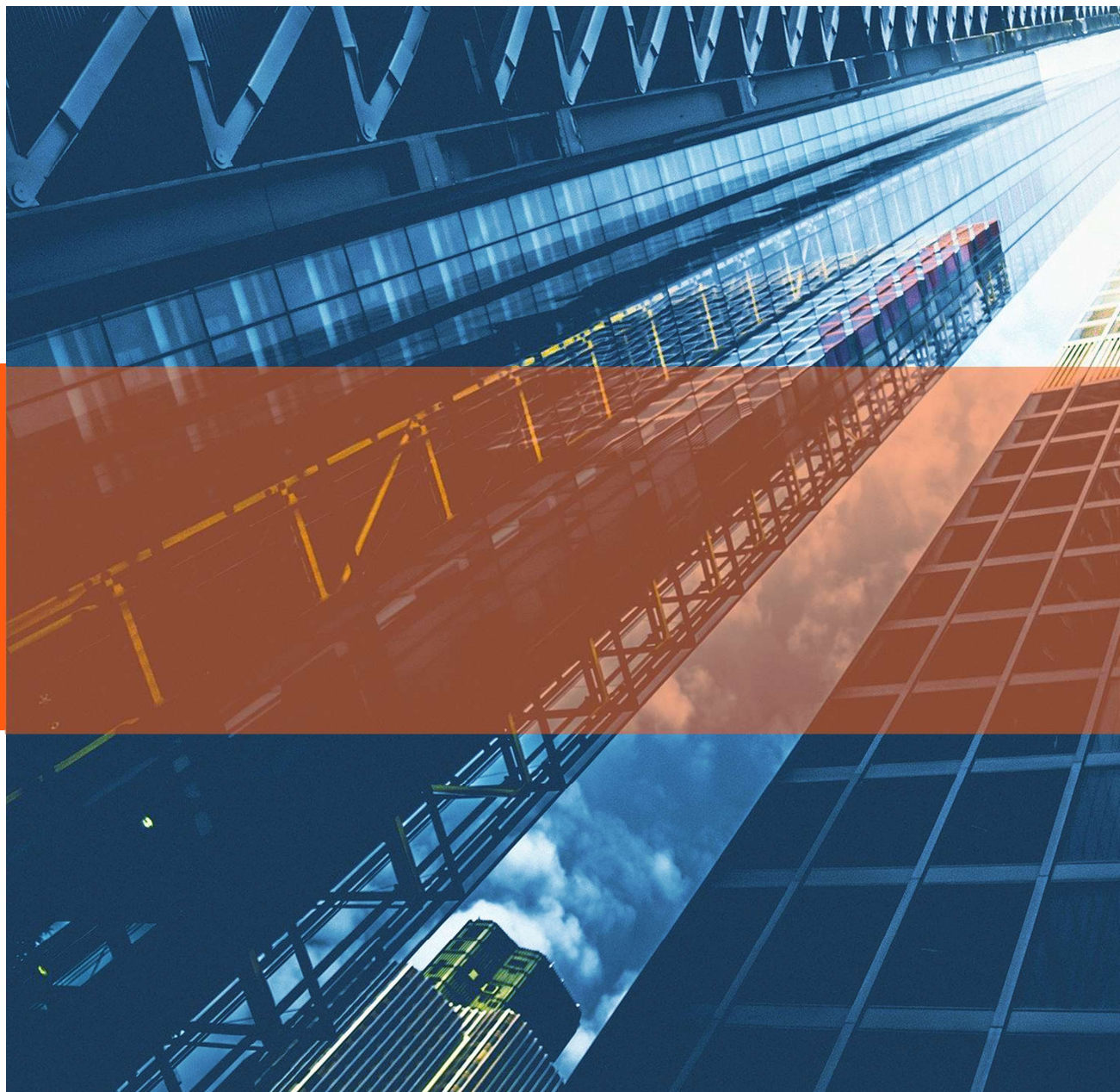


Smoke Control Design in Residential Buildings

A simple guide

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What we will look at in this presentation

- Why is smoke control provided
- Where do we get our design guidance.
- Where is smoke control required by the codes.
- The types of system available and how they work
- What flexibility in the general building design does it give us
- Statistics
- Common Faults and simple items that can be checked on site
- Regulatory Surveyors - Sufficiently checking the design and provisions for Building Regulations purposes

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Why is smoke control provided

- To maintain stairways clear of smoke for longer periods in a fire situation
- To action removal of toxic smoke build up from adjacent stair lobbies and corridors in buildings which are not small single stair buildings.
- *This benefits the Fire Service in terms of maintaining tenable conditions for fire fighting and search and rescue operations.*

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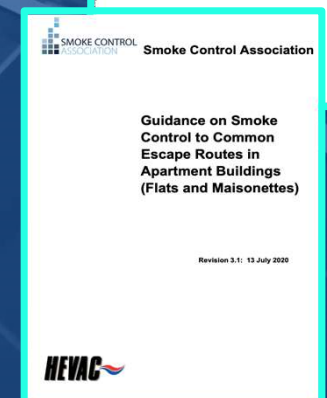


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Where do we get our design guidance

- Approved Document B volume 1
- BS 9991:2015
- The Smoke Control Association guides 2020/2021 updates
- BS 12101



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Where is Residential smoke control required by the Codes

- In Residential buildings containing self contained units where the evacuation procedure is 'stay put' or 'defend in place'. Purpose group 1a
- Other residential purpose groups over 18m with a Fire fighting shaft

Extent of the venting system

First Consider – Is it a small single stair building or not?

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Definition – Small single stair building



Small single stair buildings

3.28 For some low rise **buildings**, the provisions in paragraphs 3.26 and 3.27 may be modified and the use of a single stair, protected in accordance with Diagram 3.9, may be permitted where all of the following apply.

- a. The top **storey** of the **building** is a maximum of 11m above ground level.
 - b. No more than three **storeys** are above the ground **storey**.
 - c. The stair does not connect to a covered car park, unless the car park is open sided (as defined in Section 11 of Approved Document B Volume 2).
 - d. The stair does not serve offices, stores or other ancillary accommodation. If it does, they should be separated from the stair by a **protected lobby** or **protected corridor** (minimum REI 30) with a minimum 0.4m² of permanent ventilation, or be protected from the ingress of smoke by a mechanical smoke control system.
- NOTE:** For refuse chutes and storage see paragraphs 3.55 to 3.58.
- e. Either of the following is provided for the fire and rescue service.
 - i. A high-level openable vent with a free area of at least 1m² at each **storey**.
 - ii. A single openable vent with a free area of at least 1m² at the head of the stair, operable remotely at the fire and rescue service access level.

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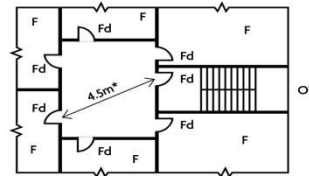


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Diagram 3.9 Common escape route in small single stair building

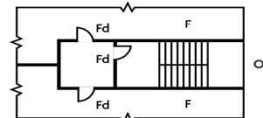


See para 3.28



a. SMALL SINGLE STAIR BUILDING

*If smoke control is provided in the lobby, the travel distance can be increased to 7.5m maximum (see Diagram 3.7, example b).



b. SMALL SINGLE STAIR BUILDING WITH NO MORE THAN TWO FLATS PER STOREY

The door between stair and lobby should be free from security fastenings.

If the flats have protected entrance halls, the lobby between the common stair and flat entrance is not essential.

NOTES:

1. The arrangements shown also apply to the top storey.
2. If the travel distance across the lobby in diagram (a) exceeds 4.5m, Diagram 3.7 applies.
3. Where, in Diagram (b), the lobby between the common stair and the dwelling is omitted in small single stair buildings, an automatic opening vent with a free area of at least 1m² is required at the top of the stair, which is operated automatically on detection of smoke at any storey in the stair.
4. For further guidance on the fire rating of the fire doorsets from the corridor to the flat and/or stairway refer to Appendix C, Table C1.

— Fire resisting construction

OV Openable vent at high level for fire service use (1.0m² minimum free area); see paragraph 3.28e

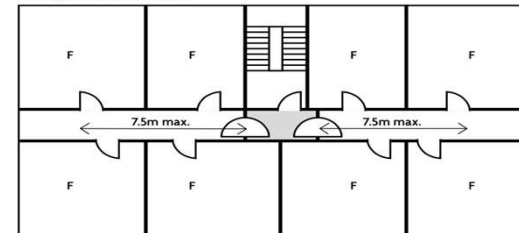
F Flat

Fd Fire doorset

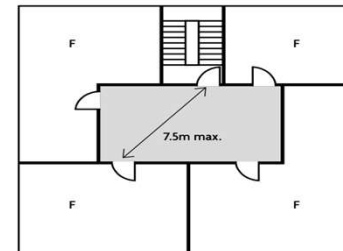
Diagram 3.7 Flats served by one common stair

See paras 3.27 and 3.36

a. CORRIDOR ACCESS FLATS



b. LOBBY ACCESS FLATS



NOTES:

1. The arrangements shown also apply to the top storey.
2. See Diagram 3.9 for small single stair buildings.
3. All doors shown are fire doorsets.
4. Where travel distance is measured to a stair lobby, the lobby must not provide direct access to any storage room, flat or other space containing a potential fire hazard.
5. For further guidance on the fire rating of the fire doorsets from the corridor to the flat and/or stairway refer to Appendix C, Table C1.

F Flat

Shaded areas indicate zones where ventilation should be provided in accordance with paragraphs 3.50 to 3.53 (An external wall vent or smoke shaft located anywhere in the shaded area)

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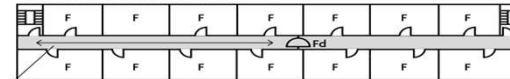
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Diagram 3.8 Flats served by more than one common stair



See paras 3.27 and 3.36

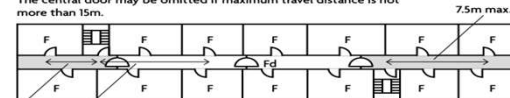
a. CORRIDOR ACCESS WITHOUT DEAD ENDS



30m max.

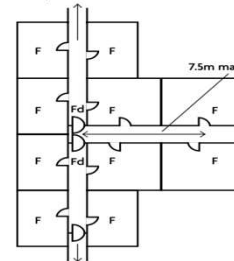
b. CORRIDOR ACCESS WITH DEAD ENDS

The central door may be omitted if maximum travel distance is not more than 15m.



7.5m max. 30m max.

c. 'T' JUNCTION WITH MAIN CORRIDOR



NOTES:

1. The arrangements shown also apply to the top storey.
2. For further guidance on the fire rating of the fire doorsets from the corridor to the flat and/or stairway refer to Appendix C, Table C1.

F Flat

Fd Fire doorset

Shaded areas indicate zones where ventilation should be provided in accordance with paragraphs 3.50 to 3.53 (An external wall vent or smoke shaft located anywhere in the shaded area)



The types of system available and how they work

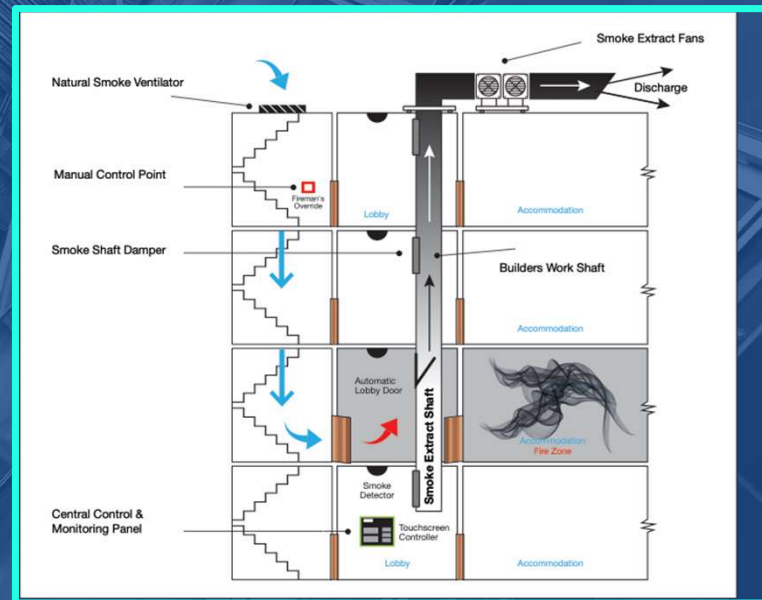
- Natural Smoke Venting
- A Natural Smoke Shaft Design
- A Mechanical Extract design or a Positive pressure smoke control system

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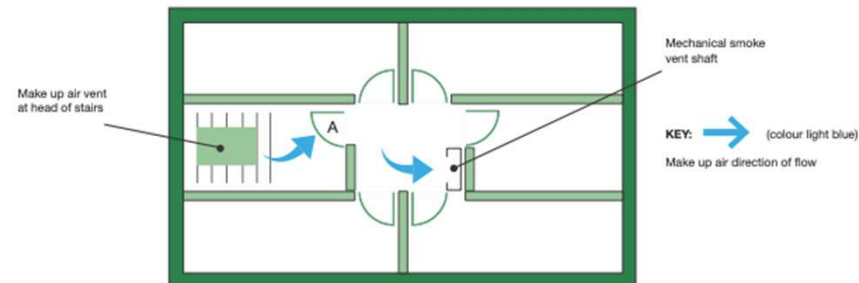
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Design – Typical Mechanical System



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Make Up Air – Buildings that are not small single stair buildings



NOTES:

1. The AOV above the stairway is to provide replacement air for a smoke shaft
2. Measures to avoid lobby depressurisation
 - a) Pressure sensing fan control to keep within acceptable pressure diff or
 - b) Reverse hang the door shown at position A. or
 - c) Motorised activator to break pressure seal on door at position A

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Key Dimensional Requirements

System type	Item	Size
Natural System	Head of stair vent	1 sqm
	Adjacent to stair Lobby/corridor vents	1.5 sqm
Natural System	Vertical Shaft	<ul style="list-style-type: none"> • Min cross-sectional area 1.5m² • Min dimension 0.85m in any direction • Opening at roof at least 0.5m above adjacent structures within 2.0m horizontally
Mechanical system	Ducts , Shafts and Fans	Specialist design and CFD

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Some other key Natural Vent dimensions and measures

Smoke control in lobbies/corridors

Locate as high as possible with top edge at least as high as the top of the stair door.

In single stair buildings, vents on the fire floor and the head of the stair, should be actuated by AFD in the common parts.

Where there is more than one stair, the vent can be actuated manually, provided the vent at the head of the stair is opened before, or at the same time, as the vent on the fire floor.

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Some other key Natural Shaft dimensions and measures

Natural Shaft Vent design

Discharge into vertical smoke shaft;

- Min cross-sectional area 1.5m²
- Min dimension 0.85m in any direction
- Opening at roof at least 0.5m above adjacent structures within 2.0m horizontally

Extend 2.5m above ceiling of highest storey

Non-combustible material

Vertical shaft with nmt 4m at an inclined max 30°

Upon direction, the vent on the fire floor and at head of staircase should open together (all other vents should remain closed)





Key Components

Firefighter's Control

From the National Fire Chiefs Council (NFCC); Mark Hardingham

The simplification and consistency of firefighter system controls.

- ▶ Designing systems to operate automatically and ensuring the controls firefighters might need to use are consistent, greatly assists firefighting operations.
- ▶ Consideration should be given to not providing any external inputs.
- ▶ Manual control points where supplied should comply with ISO 21927-9 and be coloured deep orange to RAL 2011. Where these are for FRS use only, they should be mounted at a height of 1.8-2m from floor level to discourage tampering.



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Key Components

All control equipment used for smoke control systems should comply with ISO 21927-9.

Key areas:

- ▶ Monitoring of cables
- ▶ Indication of system status and faults

Control Equipment



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What flexibility in the buildings general fire design does it give us?

Combined with other active measures such as sprinkler suppression it is possible to extend the single direction common area travel distances to the stair. 7.5m extended to 15m- Code compliant BS 9991:2015 with sprinklers and vents.

Combined with other active measures it is possible for the single direction common area travel distance to be extended from 7.5m to an upper limit of 30m- Fire Engineering design with CFD smoke modelling required-SCA Code allows consideration up to 30 metres.

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Statistic

London Fire Brigade statistics

- Out of 500 assessed Residential Blocks 65% of these failed the Fire Safety inspection

Source: Strategic Technical Advisor and Vice Chair of the NFCC at London Fire Brigade

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Common Faults

- The head of the vent not being at least at the head height of the door between the lobby and stair.
- Vent not being as close to the ceiling as possible
- Automatic vents not fully opening within 60 seconds
- Lobby/corridor vent and make up air vent in the stair not opening simultaneously
- Vertical smoke shaft vents opening on all floors not just the fire floor
- Doors between the lobby and stair not openable due the pressure differences in mechanical extract situations- i.e. Door motorised actuator, suitable direction of door opening or system pressure differential monitoring not working.
- Firefighters control switch not provided

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Regulatory Surveyors

Sufficiently checking the design and provisions for
Building Regulations purposes

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Site checks and commissioning

Consider

- Is it a small single stair building by definition para 3.28 ?
If it is, then
the following Table 1 - Small single stair building system simple checks on site and certification
- If it is NOT a small single stair building then
the following Table 2 - simple checks on site, commissioning tests and certification

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Table 1 – Small single stair buildings by App Doc Vol 1 meeting the para 3.28 definition Diagram 3.9

System type	Site observation and checks	Request Cold smoke system test	Commissioning Certification required
Automatic Opening Vent	CHECK Positioning and size of vent CHECK Vent opening on activation of common area detection . Vent to fully open within 60 sec	NO	YES
Mechanical system	CHECK Vent opening on activation of common area detection	NO	YES and the Specialist designers package

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Table 2 – Larger Diagram 3.7 Buildings

System type	Site observation and checks	Request Cold smoke system test	Commissioning Certification req
Natural AOV Openings	<p>CHECK Positioning and size of vents</p> <p>CHECK lobby vent is opening on the activated detector fire floor and only upon activation of common area detection</p> <p>CHECK stair make up air vent has also opened</p> <p>CHECK Vents fully open within 60 secs</p> <p>Check- Fire fighters control switch provided</p>	NO	YES
Natural Smoke Shaft	<p>Check Vent is opening on activated fire floor only?</p> <p>Check shaft fire stopping and compartmentation and size</p> <p>Check- Fire fighters control switch provided</p>	YES	YES including Smoke leakage test results on shaft
Mechanical system extraction	<p>Check Vent opening on activation of common area detection on the fire floor only</p> <p>Check- Fire fighters control switch provided</p>	YES	YES and to include Specialist designer CFD smoke modelling and design package

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Suitable Commissioning Certification



System/Product	Standard	Options
Mechanical Smoke Extract (smoke shaft)		
System (Design)	BS9991 & SCA Guide on Common Escape Routes in Apartment Buildings	
Extract Fans	BS EN 12101-3: 2015	F300
Roof Ventilators	BS EN 12101-2: 2003	
Lobby Dampers	BS EN 12101-8: 2011	
Control Panels	BS ISO 21927-9:2012 BS EN 12101-10: 2005	
Pressurisation Systems		
System (Design)	BS EN 12101-6:2005	
Input Fans		
Extract Fans	BS EN 12101-3: 2015	F600
Air Release 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		
Stairwell Ventilators	BS EN 12101-2: 2003	
Automatic Opening Ventilators (AOVs)	BS EN 12101-2: 2003	
Control Panels	BS ISO 21927-9:2012 BS EN 12101-10: 2005	
Car Park Ventilation		
System (Design)	BS 7346-7:2013	
Jet Fans	BS EN 12101-3: 2015	F300
Extract Fans	BS EN 12101-3: 2015	F300
Dampers	BS EN 12101-8:2011	
Control Panels	BS ISO 21927-9:2012 BS EN 12101-10: 2005	
Basement Extract System		
Control Panels	BS ISO 21927-9:2012 BS EN 12101-10: 2005	
Dampers	BS EN 12101-8:2011	
Extract Fans	BS EN 12101-3: 2015	

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Wiring Requirements

Category 2 recommended as minimum

System/Product	Standard	Options
Electrical Wiring		
Means of Escape: Natural smoke and heat exhaust ventilation systems (SHEVS) - supply and control	BS 8519:2010	Category 2
Means of Escape: Smoke Shafts - controlled MFSDs	BS 8519:2010	Category 2
Means of Escape: Powered smoke shafts and controlled MSFDs	BS 8519:2010	Category 2
Means of Escape: Smoke Curtains - supply and control	BS 8519:2010	Category 2
Means of Escape: Smoke control dampers - supply and control	BS 8519:2010	Category 2
Means of Escape: Pressurisation	BS 8519:2010	Category 2
Firefighting: Natural smoke and heat exhaust ventilation systems (SHEVS) - supply and control	BS 8519:2010	Category 2
Firefighting: Smoke Shafts - controlled MFSDs	BS 8519:2010	Category 2
Firefighting: Powered smoke shafts and controlled MSFDs	BS 8519:2010	Category 3
Firefighting: Smoke Curtains - supply and control	BS 8519:2010	Category 3
Firefighting: Motorised fire and smoke dampers - supply and control	BS 8519:2010	Category 3
Firefighting: Pressurisation	BS 8519:2010	Category 3

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Component tests



Natural Smoke Vents	Power Heat Fans	Smoke Dampers
Snow load tests	Wind load	Leakage test
Wind load	HT Test	Cycle test
Life cycle	Run tests	Aerodynamic
Performance tests	Performance	Fire resistance
Heat tests	Fire resistance	Insulation and
Low ambient temp	Operation	Integrity
	reliability	



Typical Independent testing carried out on SC products

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Case Example 1

A 6 storey single stair new
build residential flats building

Design following code -
Approved Document B vol 1

Natural Automatic opening vents and make up air from the stair



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Case Example 1 – Building Regulation actions to sign off

Not a small single stair Building

Simple Natural system onsite checks that can be made by visiting surveyors

- Head of lobby corridor AOV opening at least as high as the door between the lobby and the stairway and as near the lobby ceiling as possible. Size of opening 1.5sqm
- Head of stair system make up air vent 1sqm
- Vent opens on activated floor within 60 seconds of common area detection.
- Firefighter control switch in place

Commissioning Certification

BS 12101-2 for vents and 12101-10 for control panel

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Case Example 2

A 4 storey single stair existing residential building with two new floors of residential being added

Design following code –
BS 9991:2015

Mechanical ventilation system and make up air from the stair



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Case Example 2 – Building Regulation actions to sign off

Not a small single stair Building

Simple mechanical system onsite checks that can be made by visiting surveyors

- Head of stair system make up air vent 1sqm
- Vent opens on activated floor within 60 seconds of common area detection.
- ONLY the vent on the activated floor and stair make up air vent open
- Firefighter control switch in place
- Request Cold smoke Test
- Check suitable provision has been made all floors new and existing

Commissioning Certification

BS 12101-2 for vents and 12101-10 for control panel

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Thank you for listening
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