systems should be within their permitted range.

Where a pressurized space is separated from a SHEVS-protected space at any level by a single door or by two doors with an unpressurized lobby between, the pressure differential between the spaces is affected by both systems. If the SHEVS is in a tall space, e.g. an atrium, the combination of the negative pressure at low level in the atrium and the positive pressure from the PDS add together to increase the door opening force. The design should ensure that this does not cause the door opening force to exceed 100 N at the door handle.

6.5.4.2 PDS and other stair protection systems

If a building has one or more stairs protected by a PDS and one or more stairs protected by other systems, e.g. a BRE-type shaft, the systems should be designed so as not to conflict and the design parameters of each system should be within their permitted range.

The PDS should not, with reasonably anticipated doors open, force smoke into another stair. To this end, there should be at least three doors between any pressurized space and any naturally-ventilated stair, unless the designer can otherwise demonstrate that smoke will not prejudice any interconnected naturally-ventilated stair.

6.6 System activation

A smoke control system can be activated to its emergency operation in several ways, including smoke detection, heat detection and manual activation (e.g. via manual control points). A strict hierarchy of operation should be established at the design stage, showing detailed causes and effects resulting from any activation.

Any third party system intended to activate the smoke control system should be designed with sufficient safeguards to ensure the correct activation of the smoke control system.

NOTE 1 A fire alarm system designed and installed in accordance with BS 5839-1 is likely to have these safeguards, whereas a building management system (BMS) is unlikely to have the necessary level of hardware and software resilience, the appropriate cables or the required power supply design.

A smoke control system may be provided with further safeguards, such as manual control points for firefighter use or the incorporation of fusible links into natural smoke and heat exhaust ventilators in addition to automatic control.

Where the detection system conforms only to BS ISO 21927-9 then its use should be restricted solely to the activation of the smoke control system and for no other purpose.

NOTE 2 This does not remove the obligation to provide building-wide fire alarm systems where necessary for the safe operation of the building.

The smoke control system should achieve its design performance level within 90 s of receipt of a command signal (i.e. the prescribed operating time), unless an intentional delay is part of the fire strategy.

NOTE 3 Ancillary items such as dampers and air inlets (including doors) ought to be fully in the fire operational condition in not more than 60 s.

6.7 Control and indication, including hierarchies and cascading

6.7.1 Control equipment

The performance requirements, functionality, interactions and locations of the control equipment should be clearly defined in the design documentation. Suitable control equipment conforming to BS ISO 21927-9 should then be selected to ensure the correct operation of the smoke control system. Control of a system may be centralized or distributed, or a combination of both.

6.7.2 Performance

The control equipment should have sufficient capacity to operate the smoke control system to achieve the desired design performance. Unless the smoke control system is fail-safe in operation, the control equipment should have a secondary power supply to ensure emergency operation of the system in the event of a failure of the primary power supply. Changeover between primary and secondary power supply should be automatic. All control equipment should be compatible with the smoke control component(s) it is designed to control. Care should be taken to establish that voltages, pressures and electrical loadings are correct and that the control protocols of the various component(s) operate correctly.

Control equipment might be unable to initiate the operation of the entire smoke control system simultaneously due, for instance, to the size of the electrical start up currents. Where control equipment cascades the initiation of the smoke control components, it should still ensure that the design performance of the entire smoke control system is achieved in the prescribed operating time.

6.7.3 Functionality

Control equipment can range from extremely basic operation to complex, software-driven, multiple-outcome configurations. For more complex systems, more detailed planning and clearly defined strategies, including comprehensive cause and effect schedules, should be developed as part of the planning phase. The cause and effect schedules should define the desired functionality of the smoke control system, including all outputs, such as the fire-activated position of the components, as well as indications. If the system design requires a hierarchy of operation, then this should also be defined within the system design.

Where ultimate control of the system is to be provided by the Fire and Rescue Service via manual control points, the level of control and the required duration of availability of the control should be ascertained at the design stage. These should also be clearly identified in the specification for the system, as this information influences the selection of the system components.

6.7.4 Computerized fire control systems

If dedicated computerized control systems are to control the various operating functions of a smoke control system, relying on specific software to carry out the modes of operation as defined in the cause and effect document, the following should apply.

a) Computerized control systems should carry out the modes of operations required of the smoke control system in accordance with BS ISO 21927-9. Consideration should be given to protection of (signalling) system wiring.

b) Where computerized control systems are used as part of the operational requirements of a pressure differential system (see **6.5.4.1**), then any changes to the software controlling the fire safety functions should not affect the operation of the pressure differential system.

c) When changes are made to the software or associated computer system, a

full check of the pressure differential system should be carried out to confirm the continuing functioning of the system.

d) A comprehensive description of the control software should be provided to the building owner and/or site agent by the system designer, together with documentation of all changes made to the system after installation.

e) Signalling systems providing the information to and from the computerized control centre should be protected from the effects of fire for a period valid for the place in which the system installed and used.

6.8 Locations for control equipment

6.8.1 General

6.8.1.1 If the control equipment is to be installed in more than one enclosure, then:

a) connections between the enclosures should be suitably protected against fire and mechanical damage;

b) fault monitoring facilities should cover the interconnections between the housings.

6.8.1.2 Control equipment should preferably be installed in:

a) a permanently manned and easily accessible location;

b) a clean and dry environment free from excess temperature, humidity and dust;

c) an environment or position where the risk of mechanical damage is low;

d) an environment with a low risk of exposure to heat and fire, and appropriate access levels for the locations at which the control equipment is installed or, if this is not practicable, with special precautions to protect the equipment.

6.8.1.3 In addition, indicating control equipment should be installed in locations where:

a) lighting is such that the labels and visual indications can be easily seen and read;

b) background noise level allows audible indications to be heard.

6.8.2 Repeat indications

Repeat indicating panels may be installed where the control equipment is remote from the Fire and Rescue Service entrance, where a building has several Fire and Rescue Service entrances, or where the control equipment is not in a permanently manned area.

Repeat indicating panels should be installed in accordance with **6.8.1**.

6.8.3 Repeat controls

Where multiple manual controls are to be provided, allowing control to be taken at several locations, provision should be made to prevent contradictory operation of controls from different positions. The system designer should ensure that any remote operation of components can be performed safely.

Consideration should be given to entrapment hazards as defined in BS EN 60335-2-103.

NOTE It might be necessary to have supplementary Fire and Rescue Service controls in large or complex buildings.

6.8.4 Fire and Rescue Service override controls

Manual controls should be clearly visible and located and/or labelled, so their purpose is clear, and conform to BS ISO 21927-9.

6.9 Power supplies

6.9.1 General

Power supplies should be provided in accordance with BS 8519.

6.9.2 Power supply equipment

Power supply equipment should conform to BS EN 12101-10. The output of the power supply equipment (primary and secondary) should be sufficient to satisfy the maximum demands of the system.

Each connection to the power supply should be via an isolating protective device reserved solely for the smoke control system and independent of any other main or sub-main circuit. Such isolating protective devices should be clearly labelled and identified as to their purpose, and secured against unauthorized operation.

6.9.3 Monitoring

The indicators for powered ventilation systems and pressurization systems should indicate whether the equipment is in operation, and not merely whether it is energized.

Reference should be made to BS EN 12101-10 regarding recognition and indication of faults.

Reference should be made to BS ISO 21927-9 regarding the display of system status information. In particular, the control panel should be capable of unambiguously indicating the following functional conditions.

a) Standby condition.

b) Fire condition.

c) Fault warning condition.

Apart from a single-operation system, indicators should be provided in the control centre and/or at Fire and Rescue Service access points. The authority having jurisdiction should be consulted about location.

6.9.4 Inverters

Power supplies for life safety systems derived from frequency inverters in order to vary the speed of the motor should be equipped with a fail-safe fire mode. The fire mode should effectively disable the motor protection function to enable, if necessary, the inverter/motor to run to destruction.

Where inverter control is used and a standby fan is provided, a separate inverter should be provided for the standby fan.

When necessary to maintain the operation of the critical life safety equipment, the inverter should be equipped with a bypass.

If the life safety ventilation system is required to have predetermined multiple speeds in fire mode, in order to perform the required duty, each speed should be separately hard-wired and initiated from the individual fire alarm interface modules.

6.9.5 Standby generator

Where electrical services in the building are essential to maintain the operation of the life safety and firefighting systems, a secondary power supply, e.g. an automatically started standby generator or an alternative utility supply from another external substation, should be provided.

Any automatically started standby generator should be adequately sized to maintain in operation the maximum system design load. The fuel storage capacity should be designed in accordance with the criteria in Table 1.

Table 1 **Fuel storage capacity**

Criteria	Fuel storage capacity required
Generator set dedicated to building life safety/firefighting systems: a) only starts in case of a fire signal; and b) provides fault indication to a permanently manned control room	Minimum of 4 hours at full load
Generator operates whenever the primary power source fails and provides fault indication to a permanently manned control room	Minimum of 8 hours at full load
Otherwise	Minimum of 72 hours at full load

The generator starting electrical supply should also be independent of the primary source of supply (i.e. it should incorporate a battery backup).

The standby generator should be capable of providing the supply to the critical life safety and firefighting load within 15 s of the failure of the primary supply.

6.10 Cables

6.10.1 Cable selection

All cables and cable management systems for the smoke control system should be selected in accordance with BS 8519.

Where a smoke control system has a firefighting interaction, whereby a firefighter can change the status of the smoke control system, then it is regarded as a category 3 system in accordance with BS 8519, and both power and control cables should have a 120 min fire survival time.

6.10.2 Cable routing

Smoke ventilation system cables installed within a car park should be installed to avoid locations above parking places as far as is practicable.

NOTE In the BS 8491 cable fire test rig, the maximum temperatures developed are approximately 850 ˚C, but higher temperatures might be experienced directly above a burning car or van.

Particular attention should be given to the recommendations in BS 8519:2010, Clause **7**.

6.10.3 Cable installation

Cables should be installed in accordance with BS 7671.

Particular attention should be given to the recommendations in BS 8519:2010, Clause **10**.

6.10.4 Pneumatic pipework selection

NOTE Pipework for pneumatic systems used for smoke ventilation is broadly similar to that used in normal workshop air supply systems, but has some special performance requirements to meet the needs of life safety and smoke clearance systems. However, smoke ventilation systems are primarily intended to operate in the case of a single fire event and assume the required condition as described in the system design and cause and effect chart. This is different to a workshop pipework system that has continuous take-off.

The power supply features that are required for fail-safe and non-fail-safe pneumatic systems are specified in BS EN 12101-10.

Except as outlined in this subclause, the general recommendations of the BCAS Installation Guide [6], which gives guidance on the selection and installation of compressed air services and pipework, should be followed.

Smoke ventilation systems should reliably change from the ambient condition to the smoke ventilation condition in a prescribed operating time. The system designer should take account of the special performance requirements for life safety and smoke clearance systems when calculating and sizing compressors, air receivers, pipework, fittings and dump valves.

Copper tubing should be used for final service line installation, although steel tube may be used in the overall system design. Plastic tubing should not be used, except in fail-safe situations where the system operation will not be compromised. Care should be taken to avoid galvanic corrosion of copper tube. If there is a high level of humidity and mixing of materials that is likely to lead to galvanic corrosion then plastic-coated tube should be used.

Special consideration should be given to the ongoing performance of pneumatic systems to avoid failure, for example, the installation of a dryer can prevent water entering the air supply. The air quality should conform to BS EN 12101-10:2005, Clause **6**.

6.11 Smoke control ductwork, selection and performance

6.11.1 Single compartment

NOTE 1 Single compartment smoke control duct sections have classifications at 600 °C. They are suitable for use at all temperatures below 600 °C.

Any smoke control ducts used should as a minimum be classified to BS EN 12101-7 as single compartment smoke control duct sections (multi-compartment smoke control duct sections are allowed in their place).

For single compartment applications any smoke control ducting used should:

a) not cross a fire compartment boundary; and

b) not pass out directly through a wall or, where it passes through a compartment boundary, should be changed to multi-compartment smoke control ductwork just before the compartment wall.

Room should be allowed at any wall to allow the ductwork to be installed following the manufacturer's instructions (this is part of the classification). If smoke control dampers are required, single compartment ductwork should be fitted with single compartment smoke control dampers as a minimum.

NOTE 2 Further information is given in the ASFP Blue Book European version [5].

6.11.2 Multi-compartment

Multi-compartment smoke control duct sections have a classification as fire resisting and can be used to protect and cross compartment barriers. Any smoke control ducts used should as a minimum be classified to BS EN 12101-7 as multi-compartment smoke control duct sections.

Room should be allowed at any wall to allow the duct work to be installed following the manufacturer's instructions (this is part of the classification). If smoke control dampers are required, multi-compartment smoke control ductwork should be fitted with multi-compartment smoke control dampers.

NOTE Further information is given in the ASFP Blue Book European version [5].

6.12 Builder's work shaft used for smoke control

A builder's work shaft should have a maximum leakage rate of 3.8 m^3 per hour per m^2 at 50 pascals.

NOTE A builder's work shaft has considerably higher leakage than a tested smoke control duct.

7 Installation

NOTE The nature and quality of the installation work needs to be such as to ensure the integrity of the smoke control system and minimize the duration and extent of any disablement of the system during maintenance or modifications.

Penetration of construction (e.g. for the passage of cables, conduit, trunking or tray) ought to be made good to prevent the free passage of fire or smoke, regardless of whether the construction has a recognized degree of fire resistance.

7.1 General

All smoke control equipment should be installed by competent persons in accordance with the manufacturer's instructions and the technical specification, preferably covered by an installation certification scheme where available.

7.2 Cable Installation

7.2.1 General

The electrical distribution system should be installed by a competent person as defined in BS 7671. The electrical arrangements should conform to BS 7671 and the relevant parts of BS EN 60947.

7.2.2 Cable installation practice

When cables that are required to maintain circuit integrity under fire conditions are being installed, the resistance to fire of the cable fixings, cable containment system and any joints installed should be at least equivalent to the survival time required for the cables. Joints in cables, other than those contained within the enclosures of equipment, should be avoided wherever practicable.

Where fire-resistant cables have by their method of construction adequate mechanical protection (e.g. cables tested in accordance BS 8491), they should either be fixed directly to the building structure, or be installed such that they are enclosed in or carried upon cable management or containment systems. If the cables are fixed directly to the building, the fixings should provide adequate support in the presence of the potential hazards.

Where fire-resistant cables require additional mechanical protection, they should be enclosed in or carried upon cable management or containment systems. Such systems should provide adequate support and maintain necessary mechanical protection in the presence of the potential hazards. The systems and their supports should be sized to cater for the reduction in the tensile strength of steel when directly exposed to a fire temperature.

NOTE BS 7671 requires the installer of the mains supply to issue an electrical installation certificate.

7.2.3 Cable support systems

The cable support system should have a fire survival time equal to that of the cables it supports and for the same defined fire conditions. When sizing the support brackets for containment routes, which are intended to support fire-resistant cables in a fire condition and where the circuits are to maintain their integrity for a predetermined period, the drop rods and hangers should be sized to take into account the fact that the tensile strength of steel will be significantly reduced in a fire situation.

7.2.4 Penetrations

Where compartmentation is breached by cables and associated conduit, trunking or tray, the penetration should be made good using a penetration seal tested to BS EN 1366-3 with a classification equal to that of the compartment construction, and installed in accordance with the manufacturer's instructions.

7.3 Pneumatic pipework installation

All pneumatic pipework should be well supported and routed so as to avoid mechanical damage. Pipework for final service line installation below 2.5 m should be run on containment. The guidance in Section 6 of the BCAS Guide [6] should be followed for maximum intervals between pipe supports (see also Table 2).

Table 2 **Intervals between pipe supports**

Pipe outside diameter	Maximum intervals for vertical runs	Maximum intervals for horizontal runs
mm	m	m
4	1.0	0.6
6	1.0	0.6
8	1.2	0.6
10	1.2	1.0

Where fire-resistant pipework has by its method of construction adequate mechanical protection, it should either be fixed directly to the building structure or be installed such that it is enclosed in or carried upon cable management or containment systems. If the pipework is fixed directly to the building, the fixings should provide adequate support in the presence of the potential hazards.

When sizing the support brackets for containment routes that are intended to support fire-resistant pipework in a fire condition and where the circuits are to maintain their integrity for a predetermined period, the drop rods and hangers should be sized to take into account the fact that the tensile strength of steel will be significantly reduced in a fire situation.

The general provisions for testing in the BCAS Installation Guide [6] should be followed, but the specific performance requirements in BS EN 12101-10:2005, Clause **12**, should be met.

7.4 Smoke control duct installation

7.4.1 Smoke control duct installation practice

All hangers, joints and access panels should be installed in accordance with the manufacturer's instructions. Single or multi-compartment smoke control ductwork should be installed as applicable (see **6.11.1** and **6.11.2**). Any ductwork/shafts installed for smoke control should be checked and confirmed to meet the leakage limits defined in BS EN 12101-7.

7.4.2 Smoke control duct penetrations

Where compartmentation is breached by smoke control ducts the penetration should be made good using the method prescribed in the smoke control duct manufacturer's instructions. Single compartment smoke control duct should not breach fire compartment barriers, but may be installed at other barriers in accordance with the manufacturer's instructions.

Where smoke control dampers are to be used, the multi-compartment ductwork should pass through the compartment boundary and the correct penetration sealing method should be used for the duct. The smoke control damper should then be mounted in series or on the surface of the duct to allow easier maintenance and replacement if necessary.

7.4.3 Smoke control ductwork constructed on site

Smoke control ductwork should be installed by a competent person. The installer may take full responsibility by providing the ductwork under the scope of BS EN 12101-7.

The installer should provide a certificate to state that the smoke control ductwork has been installed correctly and that the leakage levels have been tested and verified correct.

7.5 Smoke control damper installation

7.5.1 Smoke control damper installation practice

The smoke control dampers should be fitted to the duct, in the duct or in compartment boundaries according to the manufacturer's instructions. Single or multi-compartment smoke control dampers should be installed as applicable (see **6.4.10.1** and **6.4.10.2**).

7.5.2 Smoke control damper penetrations

Where compartmentation is breached/protected by smoke control dampers, the penetration should be made good using the method prescribed in the smoke control damper manufacturer's instructions. Single compartment smoke control dampers should not be used to protect fire compartments, but may be installed at other barriers following the manufacturer's instructions.

Where smoke control dampers are to be used, the multi-compartment ductwork should pass through the compartment boundary and the correct penetration sealing method should be used for the duct. The smoke control damper should then be mounted in series or on the surface of the duct to allow easier maintenance and replacement if necessary.

7.6 Deviations from design

Any deviations from the design due, for example, to site conditions should be agreed by all appropriate parties and be recorded in the installation documentation (e.g. as-built drawings).

7.7 Completion of installation work

On completion of each element of the installation work, e.g. pipework or cabling, each installer should issue a certificate signed by a competent person (see **B.2**).

8 Commissioning, documentation, certification and acceptance

8.1 Commissioning

NOTE The process of commissioning involves thorough testing of the installed smoke control equipment, including interactions with other systems.

The responsibility of the commissioning engineer is to verify that the system operates correctly in the manner designed and that the installation workmanship is of an adequate standard. It is therefore necessary for the commissioning engineer to be provided with the agreed specification for the system.

8.1.1 The system should be commissioned by a competent person (see **8.1.2**), who has access to the requirements of the designer (i.e. the system specification) and any other relevant documentation or drawings.

8.1.2 The person commissioning the smoke control system should possess at least a basic knowledge and understanding of the activities covered in Clause **5**, Clause **6** and Clause **7**.

8.1.3 At commissioning, the entire system should be inspected and tested to ensure that it operates satisfactorily and that, in particular:

a) labelling or other means of visual identification, if specified, have been carried out;

b) the agreed "cause and effect" requirements are correctly implemented (see **6.7**) and the system is tested and responds to any planned method of initiation;

c) no changes to the building since the time of the agreed design have compromised the system's conformity with the design specification (e.g. erection of new partitioning that affects the effectiveness of the smoke control system);

d) siting of control, indicating and power supply equipment is inspected and verified;

e) primary power supplies are inspected as far as reasonably practicable;

f) secondary power supplies and the actual load currents of the system, in all circumstances, are close to the predictions used by the designer to determine the capacity;

g) when the primary power is removed, the secondary power supply operates within the interruption time specified in BS EN 12101-10;

h) when the duty equipment fails, standby equipment operates, e.g. duty standby fan sets and uninterruptable power supplies (UPS) equipment;

i) labels, visible when secondary power supplies (e.g. batteries) are in their normal position, are fixed to batteries, indicating the date of installation;

j) as far as it is reasonably practicable to ascertain, the specified cable type has been used in all parts of the system and the workmanship conforms to the design and relevant standards;

k) all fault monitoring functions operate correctly by simulation of fault conditions;

l) all relevant documentation has been provided to the relevant responsible person;

m) on completion of commissioning, a certificate signed by a competent person (see the example given in **B.3**) is issued.

All results obtained during the commissioning process should be clearly recorded.

8.2 Documentation

On completion of the system, the following documentation should be provided to the relevant responsible person.

a) Certificates for design, installation and commissioning of the system (see Annex B).

b) An adequate operation and maintenance manual for the system, providing information specific to the system in question, including:

1) a list of equipment provided and its configuration (e.g. schematic diagram), including use and operation of the system;

2) routine weekly and monthly testing of the system by the user or their appointed agent;

3) information about service and maintenance of the system;

4) the importance of ensuring that changes to the building, such as relocation of partitions, do not affect the standard of protection;

5) other user responsibilities.

c) As-fitted drawings indicating, but not limited to:

1) the positions of all control, indicating and power supply equipment;

2) the positions of all equipment that might require routine attention or replacement;

3) the type, sizes and actual routes of cables.

NOTE The cable routes shown in the drawings need to comprise a reasonable representation of the route followed, such as to enable a competent person to locate the cable in the event of a fault or need for modification or extension of the system. A simple schematic showing the sequence in which devices are wired is unlikely to satisfy this recommendation, other than in small, simple systems. In some complex buildings a cabling schedule cross-referencing the drawings might be necessary in order to help explain the cable routes.

d) A logbook (see Annex C) for recording the information.

e) A record of any agreed deviations from the original design specification.

8.3 Certification

8.3.1 On, or as soon as practicable after, completion of each of the following processes, a certificate should be issued by the organization(s) responsible for the process, certifying compliance with the recommendations of this standard relating to the following, and clearly identifying any deviations (see Annex B).

a) Design.

b) Installation.

c) Commissioning.

d) Acceptance.

8.3.2 Regardless of whether each process is undertaken by one organization or different organizations, separate certificates should be issued. An organization may issue a certificate for the process(es) for which it is responsible, regardless of whether a certificate has been issued for either of the other processes.

8.3.3 The person(s) who signs these certificates should be competent to verify whether the recommendations of this standard in respect of the process to which each certificate refers have, or have not, been satisfied.

NOTE The relevant responsible person might subsequently rely on the certificates as, for example, evidence of compliance with legislation. Liability could arise on the part of any person or organization that issues a certificate without due care in ensuring its validity.

8.3.4 Where modifications are carried out to a system, the relevant responsible person should request that the organization responsible for the work issues a modification certificate (see **B.6**).

8.4 Acceptance

8.4.1 The relevant responsible person should be asked to complete and sign an acceptance certificate (see **B.4**) provided by the organization bearing contractual responsibility for the system upon completion. The purpose of this certificate is to provide a record that the responsible person is satisfied that the requirements of the specification have been met. The certificate should also confirm that adequate documentation has been handed over to the responsible person, including the design, user instructions and maintenance instructions.

NOTE In the case of small, simple systems, or systems installed in the premises of small organizations with little relevant in-house expertise, acceptance might involve little more than a brief inspection of the system by the user, demonstration of its operation by the commissioning engineer, and handover of the relevant documents to the user. In large, complex systems, it is likely that the responsible person would wish to witness relevant tests as part of a formal and structured acceptance procedure.

8.4.2 Acceptance procedures should be carried out in accordance with the agreed specification, including any tests that are to be witnessed and details of the witnessing procedure.

8.4.3 Before accepting a system, the relevant responsible person (or appropriate representative of the responsible person) should check that:

a) all installation work appears to be satisfactory;

b) the system fully operates when the primary power supply is removed;

c) the following documents have been provided to the relevant responsible person:

   1) as-fitted drawings;

   2) operating and maintenance instructions;

   3) certificates of design, installation and commissioning;

   4) a logbook;

d) sufficient representatives of the user have been adequately trained in the operation of the system;

e) all relevant tests defined in the specification have been witnessed.

9 Maintenance and servicing

9.1 General

NOTE 1 It is essential for the safety of the occupants of a building that the smoke control system will operate in accordance with the design intent in the case of an emergency.

Frequent inspection of the system should be undertaken by a named and suitably-trained member of the premises management team.

Smoke control equipment should only be maintained by a competent person with specialist knowledge of smoke control systems, adequate access to spares and sufficient information regarding the system.

NOTE 2 Competence can be assured by using organizations that are third-party certificated.

Regular tests should be carried out to identify any component or equipment failure that might prevent the smoke control system operating correctly in the case of an emergency.

NOTE 3 In large or complex systems, it might be impractical to carry out all the required tests on one occasion, so that tests might need to be carried out to a defined programme over a fixed period.

Any faults/damage identified should be acted upon immediately, logged and repaired in a timely manner.

When changes are made to the building (e.g. erection of new partitioning that affects the effectiveness of the smoke control system), the responsible person should ensure that the performance and operation of the smoke control system is maintained. If necessary, the responsible person should consult a competent smoke control designer.

9.2 Routine inspection and maintenance

Routine inspection and maintenance of the smoke control system should be carried out in accordance with BS 9999:2008, Annex V.

Periodic inspection and maintenance should be carried out to identify unmonitored faults, take preventive measures and ensure the continued reliability of the system, and make the user aware of any changes to the building that affect the protection afforded by the system.

The system should be tested to ensure that it operates correctly and that, in particular:

a) the agreed "cause and effect" requirements function correctly and the system responds to any planned method of initiation;

b) when the primary power is removed, the secondary power supply operates within the interruption time specified in BS EN 12101-10;

c) when the duty equipment fails, standby equipment operates, e.g. duty standby fan sets and UPS equipment;

d) labels, visible when secondary power supplies (e.g. batteries) are in their normal position, are fixed to batteries, indicating the date of installation or date of last replacement and that those dates are within the manufacturer's recommended life cycle;

e) all fault monitoring functions operate correctly, e.g. by simulation of fault conditions.

9.3 Non-routine maintenance

NOTE 1 From time to time, the smoke control system is likely to require non-routine maintenance, including special maintenance.

Non-routine maintenance includes:

- *a special inspection of an existing smoke control system when a new organization takes over maintenance of the system;*
- *repair of faults or damage;*
- *modification to take account of extensions, alterations or changes in use or occupancy of the building;*
- *inspection and testing of the system following a fire.*

9.3.1 On appointment of a new maintenance organization:

a) a special inspection of the existing smoke control system should be commissioned, referencing any records, including the system design performance requirements, in order to produce a plan for effective maintenance of the system;

b) if no suitable records exist, a system design performance requirement should be agreed or developed (see **5.2**);

c) if necessary, the physical performance of the system should be checked, e.g. fan flow rates;

d) nonconformities should be documented and identified to the premises management.

NOTE 2 Not all nonconformities need to be rectified; this is a matter for the user to determine, based on the advice of the maintenance organization, the enforcing authorities, the insurer and any third-party advisers engaged by the user, as appropriate.

e) if no logbook exists, the maintenance organization should provide a suitable logbook.

9.3.2 For arranging repair of faults or damage:

a) where maintenance is carried out by a third party, there should be an agreement for emergency call out to deal with any fault or damage that occurs to the system and this agreement should be such that a technician of the maintenance organization can normally attend the premises within at least 24 hours of a call from the user;

NOTE It is accepted that this might not be possible in very remote areas and certain offshore islands, in which case this may be regarded as a variation from the recommendations of this standard in respect of maintenance arrangements and will need to be recorded in the system logbook.

b) the name and telephone number of any third party responsible for maintenance of the system should be prominently displayed at the main control panel and the records and documentation kept updated;

c) the user should record all faults or damage in the system logbook, and arrange for repair to be carried out as soon as possible.

9.4 Modification

9.4.1 For modification work, regardless of whether it is carried out on site or remotely:

a) the responsibility of modifying a smoke control system should rest with a person who is competent in the principles of smoke control design, conversant with the installed system, and has access to the as-fitted drawings;

NOTE This person may, for example, be the original designer or a competent representative of the user or maintenance organization.

b) before modifying a smoke control system, care should be taken to ensure that the proposed modifications do not detrimentally affect the conformity of the system with fire safety legislation;

c) the premises management should be aware of and agree in writing any modifications proposed for the system;

d) all components, circuits, system operations and site-specific software functions known to be affected by the modifications should be tested for correct operation following the modifications;

e) on completion of the modifications, all as-fitted drawings and other relevant system, records should be updated as appropriate;

f) on commissioning of the work and completion of the tests, a modification certificate should be issued, confirming that the work has been carried out in accordance with Clause **6**, Clause **7** and Clause **8**, or identifying any deviations.

9.4.2 Following any fire:

a) a visual examination and suitable tests should be carried out on any other part of the system that lies within the fire area and other areas affected by corrosive smoke from the fire which might have been damaged by the fire;

b) where there is evidence of damage, suitable action should be taken (e.g. damaged components replaced);

c) circuits linked to, but external to, the smoke control system and indicating equipment that might have been affected by the fire should be tested for correct operation;

d) any defects found should be acted upon immediately, logged and repaired in a timely manner.

Annex A (informative) Statutory responsibility for a smoke control system

A.1 Construction site phase

Although the Regulatory Reform (Fire Safety) Order 2005 [7] applies to construction sites, the primary piece of legislation applicable during this phase is the Construction (Design and Management) Regulations 2007 [8], which require that, following handover of the smoke control system, responsibility for the maintenance of the initial performance of the smoke control system rests with the "duty holder" as defined within the Regulations. Where phased handover is planned, the duty holder is required to ensure that, at partial occupation, the same level of protection is provided to the occupied areas as will eventually be provided to the complete building at final handover.

After handover of the system, responsibility for the maintenance of the initial performance passes to the person responsible for the building.

A.2 Occupation phase

Upon full or partial occupation of the building, the Regulatory Reform (Fire Safety) Order 2005 [7] requires the responsible person to ensure that all fire safety systems (including the smoke control system) are subject to a suitable system of maintenance and are maintained in an efficient state, in efficient working order and in good repair. The Order also requires that where there are two or more responsible persons (whether on a temporary or permanent basis) each person has to coordinate and cooperate with the other, so far as is necessary to ensure the system is properly maintained.

Annex B (informative) Model certificates

B.1 Design certificate

Certificate of design of the smoke control system at:

Address: .....

.....

..... Postcode: .....

I/we being the competent person(s) responsible (as indicated by my/our signatures below) for the design of the smoke control system, particulars of which are set below, CERTIFY that the said design for which I/we have been responsible conforms to the best of my/our knowledge and belief with BS 7346-8:2013, Clause **6**, except for the deviations, if any, stated in this certificate.

Name (in block letters): ..... Position: .....

Signature: .... Date: .....

For and on behalf of: .....

Address: .....

.....

..... Postcode: .....

Deviations from the recommendations of BS 7346-8:2013, Clause **6**:

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Extent of system covered by the certificate: .....

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Installation and commissioning

It is strongly recommended that installation and commissioning be undertaken in accordance with BS 7346-8:2013, Clause **6** and Clause **7**.

Maintenance

It is strongly recommended that, after completion, the system is maintained in accordance with BS 7346-8:2013, Clause **9**.

B.2 Installation certificate

Certificate of installation of the smoke control system at:

Address: .....

.....

..... Postcode: .....

I/we being the competent person(s) responsible (as indicated by my/our signatures below) for the installation of the smoke control system, particulars of which are set below, CERTIFY that the said installation for which I/we have been responsible conforms to the best of my/our knowledge and belief with BS 7346-8:2013, Clause **7**, except for the variations, if any, stated in this certificate.

Name (in block letters): ..... Position: .....

Signature: .... Date: .....

For and on behalf of: .....

Address: .....

.....

..... Postcode: .....

The extent of liability of the signatory is limited to the system described below.

Extent of system covered by the certificate:

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Specification against which the system was installed:

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Deviations from the specification and/or BS 7346-8:2013, Clause **7**:

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Wiring has been installed and tested in accordance with BS 7346-8:2013, **7.2**. Test results have been recorded and are provided on the appended BS 7671 electrical installation certificate:

.....

Unless supplied by others, the as-fitted drawings have been supplied to the person responsible for commissioning the system.

B.3 Commissioning certificate

Certificate of commissioning for the smoke control system at:

Address: ……..

……

…….. Postcode: ……

I/we being the competent person(s) responsible (as indicated by my/our signatures below) for the commissioning of the smoke control system, particulars of which are set below, CERTIFY that the said work for which I/we have been responsible conforms to the best of my/our knowledge and belief with BS 7346-8:2013, **8.1**, except for the variations, if any, stated in this certificate.

Name (in block letters): ……. Position: ……...

Signature: …….. …….. Date: ……...

For and on behalf of: ……..

Address: ……..

……

…….. Postcode: ……

The extent of liability of the signatory is limited to the system described below.

Extent of system covered by the certificate:

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Deviations from BS 7346-8:2013, **8.1**.

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☐ All equipment operates correctly.

☐ Installation work is, as far as can be reasonably ascertained, of an acceptable standard.

☐ The entire system has been inspected and tested in accordance with BS 7346-8:2013, **8.1**.

☐ The system performs as required by the specification prepared by:

……

a copy of which I/we have given.

☐ The documentation described in BS 7346-8:2013, **8.2**, has been provided to the user.

The following work should be completed before/after (delete as applicable) the system becomes operational:

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B.4 Acceptance certificate

Certificate of acceptance for the smoke control system at:

Address: ……

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…….. Postcode: ……

I/we being the competent person(s) responsible (as indicated by my/our signatures below) for the acceptance of the smoke control system, particulars of which are set below, ACCEPT the system on behalf of:

……

……

……

Name (in block letters): …… Position: ……

Signature: …….. …….. Date: ……..

For and on behalf of: ……..

Address: ……..

……

…….. Postcode: ……

The extent of liability of the signatory is limited to the system described below.

Extent of system covered by the certificate:

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☐ All installation work appears to be satisfactory.

☐ The system is capable of giving an audible and intelligible voice alarm signal.

The following documents have been provided to the purchaser or user.

☐ As-fitted drawings.

☐ Operating and maintenance instructions.

☐ Certificates of design, installation and commissioning.

☐ A logbook

☐ Sufficient representatives of the user have been properly instructed in the use of the system, including, at least, all means of triggering voice alarm announcements and silencing and resetting the system.

☐ All relevant tests, defined in the purchasing specification, have been witnessed. (Delete if not applicable.)

The following work is required before the system can be accepted.

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……

B.5 Inspection and servicing certificate

Certificate of servicing for the smoke control system at:

Address: .....

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..... Postcode: .....

I/we being the competent person(s) responsible (as indicated by my/our signatures below) for the servicing of the smoke control system, particulars of which are set below, CERTIFY that the said work for which I/we have been responsible conforms to the best of my/our knowledge and belief with BS 7346-8:2013, Clause **9**, except for the variations, if any, stated in this certificate.

Name (in block letters): ..... Position: .....

Signature: .... Date: .....

For and on behalf of: .....

Address: .....

.....

..... Postcode: .....

The extent of liability of the signatory is limited to the system described below.

Extent of system covered by the certificate:

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Deviations from BS 7346-8:2013, Clause **9**:

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☐ Relevant details of the work carried out and faults identified have been entered in the system logbook.

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B.6 Modification certificate

Certificate of modification for the smoke control system at:

Address: ……

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…… Postcode: ……

I/we being the competent person(s) responsible (as indicated by my/our signatures below) for the modification of the smoke control system, particulars of which are set below, CERTIFY that the said work for which I/we have been responsible conforms to the best of my/our knowledge and belief with BS 7346-8:2013, Clause **7**, except for the variations, if any, stated in this certificate.

Name (in block letters): …… Position: ……

Signature: …… ……... Date: ……

For and on behalf of: ……

Address: ……

……

…… Postcode: ……

The extent of liability of the signatory is limited to the system described below.

Extent of system covered by the certificate:

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……

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……

Deviations from BS 7346-8:2013, Clause **7**:

……

……

……

……

☐ Following the modifications, the system has been tested in accordance with BS 7346-8:2013, Clause **7**. Test results have been recorded and are provided on the appended BS 7671 electrical installation minor works certificate.

☐ Following the modifications, as-fitted drawings and other system records have been updated as appropriate.

I/we the undersigned confirm that the modifications have introduced no additional variations from BS 7346-8:2013, other than those recorded above.

Signed: ……

Capacity: ……

(e.g. maintenance organization, system designer, consultant or user representative)

B.7 Ductwork installation certificate

Certificate of installation of the smoke control system ductwork at:

Address: ……

……

…….. Postcode: ……..

I/we being the competent person(s) responsible (as indicated by my/our signatures below) for the installation of the smoke control system ductwork, particulars of which are set below, CERTIFY that the said installation for which I/we have been responsible conforms to the best of my/our knowledge and belief with BS 7346-8:2013, Clause **7**, except for the variations, if any, stated in this certificate.

Name (in block letters): …… Position: ……

Signature: …….. ……... Date: ……....

For and on behalf of: ……..…

Address: ……...

……

…….. Postcode: ……

The extent of liability of the signatory is limited to the system described below.

Extent of system covered by the certificate:

……

……

……

……

Specification against which the system was installed:

……

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……

Variations from BS 7346-8:2013, Clause **7**:

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……

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Ductwork has been installed and tested in accordance with BS EN 12101-7. Test results have been recorded and are appended to this certificate:

……

Unless supplied by others, the as-fitted drawings have been supplied to the person responsible for commissioning the system.

Signed: ……

Capacity: ……..

Annex C (informative) Model format of system logbook

Foreword

It is recommended that this logbook be maintained by a relevant member of the premises management to ensure that every entry is properly recorded.

In order to satisfy the recommendations of BS 7346-8 the following need to be recorded.

- The names of the people responsible for the smoke control system.
- Brief details of the maintenance arrangements.
- Dates of all tests.
- Dates of all fires to which the system responds.
- Dates and types of all faults and defects.
- Dates and types of all maintenance (e.g. service visits or non-routine maintenance).

Reference data

Address of protected premises:

. . . . . .

. . . . . .

. . . . . .

The system is maintained under contract by:

. . . . . until: . . . . . .

Telephone number: . . . . . .

Contact instructions: . . . . . .

The smoke control system comprises the following components.

- List of installed components.
- Schematic diagram.

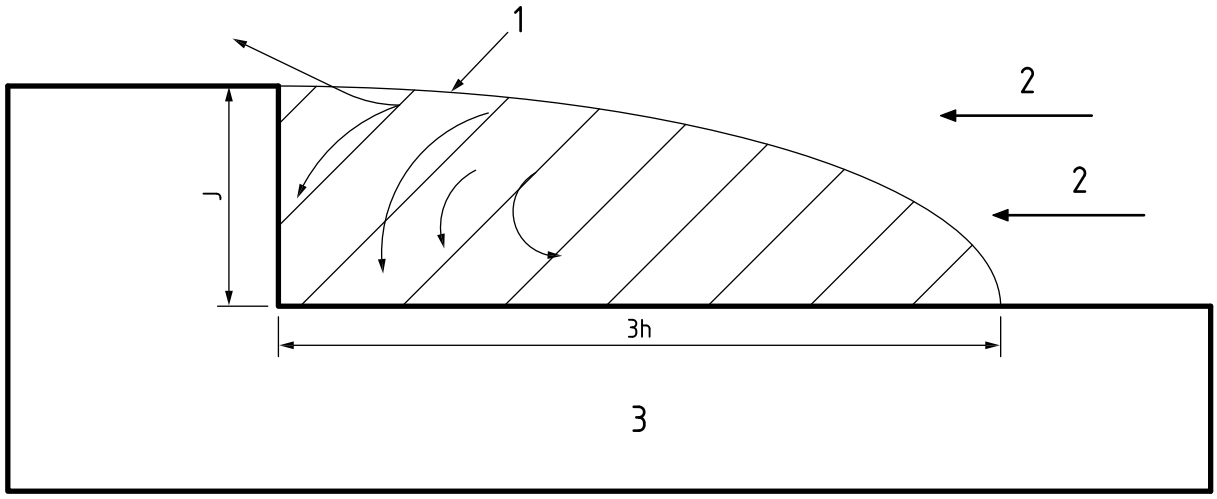
Figure C.1 **Sample logbook event recording table**

Date	Nature of work (PPM/Call out)	Engineer's name	Activation cause (Location/ Device ref.)	System operation satisfactory? (Yes/No)	Signature	Remedial action needed	Date remedial work completed	Signature

Annex D (informative) Location of roof ventilators in areas potentially subject to positive pressures

NOTE Copyright is claimed in Figures D.1 to D.7. Reproduction of these figures and making products from them might infringe that copyright. Details of the copyright owner can be found in the Foreword, Information about this document.

Figure D.1 **Effect of adjacent tall buildings: Section through building with adjacent or adjoining high bay**



Key

1 Possible area of positive pressure created on the low-level roof in adverse weather conditions
2 Wind direction
3 Area of roof where natural smoke ventilators are not to be used

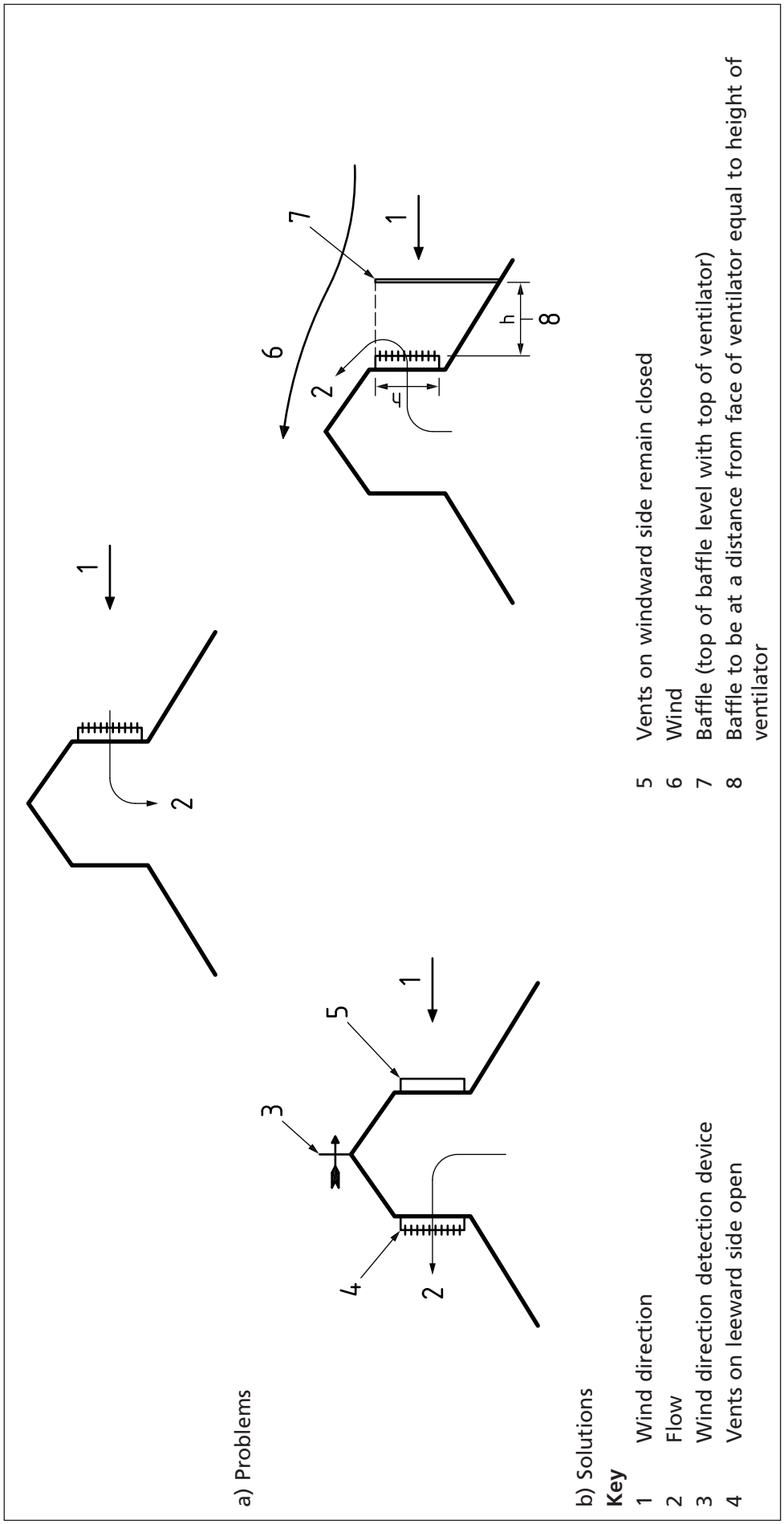
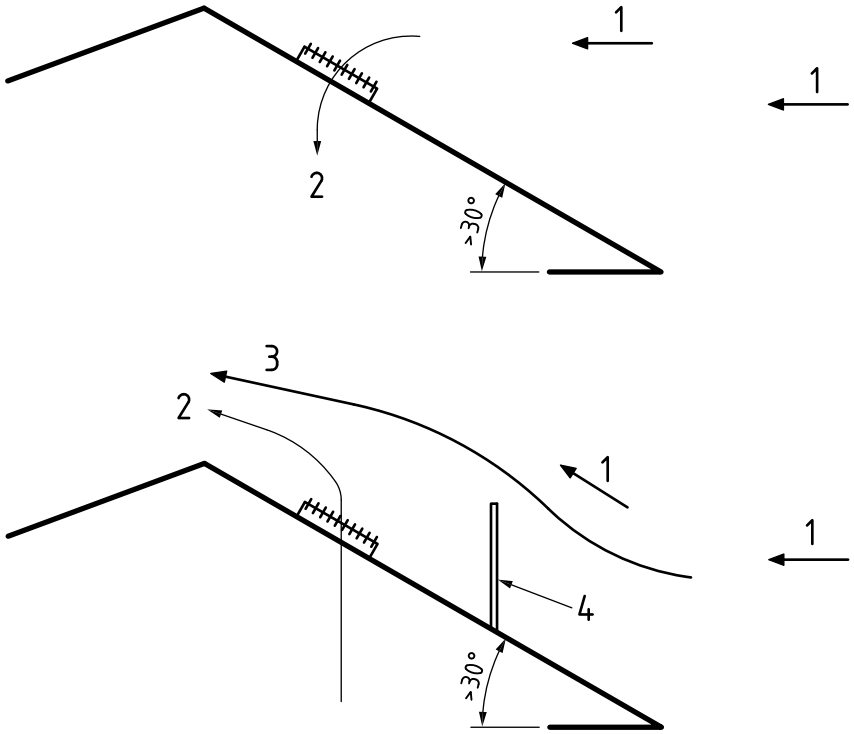


Figure D.2 **Louvred ventilators installed in the vertical**

Key

1 Wind direction
2 Flow
3 Wind direction detection device
4 Vents on leeward side open
5 Vents on windward side remain closed
6 Wind
7 Baffle (top of baffle level with top of ventilator)
8 Baffle to be at a distance from face of ventilator equal to height of ventilator

Figure D.3 **Louvred ventilators installed at an angle greater than 30°**



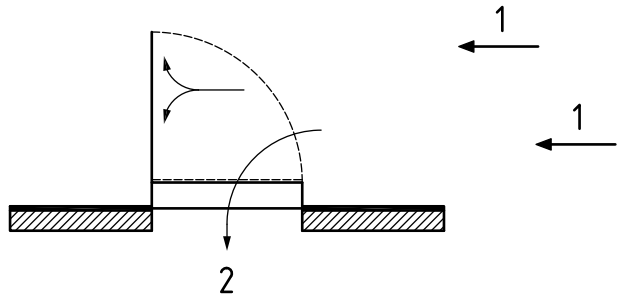
a) Problem

b) Solution

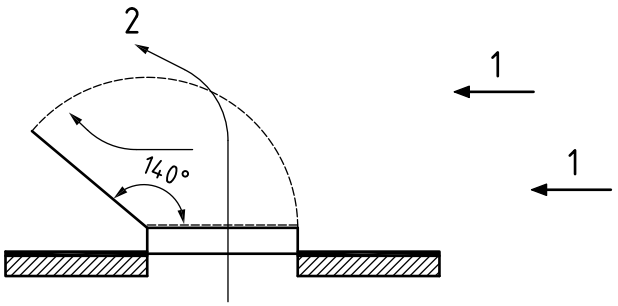
Key

1	Wind direction	3	Wind
2	Flow	4	Baffle

Figure D.4 **Single-flap ventilators installed at 0° – 10° to the horizontal**



a) Problem

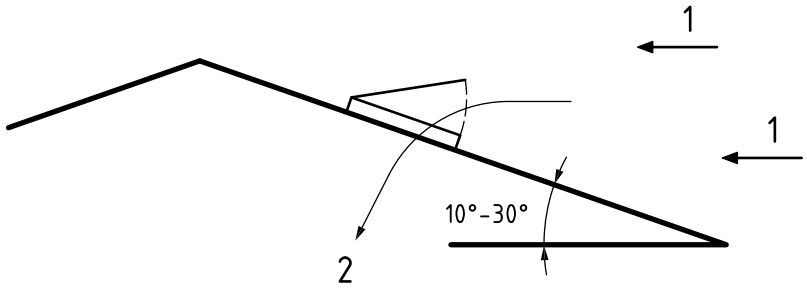


b) Solution

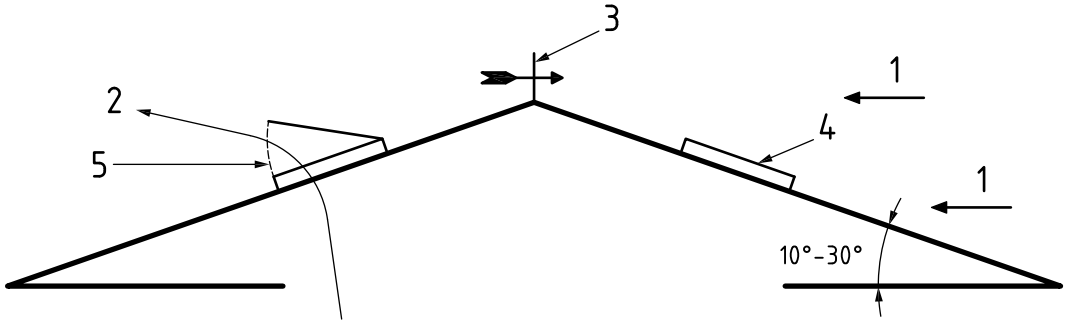
Key

1 Wind direction
2 Flow

Figure D.5 **Single-flap, top-hinged units installed at 10° – 30° above horizontal**



a) Problem

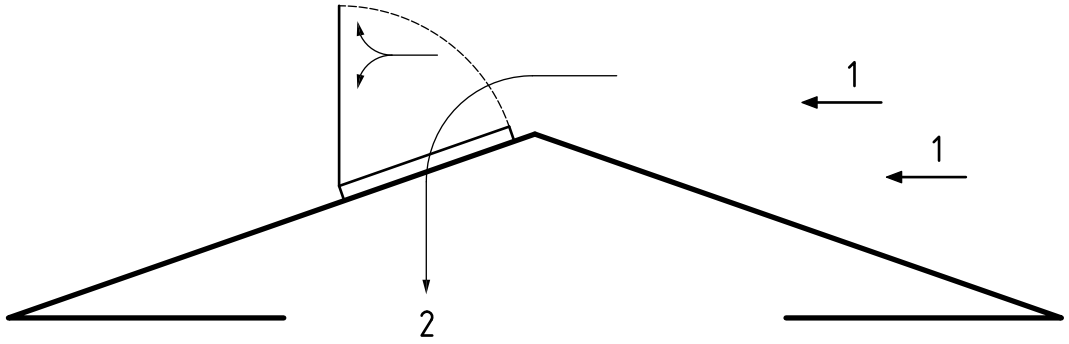


b) Solution

Key

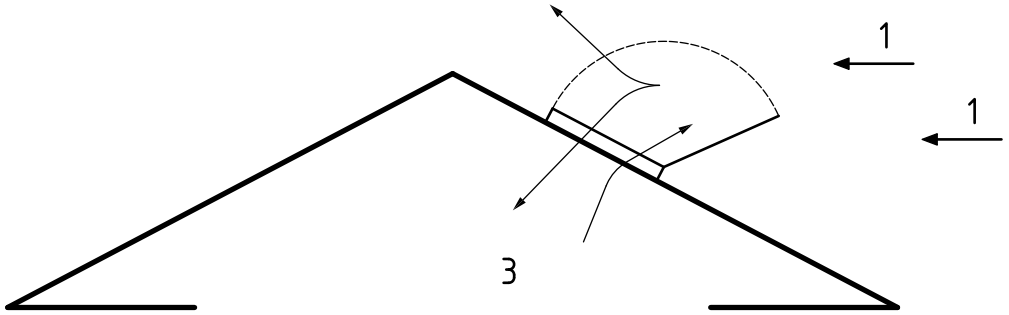
1 Wind direction
2 Flow
3 Wind direction detection device
4 Vents on windward side remain closed
5 Only vents on leeward side open

Figure D.6 **Bottom-hinged, single-flap ventilators**



a) Problem: Ventilators sited too high up the roof slope

Solution: Top of opening element should not be above ridge level.



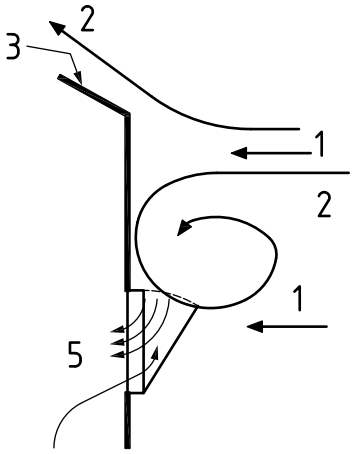
b) Problem: Ventilators open too far, creating turbulent flow

Solution: The opening element should not open beyond the vertical.

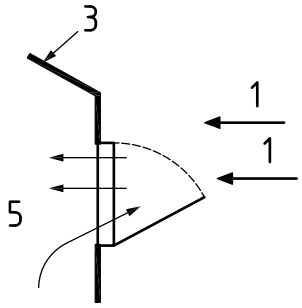
Key

1 Wind direction
2 Flow
3 Turbulent flow

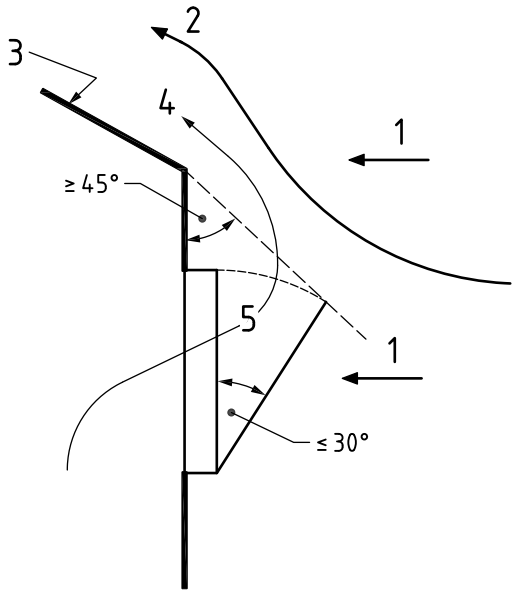
Figure D.7 **Single-flap top-hinged units installed at 10° – 30° above horizontal**



a) Problem: Back pressure created by wind striking the wall above ventilator



b) Problem: Ventilators open too far into wind

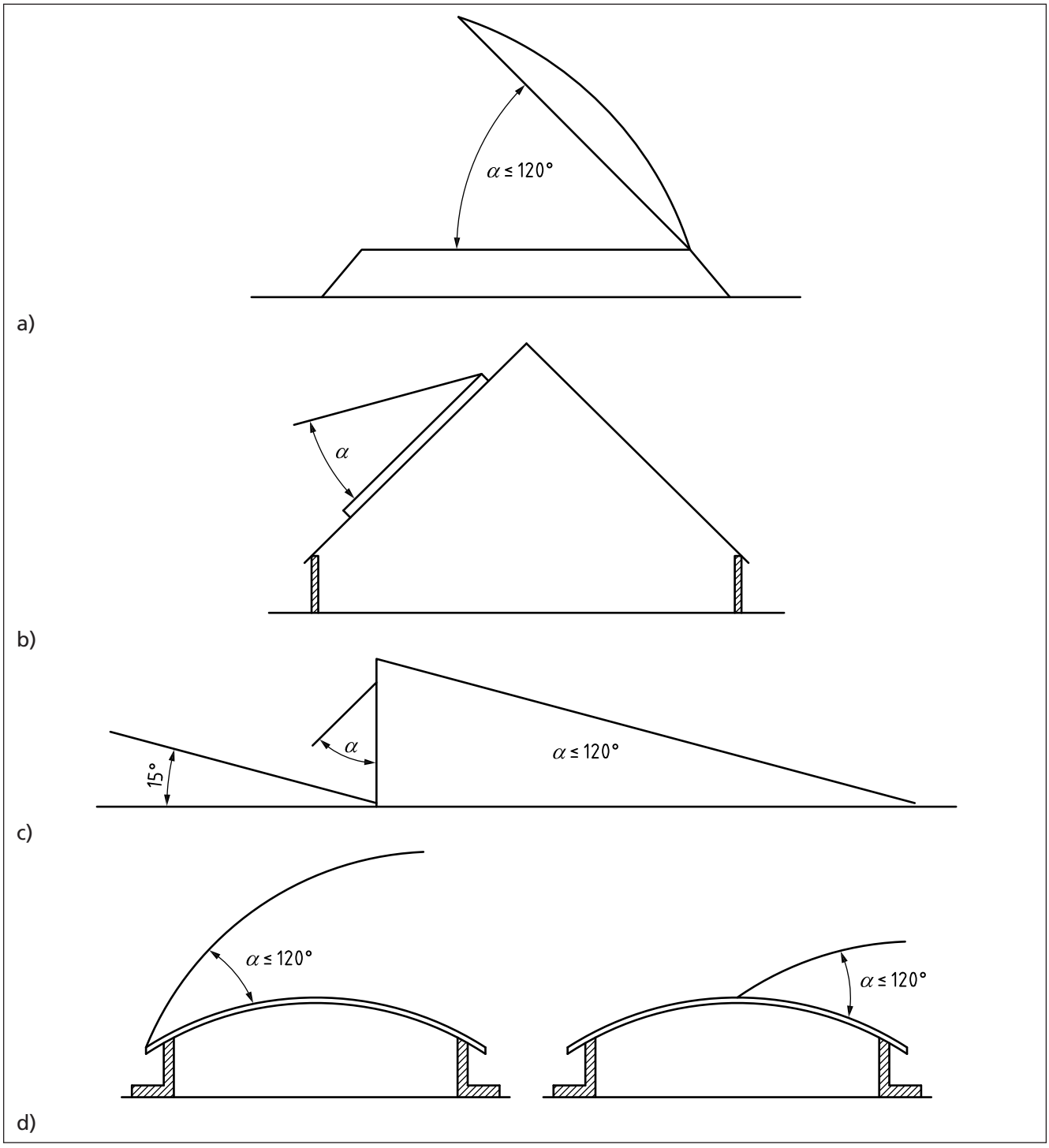


c) Solution

Key

1 Wind direction
2 Wind
3 Roof
4 Flow
5 Turbulent flow

Figure D.8 **Examples of types of ventilators probably leading to negative discharge**



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