Guide to Assessing High Rise Residential Smoke Control Systems

Smoke control systems protecting the common escape routes from higher risk residential buildings (HRRBs)

GROUP SCS | systemair

Introduction

A framework that helps competent contractors assess existing smoke control systems

Smoke vent maintenance encompasses more than just testing smoke detectors. Issuing a service certificate after carrying out an annual inspection of a system is giving tacit approval to its suitability which can have serious implications.

BS7346:8 Components for Smoke Control Systems: Code of Practice for design installation, commissioning and maintenance recommends that special inspections of smoke vent systems are completed when a new contractor takes over maintenance. This will also be required as part of a building safety case for submission to the Building Safety Regulator under the Building Safety Act.

The frequent lack of sufficient documentation available on site can make it difficult to ascertain the original design intent for systems, particularly fire engineered solutions that do not follow the approved guidance. In such cases an assessment must be made using fire engineering to arrive at appropriate performance criteria that can be tested to on site. Unless clear performance requirements are available then any regular testing and maintenance will be inadequate and inconclusive.

Failing to adequately maintain a fire system breaches Section 9 & 18 of the Regulatory Reform (Fire Safety) Order 2005:

- **Section 9 Risk Assessment** - failure to inform responsible persons of deficiencies in fire systems affecting the accuracy of the fire risk assessment in place
- **Section 18 Safety Assistance** - A person is to be regarded as competent for the purposes where he has sufficient training and experience or knowledge and other qualities to enable him properly to assist in undertaking the preventive and protective measures.

This document offers a framework for use by competent contractors to manage and record the process of systematically assessing existing smoke control systems and making recommendations for remedial work where required.

Introduction

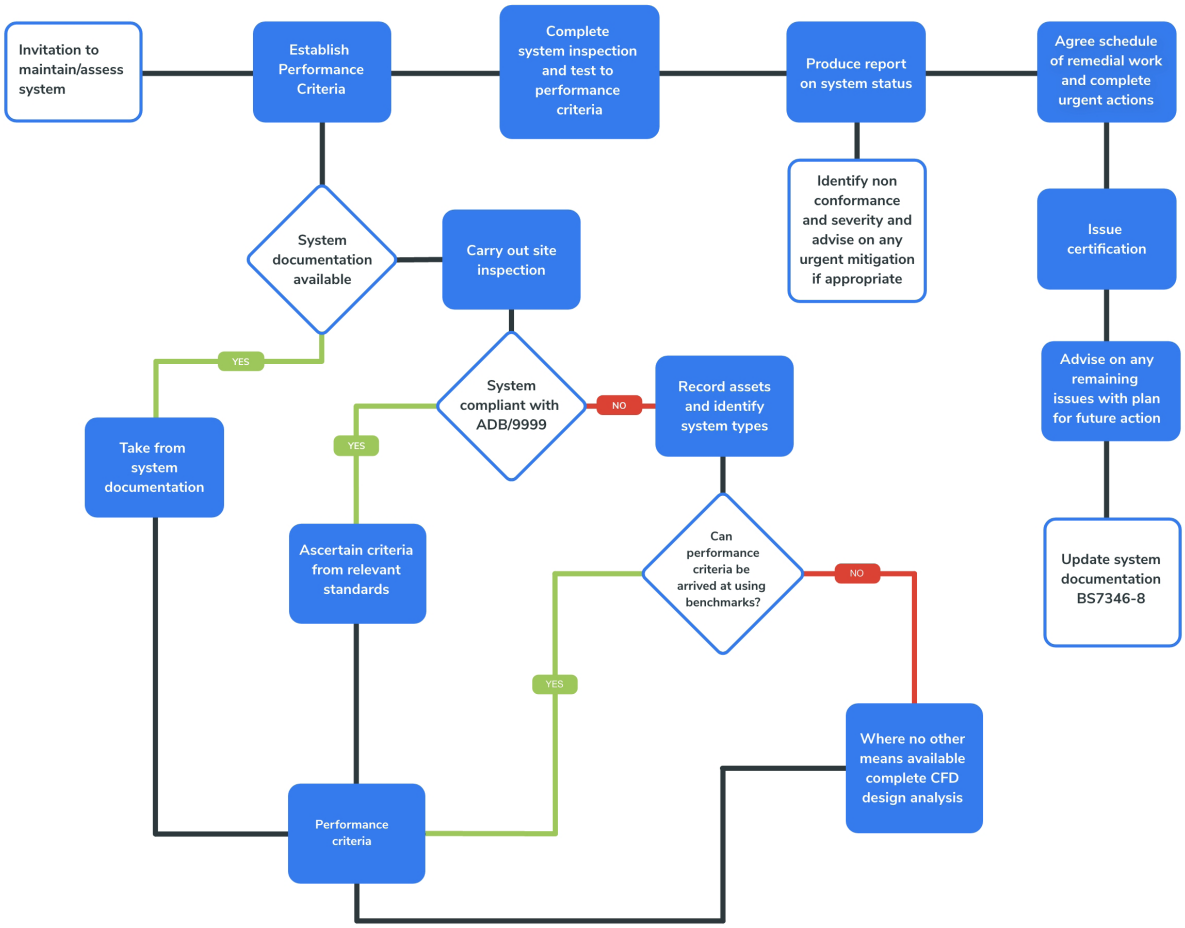
A framework that helps competent contractors assess existing smoke control systems

Competence

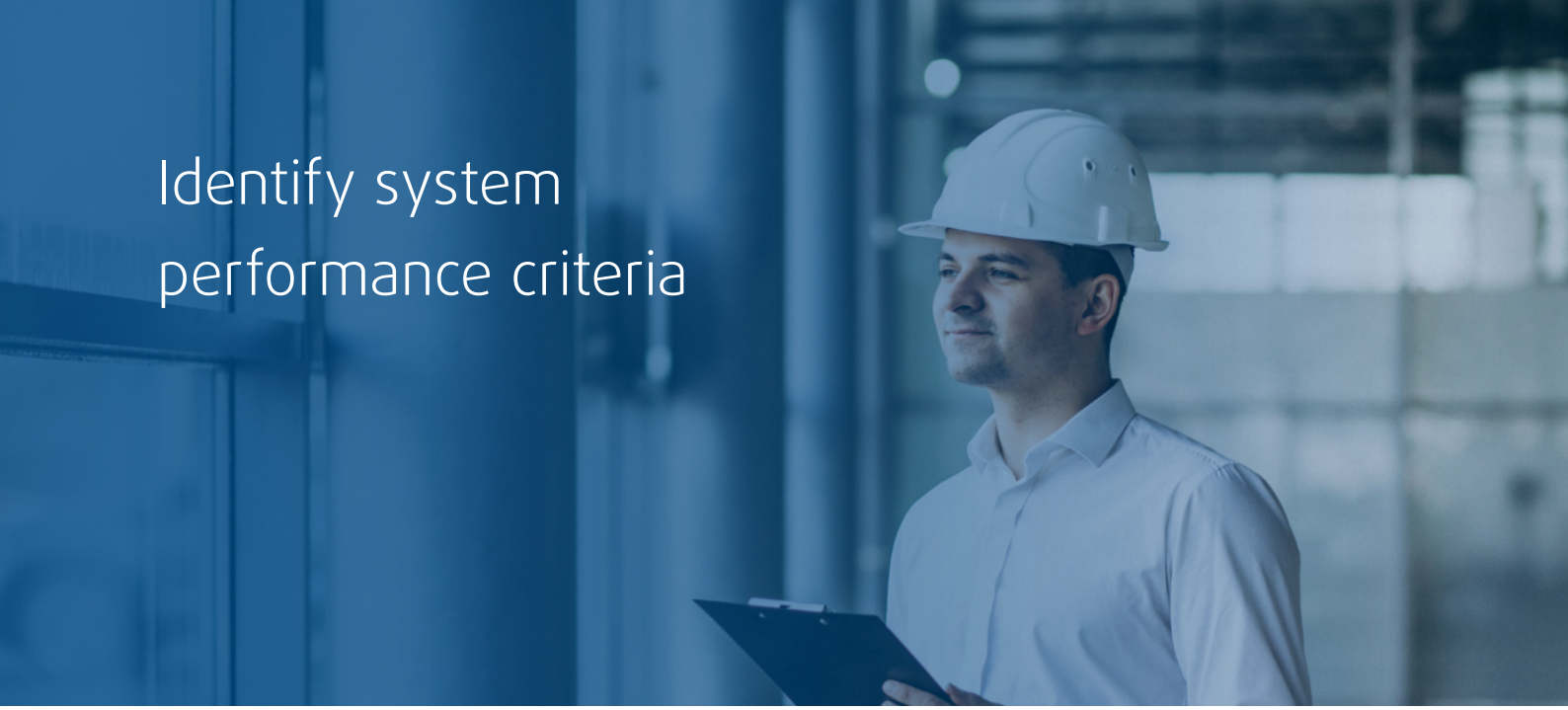
A good understanding of the Building Regulations and standards relating to smoke ventilation is required to complete the works described in this document. Smoke ventilation expertise involves a broad range of knowledge including fire safety, air movement and electrical engineering and staff should be suitably trained and experienced. Third party certification to an appropriate scheme is advisable as a minimum requirement.

Assessment Flowchart

The Group SCS system assessment flowchart offers a step-by-step guide to assessing, inspecting, testing and certifying smoke ventilation systems in HRRBs. Simply follow the process using the additional instructions and guidance in this document. For buildings that fall outside of the guidance then please contact our Aftercare department for advice.



Identify system performance criteria



For an effective appraisal of an existing installation, it is essential to gain an as-thorough-as-possible understanding of the purpose of the system, the design approach taken, the appropriate product specification and the service history.

Wherever possible the required performance criteria should be established before attending site so that there are clear objectives for site testing activities.

1 Interrogate System Documentation

BS 7346-8:2013 Components for smoke control systems – Code of practice for planning, design, installation, commissioning and maintenance details the information that should be provided at handover as follows:

1. As-fitted drawings
2. Operating and maintenance instructions
3. Certificates of design, installation and commissioning
4. A logbook

The standard of information available will vary greatly depending on the capability of the installer and for effective long-term maintenance it is recommended that where information is not available at the site then the installer is contacted to request the above information.

If there is insufficient information available, then a preliminary site survey will be required to identify what is installed.

2 Ascertain System Type(s)

ADB-Compliant Systems:

1. **Natural smoke shaft (BRE shaft)** - Normally a builders work shaft rising vertically though the building with a vent at each level controlled by smoke detection and a natural vent at the head of the shaft.
2. **Automatic Opening Ventilator** - A ventilator in the lobby opening directly to atmosphere controlled by smoke detection sized to give a specified free area.
3. **Pressurisation System** - Air will naturally try to move from an area of higher pressure to an area of lower pressure. By increasing the pressure in the protected areas (i.e. the escape routes) above that in the areas where the fire is likely to occur (in this case the apartments), it is possible to prevent smoke spread into these escape routes. This is usually achieved by pressurising the parts of the escape route to be protected.

If the system complies with the requirements of Approved Document B then the performance criteria is detailed within the guidance (the relevant parts of ADB are reproduced in Appendix B).

When assessing an existing building it is inappropriate to impose current guidance retrospectively however there are guidelines that can be used, for example, the LGA Guide to Fire Safety in Purpose Built Flats. The guide was produced in 2010 and is currently in the process of being updated. For smoke control systems, it's generally accepted that firefighting systems installed to the 2006 edition of the Building Regulations can be brought up to the standard of the day and maintained in efficient working order. Older systems based on smoke dispersal by means of cross-ventilation are no longer accepted as an effective means of keeping common escape routes clear of smoke.

The primary objective is to meet the requirements of the Building Regulations. Also, where appropriate under the Construction Products Regulation (CPR), the products used should be CE/CA marked to a harmonised European Standard.

The current standards for smoke control products are detailed in the tables in Appendix C, however it is important to consider the standards prevailing at the time of the implementation of the system.

Fire Engineered Solutions - Mechanical Smoke Ventilation Systems (MSVS):

A fire engineered smoke control solution that sits outside the prescriptive guidance in ADB and is designed for the building, often to justify the extension of escape travel distances.

There are many different types of MSVS and a wide variety of solutions within each category. The Smoke Control Association Guide to Smoke Control in Apartment Buildings contains the most comprehensive guidance on MSVS and should be used as a reference document in assessing compliance. Broad system categories as defined by the SCA are:

1. **Mechanical Extract/Natural Inlet** - Natural ventilation is provided to give replacement air to the extract fans, this may be via automatic opening vents or windows to atmosphere or an additional ventilation shaft.
2. **Mechanical Extract/Mechanical Inlet** - Commonly known as a push pull system, using two shafts, one for inlet and another for extract. Note it is possible to have reversable fans and either shaft can extract depending on the fire location.
3. **Mechanical Extract Only** - These systems obtain their replacement air from the vent in the stairwell and this can be achieved by several methods including "floppy doors" where the stair door is pulled open by the pressure drop in the lobby caused by the fan, or the fan may be modulated according to the pressure difference between stair and lobby so that it speeds up when the stair door is open.

The critical site measurement for MSVS will be the extract flow rate from the protected lobby and this is the minimum requirement needed to complete a meaningful assessment of system performance.

The project specific acceptance criteria should be detailed within the design document submitted to Building Control as part of the approval process and
should also be contained within the commissioning documentation. Review the commissioning reports if available to assess actual system performance at handover of project.

3 Complete a Design Check

Where there is insufficient information available to identify the design intent of a fire engineered solution then a design check by a suitably qualified fire engineer will be required. This will normally include a computational fluid dynamic (CFD) model to demonstrate safe conditions within the building.

4 Document the acceptance criteria for site testing phase

Once the performance requirements have been established, they should be documented and form the basis of the site inspection and testing exercise. See examples of this in the tables below.

Fire-Engineered System

Mechanical Smoke Ventilation System	Means of Escape	Firefighting
Extract flow rate	2.5m^3/s	5.0m^3/s
Max Door Opening Force	100N	100N
Damper Opening Time	60 seconds	
Fan Ramp up time	90 seconds	
Power Supply Changeover	15 seconds	
Maximum pressure difference lobby/stair	25Pa	

ADB-Compliant System

Automatic Opening Ventilator (AOV)

Minimum free area (see appendix B)	1.5m^2
Maximum opening time	60 seconds
Open on smoke detection in lobby	
Other floors to be locked out on activation	
Stairwell vent to be opened with lobby vent	
Minimum cable category to BS8519	Cat 2 or Cat 3 for firefighting
Power supply to be CE/CA marked to BS EN 12101-10	
Ventilator CE/CA marked to BS EN 12101-2	

5 Complete the site survey and tests

Group SCS has developed inspection and test regimes for common system types to ensure tests are completed and documented thoroughly and consistently. Standard checklists for system types are available to Group SCS Aftercare Providers, Approved Contractors, and Approved Partners, including:

1. Mechanical Smoke Ventilation Systems (MSVS)
2. Automatic Opening Ventilators (AOV)
3. Natural Smoke Shafts (BRE Shaft)
4. Pressurisation Systems
5. Car Park Ventilation Systems
6. Basement Systems

6 Reporting

On completion of the survey a report should be prepared and issued to the client as soon as practicable, detailing the current status of the system and identifying any areas of non-conformance together with recommendations for remedial action where needed. An indication of the severity of any defects should be provided highlighting any issues preventing correct functioning of the system which prejudice the safety of the occupants of the building.

On completion of any remedial works required, the on-site documentation should be brought up to date and then routine testing preventative maintenance can commence.

Appendix

Appendix A - Excerpts from ADB

Smoke control in common escape routes

3.49 Despite the provisions described, it is probable that some smoke will get into the common corridor or lobby from a fire in a flat.

There should therefore be some means of ventilating the common corridors/lobbies to control smoke and so protect the common stairs. This means of ventilation offers additional protection to that provided by the fire doors to the stair, as well as some protection to the corridors/lobbies.

Ventilation can be natural (paragraphs 3.50 to 3.53) or mechanical (paragraph 3.54).

Smoke control of common escape routes by natural smoke ventilation

3.50 Except in buildings that comply with Diagram 3.9, the corridor or lobby next to each stair should have a smoke vent. The location of the vent should comply with both of the following.

1. Be as high as practicable.
2. Be positioned so the top edge is at least as high as the top of the door to the stair.

3.51 Smoke vents should comply with one of the following:

1. They should be located on an external wall with minimum free area of 1.5m^2.
2. They should discharge into a vertical smoke shaft, closed at the base, that meets all of the following criteria.

   i. The shaft should conform to the following conditions.
   - Have a minimum cross-sectional area of 1.5m^2 (minimum dimension 0.85m in any direction).
   - Open at roof level, minimum 0.5m above any surrounding structures within 2m of it horizontally.
   - Extend a minimum of 2.5m above the ceiling of the highest storey served by the shaft.

Appendix

Appendix A - Excerpts from ADB

ii. The free area of all the following vents should be a minimum of 1m^2 in the following places.

- From the corridor or lobby into the shaft.
- At the opening at the head of the shaft.
- At all internal locations within the shaft (e.g. safety grilles).

iii. The smoke shaft should be constructed from a class A1 material. All vents should either be a fire doorset (see Appendix C, Table C1, item 2.e for minimum fire resistance) or fitted with a smoke control damper achieving the same period of fire resistance and designed to operate as described below. The shaft should be vertical from base to head, with a maximum of 4m at a maximum inclined angle of 30 degrees.

iv. If smoke is detected in the common corridor or lobby, both of the following should occur.

- Simultaneous opening of vents on the storey where the fire is located, at the top of the smoke shaft and to the stair.
- Vents from the corridors or lobbies on all other storeys should remain closed, even if smoke is subsequently detected on storeys other than where the fire is located.

3.52 A vent to the outside with a minimum free area of 1m^2 should be provided from the top storey of the stair.

3.53 In single stair buildings, smoke vents on the storey where the fire is initiated, and the vent at the head of the stair, should be activated by smoke detectors in the common parts.

In buildings with more than one stair, smoke vents may be activated manually. The control system should open the vent at the head of the stair before, or at the same time as, the vent on the storey where the fire is located. Smoke detection is not required for ventilation purposes in this instance.

Smoke control of common escape routes by mechanical ventilation

3.54 Guidance on the design of smoke control systems that use pressure differentials is available in BS EN 12101-6 & BS EN 12101-13.

Appendix

Appendix A - Excerpts from ADB

Venting of heat and smoke from basements – flats

Natural smoke outlets

16.1 Heat and smoke from basement fires vented via stairs can inhibit access for fire fighting personnel. This may be reduced by providing smoke outlets, or smoke vents, which allow heat and smoke to escape from the basement levels to the open air. They can also be used by the fire and rescue service to let cooler air into the basements (Diagram 16.1).

16.2 Each basement space should have one or more smoke outlets.
Where this is not practicable (for example, the plan area is deep and the amount of external wall is restricted by adjoining buildings), the perimeter basement spaces may be vented, with other spaces vented indirectly by opening connecting doors. This does not apply for places of special fire hazard (see paragraph 16.7). If a basement is compartmented, each compartment should have one or more smoke outlets, rather than indirect venting. A basement storey or compartment containing rooms with doors or windows does not need smoke outlets.

16.3 Smoke outlets connecting directly to the open air should be provided from every basement storey, except for any basement storey that has both of the following.

- A maximum floor area of 200m^2.
- A floor a maximum of 3m below the adjacent ground level.

16.4 Strong rooms do not need to be provided with smoke outlets.

16.5 Smoke outlets should be both of the following. Sited at high level in either the ceiling or wall of the space they serve. Evenly distributed around the perimeter, to discharge to the open air.

16.6 The combined clear cross-sectional area of all smoke outlets should be a minimum of 1/40 of the area of the floor of the storey they serve.

16.7 Separate outlets should be provided from places of special fire hazard.

16.8 If the smoke outlet terminates at a point that is not readily accessible, it should be kept unobstructed and covered only with a class A1 grille or louvre.

Appendix

Appendix A - Excerpts from ADB

16.9 If the smoke outlet terminates in a readily accessible position, it may be covered by a panel, stallboard or pavement light that can be broken out or opened. The position of covered smoke outlets should be suitably indicated.

16.10 Outlets should not be placed where they prevent the use of escape routes from the building.

Mechanical smoke extract

16.11 If basement storeys are fitted with a sprinkler system in accordance with Appendix E, a mechanical smoke extraction system may be provided as an alternative to natural venting. Sprinklers do not need to be installed on the other storeys unless needed for other reasons. Car parks are not normally expected to be fitted with sprinklers (see Section 11 of Approved Document B Volume 2).

16.12 The air extraction system should comply with all of the following.

- It should give at least 10 air changes per hour.
- It should be capable of handling gas temperatures of 300°C for not less than one hour.
- It should do either of the following.

i. Be activated automatically if the sprinkler system activates.

i. Be activated by an automatic fire detection system that conforms to BS 5839-1 (minimum L3 standard).

Further information on equipment for removing hot smoke is given in BS EN 12101-3.

Venting of heat and smoke from basements – flats

Natural Ventilation

11.4 Each storey should be ventilated by permanent openings at each car parking level. The openings can be at ceiling level. The aggregate free vent area should be a minimum of 1/40 of that level's floor area, at least half of which should be provided equally by two opposite walls (1/160 on each side). The remaining free area can be distributed wherever possible.

Appendix

Appendix A - Excerpts from ADB

Mechanical Ventilation

11.5 If the minimum standard of natural ventilation is not possible, a system of mechanical ventilation should be provided that complies with all of the following.

1. The system should be both of the following.

    i. Independent of any other ventilating system (other than any system that provides day to day ventilation to the car park).
    ii. Designed to operate at 10 air changes per hour during a fire.

2. The system should run in two parts, each of which is:

    i. Capable of extracting 50% of the rates set out in item (a)
    ii. Able to operate alone or with the other part
    iii. Provided with an independent power supply capable of operating if the main supply fails.

3. 50% of the outlets should be at high level and 50% at low level.
4. The system should use E, I and S ductwork in accordance with BS EN 1366-8.

For further information on equipment for removing hot smoke, refer to BS EN 12101-3.
An alternative method of providing smoke ventilation from enclosed car parks is given in BS 7346-7.

Appendix

Appendix B - Diagram D7 from ADB

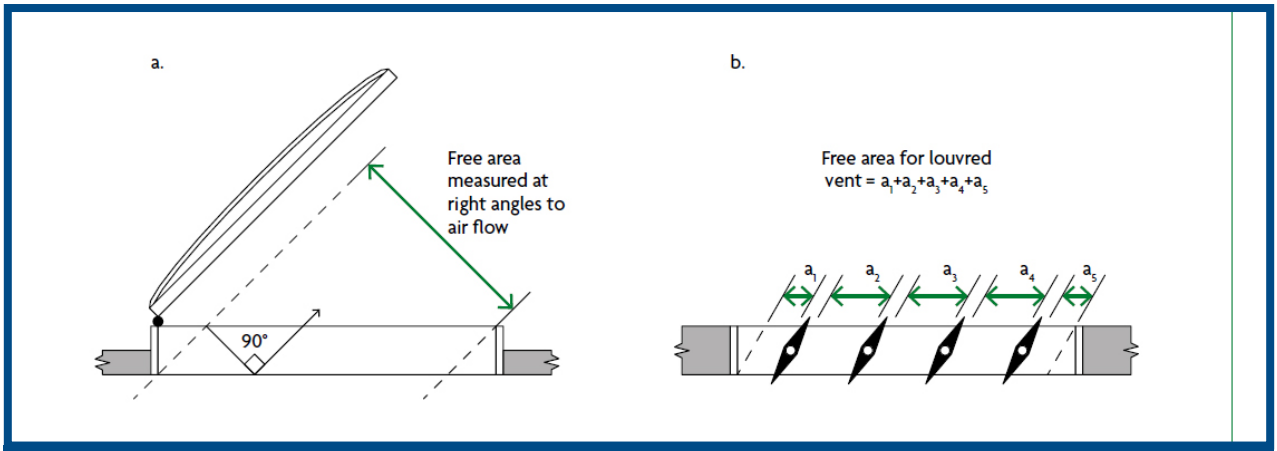


Diagram D7 - Free area of smoke ventilators

Appendix

Appendix C - Tables of Standards

Mechanical Smoke Ventilation System (MSVS) Standards

System/Product	Standards
System Design	BS 9991:2024 SCA Guide on Common Escape Routes in Apartment Buildings
Extract Fans	BS EN 12101-3: 2015
Roof Ventilators	BS EN 12101-2:2003
Smoke Control Dampers	BS EN 12101-8.2011
Control Panels	BS ISO 21927-9: 2012 BS EN 12101-10: 2005

Pressurisation System Standards

System/Product	Standards
System Design	BS EN 12101-13: 2022
System - Kits	BS EN 12101-6: 2022
Extract Fans	BS EN 12101-3: 2015
Smoke Control Dampers	BS EN 12101-8: 2011
Roof Ventilators	BS EN 12101-2: 2003
Control Panels	BS ISO 21927-9:2012 BS EN 12101-10: 2005

Natural Smoke Extract Standards

System/Product	Standards
Stairwell Ventilators	BS EN 12101-2 2003
Automatic Opening Ventilators (AOVs)	BS EN 12101-2: 2003
Smoke Control Dampers	BS EN 12101-8: 2011

Appendix

Appendix C - Tables of Standards

Car Park Ventilation System Standards

System/Product	Standards
System Design	BS 7346-7: 2013
Impulse Fans	BS EN 12101-3: 2015
Extract Fans	BS EN 12101-3: 2015
Smoke Control Dampers	BS EN 12101-8: 2011
Control Panels	BS ISO 21927-9: 2012 BS EN 12101-10: 2005

Basement Extract System Standards

System/Product	Standards
Extract Fans	BS EN 12101-3: 2015
Smoke Control Dampers	BS EN 12101-10: 2005
Control Panels	BS ISO 21927-9:2012

Acceptance Criteria Table

	Means of Escape	Firefighting
Extract flow rate	2.5m^3/s	5.0m^3/s
Max Door Opening Force	100N	100N
Damper Opening Time	60 seconds	
Fan Ramp up time	90 seconds	
Power Supply Changeover	15 seconds	
Maximum pressure difference lobby/stair	25Pa	

Appendix

Appendix C - Tables of Standards

Cabling and Electric Power Supply Installation - Means of Escape

System/Product	Standards	Options
Natural smoke and heat exhaust ventilation systems (SHEVS) – supply and control	BS 8519:2010	Category 2
Mechanical Smoke Ventilation Systems (MSVS)	BS 8519:2010	Category 2
Smoke Extract Fans	BS 8519:2010	Category 3
Natural Smoke Shaft Systems (as described in ADB)	BS 8519:2010	Category 2
Smoke Curtains – supply and control	BS 8519:2010	Category 2
Smoke control dampers – supply and control	BS 8519:2010	Category 2
Pressurisation	BS 8519:2010	Category 2

Cabling and Electric Power Supply Installation - Firefighting

System/Product	Standards	Options
Natural smoke and heat exhaust ventilation systems (SHEVS) – supply and control	BS 8519: 2010	Category 3
Mechanical Smoke Ventilation Systems (MSVS)	BS 8519: 2010	Category 3
Smoke Extract Fans	BS 8519: 2010	Category 3
Natural Smoke Shaft Systems (as described in ADB)	BS 8519: 2010	Category 3
Smoke Curtains – supply and control	BS 8519: 2010	Category 3
Smoke control dampers – supply and control	BS 8519: 2010	Category 3
Pressurisation	BS 8519: 2010	Category 3

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