SMOKE CONTROL

F2-F3/F4 Smoke Ventilation Technical Submittal

FNF-ADS-XX-F2/F3F4-XX-RP-0001

Above Ground Smoke Ventilation System Technical Report

Smoke Ventilation

ISSUE 07

Issue Date: 01 December 2022

innovation in smoke control

SMOKE CONTROL | CAR PARK VENTILATION | SPECIAL PROJECTS | SERVICE & MAINTENANCE

AdVanced smoke group

REVISION SCHEDULE

Issue	Date	Details	Prepared by	Reviewed by	Approved by
01	21/02/2022	Pre-order issue	RT		
02	15/03/2022	Updated following internal review	RT	CT	
03	31/03/2022	Updated to reflect comments made	RT	CT	
04	28/04/2022	Updated to reflect DMFK comments	RT	CT	
05	27/06/2022	Updated post teams meeting	RT	CT	
06	10/10/2022	Updated daily ventilation strategy	RT	CT	
07	01/12/2022	Updated document register	RT	CT	

Contents

1 Background

1.1 Drawing References and Sources of Information

The following information has been used in the consideration and preparation of this report. No other information has been considered in this report. If any documents are missing from the below register or the ones listed become superseded, it is the client's responsibility to inform ASG of this so that a new/revised analysis can be carried out of the project, any implications of these changes will be reflected within a revised quotation. ASG will not monitor/ keep track of electronic document registers unless otherwise explicitly stated within this quotation. It will be the responsibility of the client to inform ASG of any new documents that are thought to be of relevance to ASG's package.

Drawing Title	Drawing Number	Rev	Date
Fire Strategy – Ground Floor Plan	FNF-A-F2-dMFK-DR-08-100	C5	21/09/2022
Fire Strategy – First Floor Plan	FNF-A-F2-dMFK-DR-08-101	C4	21/09/2022
Fire Strategy – Second Floor Plan	FNF-A-F2-dMFK-DR-08-102	C4	21/09/2022
Fire Strategy – Third Floor Plan	FNF-A-F2-dMFK-DR-08-103	C4	21/06/2022
Fire Strategy – Fourth Floor Plan	FNF-A-F2-dMFK-DR-08-104	C4	21/09/2022
Fire Strategy – Fifth Floor Plan	FNF-A-F2-dMFK-DR-08-105	C4	09/11/2022
Fire Strategy – Roof Plan	FNF-A-F2-dMFK-DR008-106	C1	20/05/2022
Fire Strategy – Ground Floor	FNF-A-F3-dMFK-DR-08-100	C5	10/06/2022
Fire Strategy – First – Fourth Floor	FNF-A-F3-dMFK-DR-08-101	C2	10/06/2022
Fire Strategy – Fifth Floor	FNF-A-F3-dMFK-DR-08-105	C2	10/06/2022
Fire Strategy – Sixth Floor	FNF-A-F3-dMFK-DR-08-106	C2	10/06/2022
Fire Strategy – Seventh Floor	FNF-A-F3-dMFK-DR-08-107	C2	10/06/2022
Fire Strategy – Eighth – Tenth Floor	FNF-A-F3-dMFK-DR-08-108	C2	10/06/2022
Fire Strategy – Roof Plan	FNF-A-F3-dMFK-DR-08-111	C2	10/06/2022

Other Sources	From	Rev	Date
Fire Strategy – HHF_UK02177_CFD_F2_001_01	HH Fire	01	26/07/2021
Block F3 Fire Strategy Report – HHF_UK02177_FS_007	HH Fire	04	07/02/2022
Block F2 Fire Strategy Report – HHF_UK02177_FS_006	HH Fire	04	18/10/2022
CFD Report for Block F3 – HHF_UK02177_CFD_F3_001_01	HH Fire	01	06/09/2021

1.2 Legal Liabilities

This report has been prepared for Barratt Homes Ltd and is intended for use in connection with the titled project only. The information herein shall not be relied upon by any third party (excluding Barratt Homes Ltd and any company directly involved with this project), and Advanced Smoke Group Limited will not accept any liability for use of this information in connection with any other project. Future variations in the building design and/or layout may invalidate the conclusions and recommendations in this report. This report may be subject to amendments dependent on feedback on structural and other elements by others, or other design changes.

This report is based on the drawings and documents listed above issued to ASG only.

This report should be read in conjunction with the Fire Strategy document, by others, which gives the basis for design and overall strategy for fire safety. This report focuses only on the smoke ventilation aspect of fire safety, the main ventilation principles are detailed and justified within the fire strategy. Therefore, the fire engineers take responsibility that the ventilation principles meet the requirements of the building regulations and ASG take responsibility that our system meets the requirements of the fire strategy.

2 Building Overview

2.1 Basis of Report

This report addresses the control of smoke in Block F2-F3/F4 only of the project titled “Hayes Village”. Within this development, there are 2 separate cores being provided with smoke ventilation and are as follows:

- Core F2: (Ground – Level 05)
- Core F3: (Ground – Level 08)

2.2 Design Objectives

The objectives of the ventilation system on all levels served are to:

- Provide sufficient airflow under means of escape mode to maintain tenable conditions by adequately diluting and extracting smoke which will enter the common escape route as the occupants of the apartment on fire make their escape.
- Protect the “sterile” area of the stairwell from smoke contamination by utilising a mechanical ventilation system sufficient to prevent untenable levels of smoke entering the stair core
- Provide air to the fire service personnel during fire-fighting operations by maintaining an airflow rate when the stairwell door and apartment door are fully open.
- Meet the requirements laid out within the fire strategy & subsequent CFD reports
- Aid the natural buoyancy of the hot smoke/gases and provide a means of egress for the smoke/gases

3 System Overview & Operation – Smoke Ventilation

3.1 Core F2

3.1.1 System Overview Levels, 1 - 4

F2 is provided mechanical ventilation via 2 separate shafts, serving the levels as seen in table 1 below.

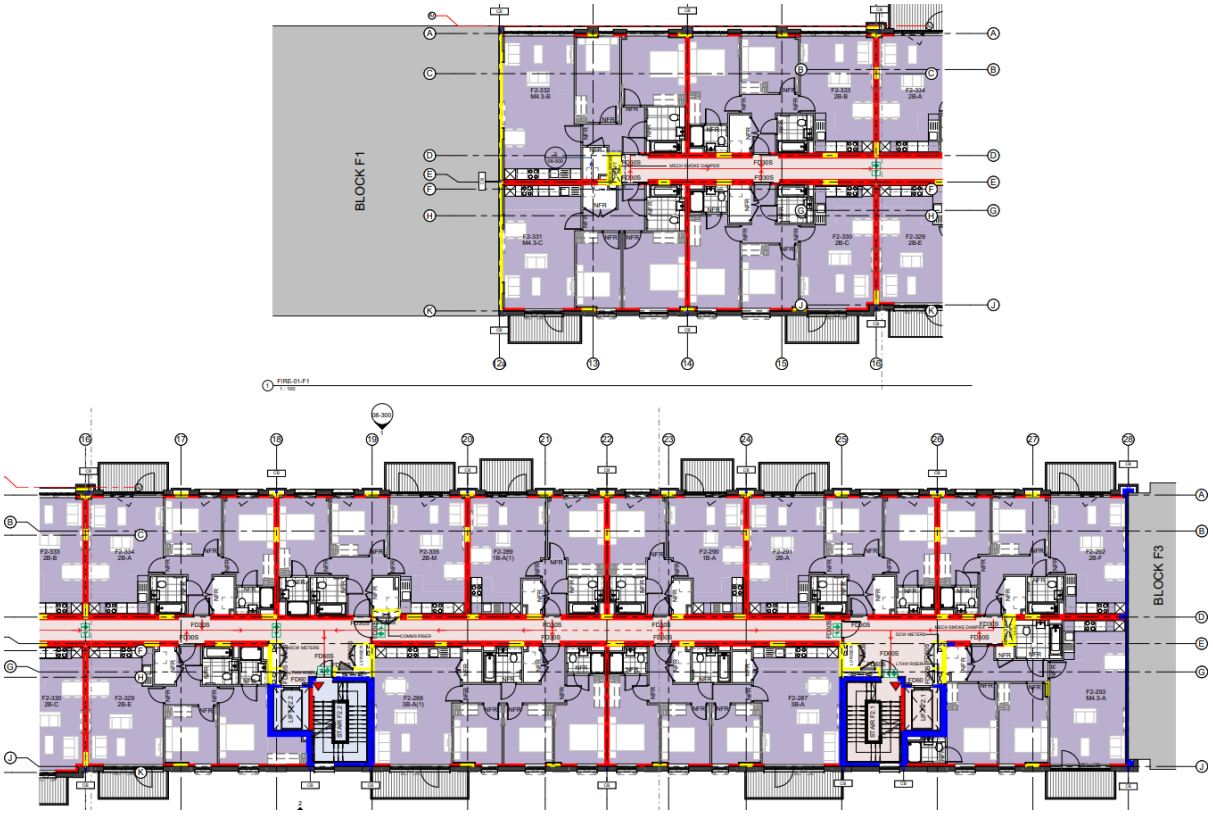


Image 01: Core F2 MAOV Locations

Shaft Name	Fan set Location	Floors Served
MAOV-F2.1	ROOF	Ground – Level 04
MAOV-F2.2	ROOF	Ground – Level 04

Table 1: Core F2 Shaft Details

Each of the smoke shafts will have a run and standby fire rated smoke extract fan set located in the position indicated in the table above. The fan set will be given a reference and duty as shown in the table below:

Fan Set Reference	Fan set Location	Max Duty Required at Extract Point
SEF-F2.1	ROOF	4.0m^3/s Extract
SEF-F2.2	ROOF	4.0m^3/s Extract

Table 2: Block F2 Fan Set Details

Block F2 is to be provided with two separate stairwells, the stairwell are to be provided with glazed AOV's, these are supplied and installed by others and should be tested in accordance with BSEN1210:2 and should be 24v. The stairwell AOV's will be used to facilitate the make-up air requirements from level 1 – level 4.

The smoke shaft at each floor served will be fitted with an AOV in the form of an LD Damper; this is to offer no less than 0.6m^2 throat free area. This vent will require a builder work opening into the smoke shaft of 800mmW x 1400mmH and will be finished with a grille painted to RAL9010 unless otherwise specified.

3.1.2 System Overview, Ground Floor

Image 2: Core F2 Ground Floor Layout

At ground floor level there are two entrance foyers and a single corridor that are all to be provided with natural ventilation direct to atmosphere, these AOV's are to supplied and installed by others and should be tested in accordance with BSEN1210:2 and should be 24v.

In addition to the natural ventilation there are two corridors at ground floor level which are to be provided with mechanical ventilation The extract points within both of these corridors are to be connected to the base of the smoke extract shaft via a ductwork connection, the ductwork is to be supplied and installed by others with ASG supplying and installing the two extract dampers required. Fire engineers to confirm specification of ductwork, we believe this to be 1366-8.

Due to the door within the smaller lobby to the right being handed against the airflow and there being limited space to accommodate both an inlet and extract duct ASG propose we use our DPS technology. The DPS will be installed to the door frame and shall monitor the position of the door during a scenario within this lobby. The DPS will monitor the of the door in real time, when the door is closed he lobby will be depressurised to 40-50pa, then in an open door scenario the face velocity

across the door opening of 2ms shall be created to prevent smoke from the lobby entering the foyer/circulation area.

Currently we believe the solution to provide make up air to the longer ground floor corridor is yet to be confirmed and still in abeyance.

3.1.3 System Overview, Level 5

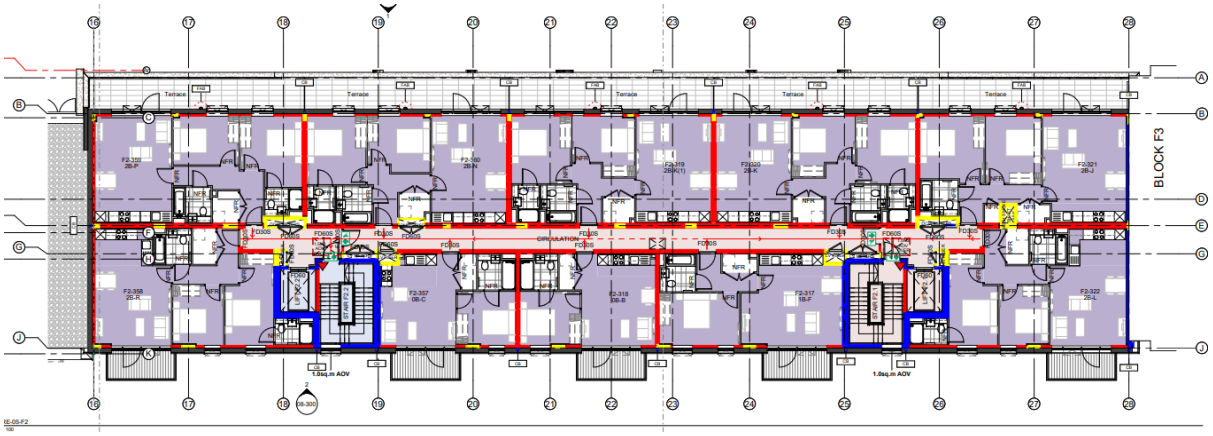


Image 3: Core F2 Level 05 Layout

Due to the smoke shafts not serving level 05 the two lobbies/corridors at this level are to be provided with Powrmatic Open Sky polycarbonate louvres, the louvres are to offer a minimum free area of 1.5m². We will require a builders work upstand with internal measurements of 2090mm x 1000mm and external measurements of 2390mm x 1300mm including all weathering, soundboard, and insulation. The width has been reduced to accommodate comments made.

3.1.4 System Operation

Upon receipt of a fire alarm signal the AOV at the head of the stair and the appropriate shaft/Lobby AOVs will fully open. The smoke extract fan sets will operate at full speed to provide an extract rate of no less than 4.0m³/s as confirmed by CFD analysis. Where natural ventilation is utilised, the fans shall remain dormant as per the cause and effect.

Because the make-up air for the system is to be drawn from the stairwell on levels 1 - 4, all stair doors are to be swung into the corridor with no latching or locking mechanisms, at ground floor the system is required to 'crack' ajar two separate doors, it is crucial that when others are setting up the door closures, they don't offer excessive resistance. At ground floor the means of inlet air has been described earlier in this report.

Should the fire alarm signal come from the west corridor located at ground level, the dampers shall remain closed and the fans dormant, the head of stair and the AOV to atmosphere within the corridor shall open.

3.2 Core F3

3.2.1 System Overview

F3 is provided mechanical ventilation via 2 separate shafts, serving the levels as seen in table 3 below.

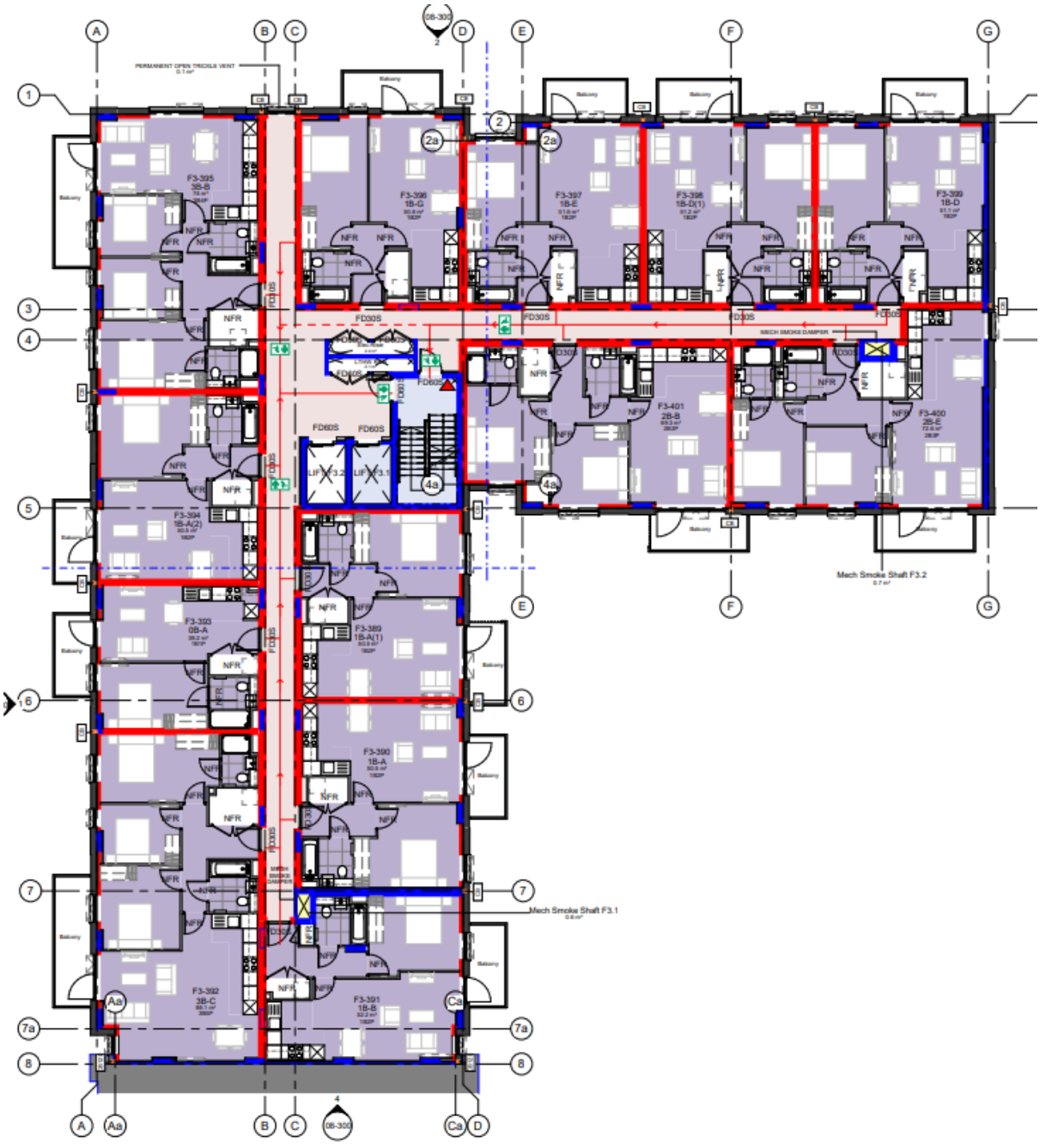


Image 04: Core F3 MAOV Locations Level 01 – Level 05

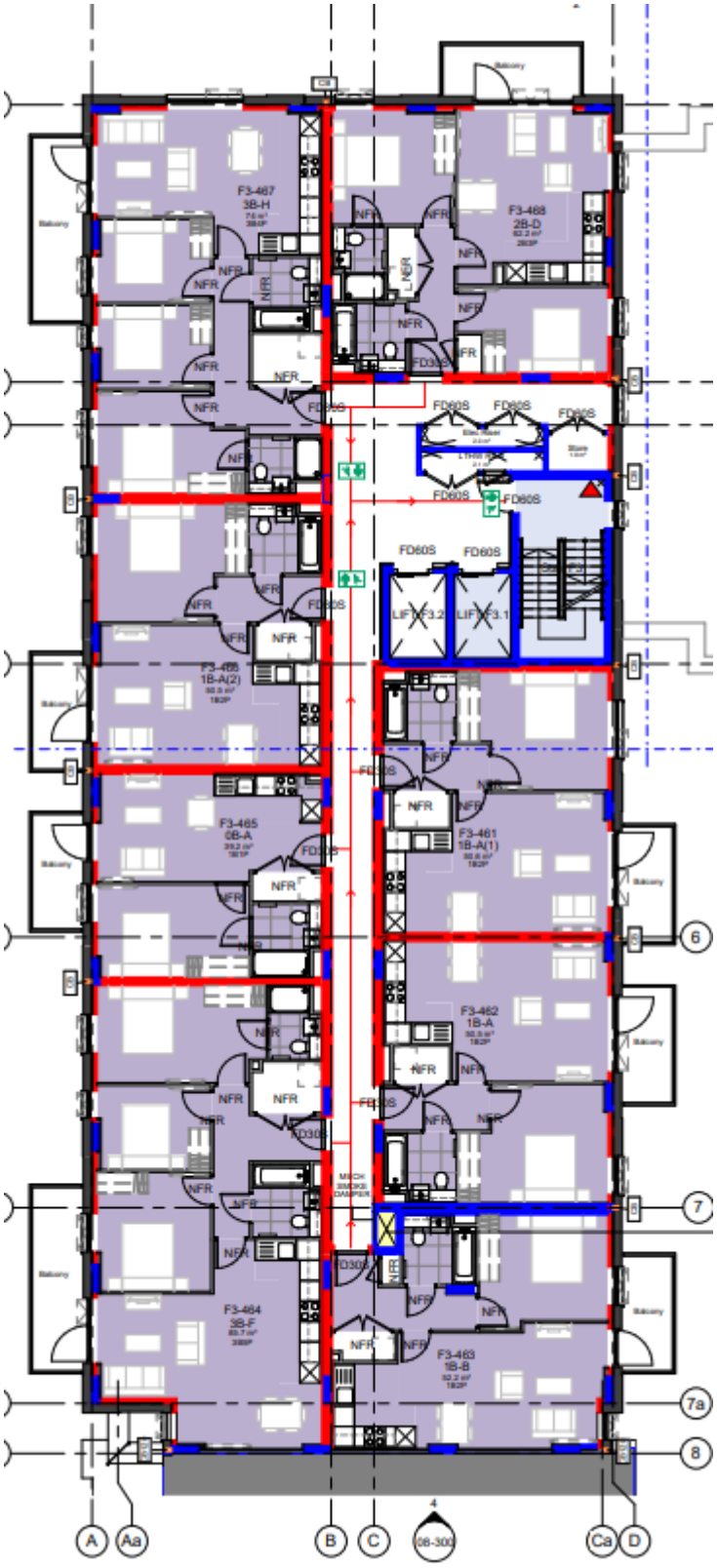


Image 05: Core F3 MAOV Locations Level 06 – Level 08

Shaft Name	Fan set Location	Floors Served
MAOV-F3.1	ROOF	Ground – Level 08
MAOV-F3.2	Level 06	Ground – Level 05

Table 3: Core F3 Shaft Details

Each of the smoke shafts will have a run and standby fire rated smoke extract fan set located in the position indicated in the table above. The fan set will be given a reference and duty as shown in the table below:

Fan Set Reference	Fan set Location	Max Duty Required at Extract Point
SEF-F3.1	ROOF	4.0m^3/s
SEF-F3.2	Level 06	4.0m^3/s

Table 3: Block F3 Fan Set Details

Block F3 is to be provided with a single stairwell, the stairwell will be provided with a Powrmatic Open Sky polycarbonate louvre, the louvre is to offer a minimum free area of 1.0m² free area. We will require a builders work upstand with internal measurements of 1260mm x 1260mm and external measurements of 1410mm x 1410mm including all weathering, soundboard, and insulation. The stairwell AOV's will be used to facilitate the make-up air requirements from Ground – Level 08. Roof access is to be provided by other means and is not covered by ASG. To facilitate additional inlet air some of the upper floors are to be provided trickle vents to atmosphere (these are by others).

The smoke shaft at each floor served will be fitted with an AOV in the form of an LD Damper; this is to offer no less than 0.6m^2 throat free area. This vent will require a builder work opening into the smoke shaft of 800mmW x 1400mmH and will be finished with a grille painted to RAL9010 unless otherwise specified.

3.2.2 System Overview, Ground Floor

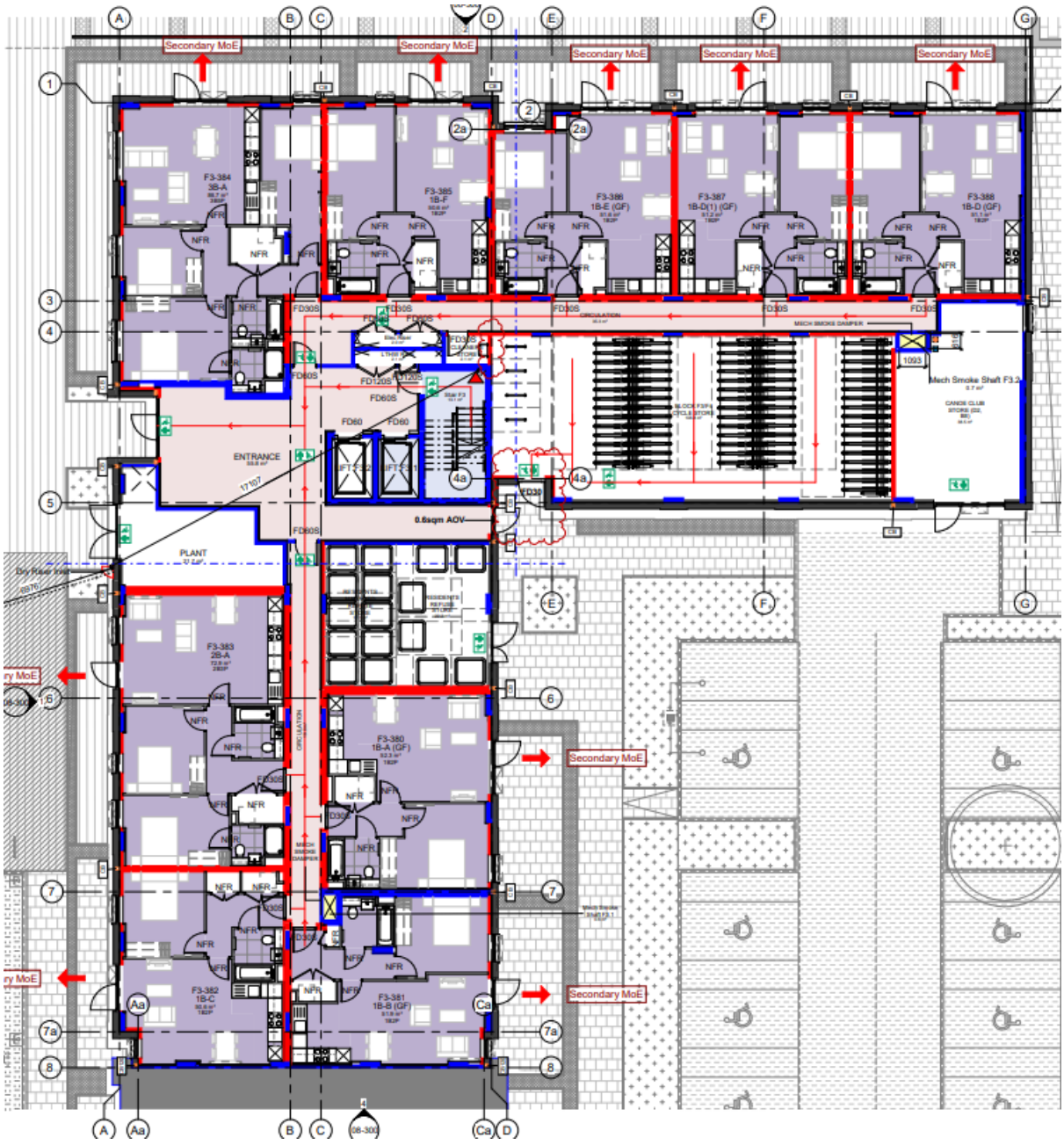


Image 05: Core F3 Ground Floor Layout

At ground floor level the mechanical ventilation layout remains the same as the above ground levels, with the addition of an AOV located above the door below grid line 05 offering a free area of 0.6m² this is to help facilitate make-up air at this level only.

3.2.3 System Operation

Upon receipt of a fire alarm signal the AOV at the head of the stair and the appropriate shaft/Lobby AOVs will fully open. The smoke extract fan sets will operate at full speed to provide an extract rate of no less than 4.0m^3/s, both fan set are to run simultaneously.

Because the make-up air for the system is to be drawn from the stairwell, all stair doors are to be swung into the corridor with no latching or locking mechanisms, at ground floor the system is required to 'crack' ajar two separate doors, it is crucial that when others are setting up the door closures they don't offer excessive resistance.

4 System Operation – Day Ventilation

During day-to-day activities parts of the smoke ventilation systems are to be used for the daily ventilation of the common corridors within F2 and F3. It is important to note that these systems will not introduce conditioned air into the buildings, it will only cycle atmospheric air throughout the building. The daily ventilation system is programmable and subject to change post commissioning. Different activation hours and temperatures can be accommodated.

4.1 Core F2

Day to ventilation is to be provided to the corridors from ground – level 04 by mechanical means, the day to day ventilation system shall bring in ambient air from atmosphere and cycle this through the corridor.

The daily ventilation shall work on a push/pull basis, using one smoke shaft to supply the air and the other to extract, at the head of the smoke shafts there will be dedicated daily ventilation fans connected to the smoke extract ductwork via a power open/spring return fire/smoke damper.

Within the smoke shaft we shall install high level dampers above ceiling level, these dampers will require a builders work opening of 500mmW x 175mmH, air shall be transferred into the corridors by ceiling grilles (by others).

It is understood that for this design to work ASG will install daily ventilation dampers above the left cross corridor door, and the right door shall be hung in the same direction as the air flow, to allow the door to crack ‘ajar’ slightly during daily ventilation operations.

Upon day vent activation, the system will not operate all floors at the same time, it will cycle 2 floors and cascade through the building.

As the most upper level isn’t served by the mechanical shaft the ceiling mounted louvres shall open and provide natural ventilation at this level.

There will be an externally mounted temperature sensor for each block to ensure that the air that is being cycled through the building is cooler than the internal temperature. It is understood that if external temperatures are higher than the internal temperatures that the system is still to run to help mitigate smells and stale air.

Upon detection of fire within this block all day vent facilities will shut down with all dampers returning to their default position (closed).

4.2 Core F3

Day to day ventilation is to be provided to the corridors from level Ground – level 08 by mechanical means, the day-to-day ventilation system shall bring in ambient air from atmosphere and cycle this through the corridor.

The daily ventilation from Ground – Level 05 shall work on a push/pull basis, using one smoke shaft to supply the air and the other to extract, at the head of the smoke shafts there will be dedicated daily ventilation fans connected to the smoke extract ductwork via a power open/spring return fire/smoke damper.

From levels 06 – 08 where a single smoke shaft is provided the make-up air shall be drawn from the stairwell via a high-level damper located above the stairwell door.
Within the smoke shaft and above the stairwell door (where required) We shall install high level dampers above ceiling level, these dampers will require a builder's work opening of 500mmW x 175mmH, air shall be transferred into the corridors by ceiling grilles (by others).

It is understood that for this design to work any cross-corridor doors at to be held open by devices supplied and installed by others, these devices shall release the doors under a fire scenario.

Upon day vent activation, the system will not operate all floors at the same time, it will cycle 2 floors and cascade through the building.

There will be an externally mounted temperature sensor for each block to ensure that the air that is being cycled through the building is cooler than the internal temperature.

Upon detection of fire within this block all day vent facilities will shut down with all dampers returning to their default position (closed).

5 MAOV Shafts and Cores Served

Shaft Reference	Fan Set Reference	Fan Set Location	Levels Served
MAOV-F2.1	SEF-F2.1	ROOF	Ground – Level 04
MAOV-F2.2	SEF-F2.2	ROOF	Ground – Level 04
MAOV-F3.1	SEF-F3.1	ROOF	Ground – Level 08
MAOV-F3.2	SEF-F3.2	Level 06	Ground – Level 05

Table 4: MAOV & Fan set Schedule

All shafts are to be a builder's work smoke shaft (by others) and to serve the levels as seen in table 2. Smoke extraction will be provided by smoke extract fan set as referenced in the same table, these will be a duty/standby fan set and fire rated to 300°C for 2 hours and achieves the extract rates detailed earlier in this report.

The shaft requires an internal cross sectional free area of 0.6m² with an aspect ratio of no more than 2:1. The leakage rate should be no greater than 3.8 $m^3/h/m^2$ @50 Pa.

Each floor will be provided with an AOV in the form of an LD Damper opening into the smoke shaft as discussed previously in this report.

For a mechanical extraction system the current shaft setting out is acceptable.

6 Activation, Controls & Power Supply

6.1 Activation

6.1.1 Smoke Ventilation

In all cases, the smoke extract system will be activated via smoke detection installed within the common corridors/lobbies by ASG. If the building is to have a separate fire alarm system we would be able to interface with this system and omit our detection.

6.1.2 Daily Ventilation

In all cases the daily ventilation system will be activated via dedicated temperature sensors within corridors.

6.2 Controls

The control panels within F2 & F3 will incorporate an auto-changeover device (inclusive of auto changeover maintenance bypass switch) provided by ASG. The panel will utilise current monitoring to detect failure of the running fan, it will then enable the system to switch from a failed fan to the standby fan.

A Human Machine Interface (HMI) display will be supplied with the control panel within each core to provide an interface to the system; this is to be located at ground floor level within the fireman's entry lobby, next to the fire alarm panel "by others". This HMI panel will not only display the status of the system displaying any errors that may be present.

There is to be a fireman's override switch located within the stairwell at each floor level served. Testing will be carried out by the ASG HMI panel.

6.3 Control Panels & Power Supplies

To reduce the risk of the loss of electrical supply to fire protection systems that are required to operate continuously during a fire, a protected power supply is to be provided to the ASG smoke ventilation system. The protected supply will be provided via an auto-changeover device therefore, ASG will require two independent 3 phase (+ neutral & earth) power supplies taking diverse routes direct to each of our master control panels, the control panels, ratings required for these power supplies can be seen in table 5 below. All ASG field equipment inclusive of the HMI are to be powered by ASG from our control panels and various I/O boxes.

Panel Reference	Panel Location	Power Supply Requirements
MCP-F2.1	ROOF	Dual 40A (3 Phase + Neutral & Earth)
MCP-F3.1	ROOF (Local to SEF-F3.1)	Dual 32A (3 Phase + Neutral & Earth)
MCP-F3.2	ROOF (Local to SEF-F3.2)	Dual 32A (3 Phase + Neutral & Earth)

Table 5: Control Panel & Power Supply Schedule

6.4 Interfacing Schedule

The smoke ventilation system will be required to take and provide interfaces to multiple systems for the building/system to function as needed, these are detailed in table 4 below. Note, these may not be required but are allowed as standard, should these need to be removed that can be done.

Interface Description	Interface Type	Cores Affected	Cabled By
Signal to BMS	System Status (Active /Fault)	All Cores	Others
Sprinkler (1 per level)	Sprinkler Active	All Cores	ASG
Lift interface (1 per core)	Output smoke vent active	All Cores	Others
Access controls (1 per core)	Output smoke vent active	All cores	Others

Table 6: Interface Schedule

Should any further interfaces be required to be given or received, this will need to be agreed prior to implementing into our control system. All interfaces are to be given as volt free contacts within our master control panel at roof level, wiring and connection to 3rd party equipment by others. All interfaces should be pulled back to the relevant ASG MCP with the tails clearly marked detailing what they serve.

6.5 Cabling & Containment

Cable Description	Equipment Where Used
FP200 2C + Earth 1.5mm	Smoke Evacuation Dampers, MFSD's, Head of Stair AOV's
FP200 4C + Earth 1.5mm	Firefighters Override Switches
FP200 4C + Earth 2.5mm	Control System Wiring
FPTY Data Cable	Control System Wiring
FP600 4C + Earth 4.0mm	Smoke Extract Fan sets

Table 7: Cabling Schedule

All ASG equipment (excluding the main extract fans) is 24v and therefore will go on the buildings fire alarm tray. Therefore, all containment (primary & secondary) is deemed to be supplied & installed by others.

7 Cause & Effect Tables

To be issued

8 Datasheets

8.1 Powrmatic Louvres

POWRMATIC

PRODUCT SPECIFICATION SHEET

Opensky

Roof Opensky Ventilator

Smoke & Natural Ventilator

Tested to BS-EN 12101: Part 2: 2003

Overview

The roof louvred Opensky is a natural and smoke ventilator perfect for comfort ventilation or as part of a N-SHEV (Natural, smoke and heat exhaust ventilation) system.

Product Specification

Sides & Ends
1.5mm press formed aluminium.

Louvre Blade Options
- 1.5mm single skin aluminium.
- 1.5mm double skin with 25mm PIR.
- 2.0mm translucent double skin polycarbonate.

Louvre Blade Pivots
6.0mm diameter solid aluminium bearings in shouldered nylon66 bushes for maintenance free operation.

Finish Options
- Mill finish aluminium
- Polyester powder coated to a BS Standard or RAL colour

Optional Accessories
- Birdguards - 12mm square galvanised wire mesh
- Security Bars/Guards - 16mm Ø solid steel bar
- Insect Mesh - woven aluminium
- Fusible link shields
- Internal closure pieces and flashings

Control Options
- Electric
- Pneumatic
- Manual
- Thermal Release

Installation

The roof Opensky is suitable for fixing in a wide variety of applications. The ventilator is supplied in two parts to facilitate easy installation on site, the base assembly and louvre box assembly. The base types and applications are as follows:

Turndown Base - mounting onto weathered roof upstand
Flat Base - mounting directly onto roof sheeting
Glazing Base - integrating into glazing systems

The Roof Opensky can also be supplied with a hinged base for use as an access hatch.

Louvre Blade U-values
The roof Opensky can be supplied with both insulated louvre blades and an insulated body to assist in ensuring the building is adequately insulated.

The comparative U-Values for the available louvre blades options are as follows;

Louvre Specification	U-Value $W/m^2 \cdot k$
Single Skin Aluminium (1.5mm)	6
Insulated Blades (25mm PIR)	0.66
Polycarbonate Blades (2mm Translucent)	1.75

Translucent polycarbonate louvre blades provide excellent daylighting using a durable UV stabilised material. When closed it can provide an average diffused light transmission in excess of 80%, enabling savings on artificial lighting. Pile weather seals are also fitted to the louvre blade edges and sides to minimise heat loss.

Control Options & Certification
The following control options are tested to the below standards.

Control Options	Tested To
24v Electric Drive Open/Drive Close	EN-12101
Electric 230v Drive Open/Drive Close	BS-7346
Electric 24v & 230v Spring Return	BS-7346
Pneumatic Air To Open	EN- 12101
Pneumatic Air To Close	EN-12101
Manual	BS-7346

Testing
The roof Opensky has been tested to BS EN 12101 – Part 2: 2003: Specification for natural and heat exhaust ventilators. When closed the ventilator is weatherproof and is tested to BS 5368 Parts 1 & 2.

Test	Class	Test	Class
SN- Pneumatic	SL-500	Temp (Low)	T (-5°C)
SN - Electric	SL-125	Temp (High)	B-300
Wind Load	WL-1500	Reliability	RE-1000

bsi.

By Royal Charter

Certificate of Constancy of Performance

This is to certify that:

Powrmatic Limited
Hort Bridge
Ilminster
TA19 9PS
United Kingdom

Holds Certificate No: **0086-CPR-523047**

In respect of:

EN 12101-2:2003 - Natural smoke and heat exhaust ventilators.

Open Sky Louvre Ventilators
Krystalite NSHEV
Stirling vent

In compliance with Regulation 305/2011/EU of the European Parliament and of the Council of 9 March 2011 (the Construction Products Regulation or CPR), this certificate applies to the above construction product.

This certificate attests that all the provisions concerning the assessment and verification of constancy of performance described in Annex ZA of the above standard under system 1 are applied and that the product fulfils all the prescribed requirements set out above.

For and on behalf of BSI,
a Notified Body for the above Regulation
(Notified Body Number 0086):

Pietro Foschi - Strategic Delivery Director

This certificate remains valid as long as the test methods and/or factory production control requirements included in the harmonised standard(s), used to assess the performance of the declared characteristics, do not change and the product(s), and the manufacturing conditions in the plant(s) are not modified significantly.

First Issued: 28 November 2007 Latest Issue: 15 December 2014

Ventilation report

Tested to ACR[M]001:2014 standard

POWRMATIC
Delivering complete climate control solutions worldwide

Test no:	1003
Tested by:	J. Firmin
Test Date:	23/12/2020
Sample vent build date:	30/11/2020
Vent type:	OPENSKY INSULATED
Vent description & size:	OSREN0420/Q/IA/IA
Poly/ally/insulated blades:	Insulated Blades
Painted / non painted:	Non Painted
Vent static test:	
Vent height before test (mm):	83mm
20 kg stacked, removed after 2 mins	83mm
Height after datum test:	83mm
Static kg weight:	83mm
10kg	83mm
20kg	83mm
30kg	82mm
40kg	82mm
50kg	82mm
60kg	82mm
70kg	82mm
80kg	82mm
90kg	82mm
100kg	82mm
Damage to the vent yes/no. Explain in comments section below:	NO
Pass / fail	Pass
Comments:	1mm deflection between Pre and Post Test.

1.3.2.2 A pre-load of 20 kg shall be applied at the centre of the test sample and held there for two minutes. The load shall be removed and the sample in this state shall be the datum for all subsequent measurements of deflection.

1.3.2.3 A test load of 100kg shall be applied, in 10kg increments. At each incremental load point the deflection under load shall be measured and recorded. The load shall be removed and on completion of this operation, the deflection of the sample shall be re-measured.

1.3.2.4 On completion of testing the following average values from Five tests shall be calculated:

a) The deflection under maximum load;
b) The residual deflection after removal of the load;
c) The deflection modulus, E, defined as follows (see Figure A2/1, in Annex 2):
   i) for non-linear load deflection behaviour: the gradient of the straight line connecting the origin of the load deflection curve to the 20kg point;
   ii) for the linear load deflection behaviour: the gradient of the line

1.3.2.5 For a material to satisfy the requirements for cross-sectional consistently of this standard, no individual test deflection modulus shall be more than 10% different from the average values calculated in (a), (b) and (c) above.

1.3.3 Only samples which satisfy the requirements of 1.1.2 or both the requirements for consistency, described in and 1.3.1 and 1.3.2, shall qualify for a non-fragile classification under this standard.

Vent drop test:		
Vent height before test (mm):	83mm	Link to drop test photos
Weight of sand bag (min 45kg)	60KG	Emails provided.
Height of the sand bag (min 1200mm from highest point on sample vent)	1200mm	
Drop tests	Deflection (mm):	
1st drop test within 150mm of the centre	150mm	
2nd drop within 300mm of support point	300mm	
3rd within 150mm of the edge of the unit	150mm	
If you are unsure on drop point locations please refer to diagram A2/3		
Damage to the vent yes/no. Explain in comments section below:	YES	
CLASSIFICATION	Class B Non Fragile	
Comments:	1st droptest buckling , 2nd drop test buckling and minor tearing , 3rd drop test major tearing and penetration through unit.	

Signed

Date 6/1/2021

3.3 Assemblies subjected to a single drop test

If after the first impact the impactor is retained on the test sheet, satisfying conditions set out in 3.2, and no other drop tests are carried out on the assembly, the assembly shall be classified as a **Class C non-fragile assembly.**

3.4 Assemblies subjected to multiple drop-tests

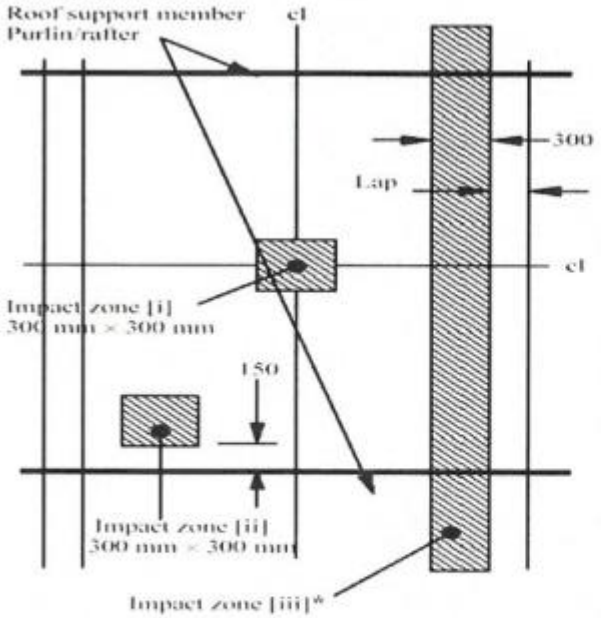
3.4.1 The impactor may be removed and the test sheet may be subjected to a second drop test at the same locations as the first drop from 1200mm measured from height at which the impactor is retained on the test sample after the first drop.

3.4.2 If the impactor passes through the test sheet and hits the ground, the assembly shall be classified as a **Class C non-fragile assembly.**

3.4.3 If the impactor is retained on the test sheet, satisfying the conditions set out in 3.2, the assembly shall be classified as a **Class B non-fragile assembly.**

3.4.4 On conclusion of the second drop test, the load shall be removed and the assembly examined by the competent person and if, in his opinion, the roof sheet and the assembly shows no signs of significant damage that will affect the long term strength and weatherability of the assembly – see Note 6, the assembly may be classified as a **Class A non-fragile assembly.**

Note 6: Any tearing at the fixings, fractures in the sheet or the assembly support structure, delamination of the sheet or damage to the surface protection which could accelerate the degradation process should be seen as sufficient to withhold a Class A rating. See also paragraph 6.1



Note 1: * exact position in zone [iii] to be specified by the competent person.
Note 2: All dimensions are in millimetres.

FIGURE A2/3 – Impact zones for drop-test in accordance with 2.3.5

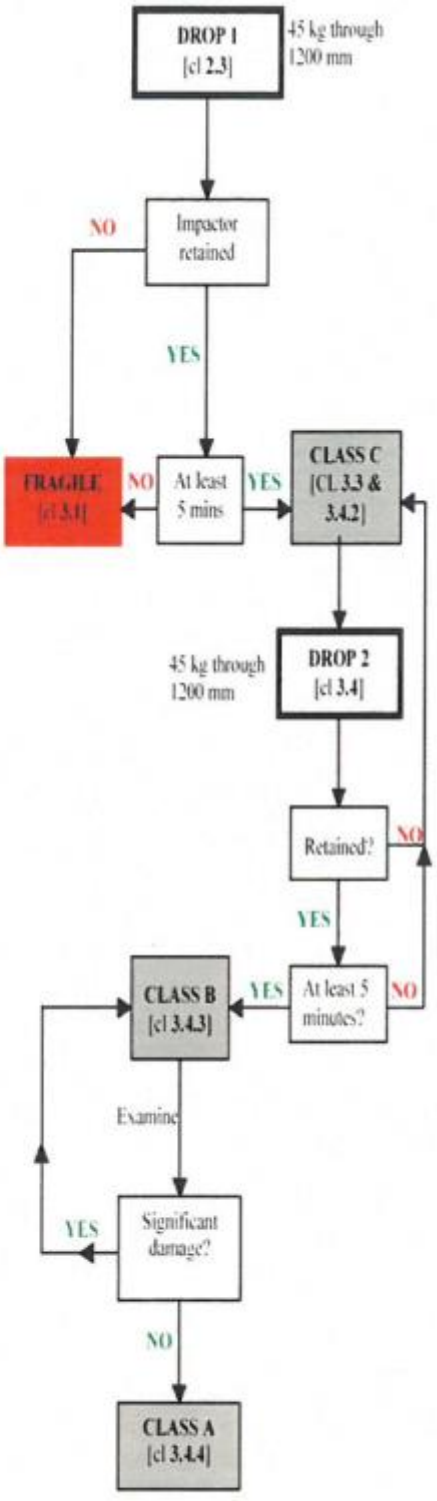


Figure A3/1: Flow-chart for classification

Powrmatic Limited
Hort Bridge
Ilminster
Somerset
TA19 9PS
United Kingdom

Roof Open Fragility Test

Tested to ACR(M)001:2000 – Test for Fragility of Roofing Assemblies.

Test Specimen

Roof Open Sky Ventilator, OSREN1720, 3470mm x 2000mm Polycarbonate and Aluminium Blades

Test Results

Carried out to Clause 2.3.3 to 2.3.5

The load was positioned over a central point of the vent that was deemed to be the most vulnerable point.

Roof Open Sky Ventilator, OSREN1720, 3470mm x 2000mm Aluminium Blades
The sandbag cause severe deformation of the aluminium blades but did not fall through. This was classed as Class C, non fragile.

Roof Open Sky Ventilator, OSREN1720, 3470mm x 2000mm Polycarbonate Blades
The sandbag fell through. Polycarbonate blades but was arrested by the tie bars. This was classed as fragile.

Date Tested – 16/12/2009

Tested By - John Hallett – Test Engineer

Witnessed By – Tony Fells – Chief Engineer

8.2 Smoke Extract Fan Set

Theoretical Working Point

Airflow	6,00 m³/s
Static Pressure	350 Pa
Temperature	20 °C
Altitude	0 m
Density	1,2 kg/m³
Frequency	50 Hz

Working Point

Airflow	6,24 m³/s
Static Pressure	379 Pa
Dynamic pressure	243 Pa
Total Pressure	622 Pa
Shaft power	11,1 kW
Max shaft power	11,2 kW
Outlet speed	20,1 m/s
Fan speed	2956 rpm
Specific Fan Power	1,94 W/l/s

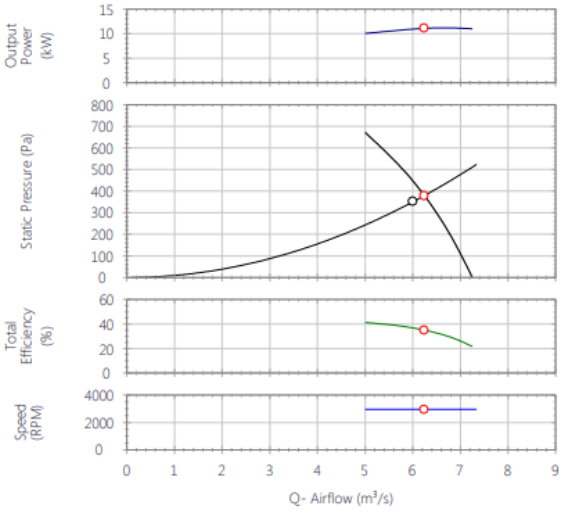
Construction

Discharge diameter	630 mm
Blades	6
Angle	22°
Certification	F300/F200
Weight	179,00 kg

Motor Characteristics

Number of poles	2
Motor Power	11 kW
Voltage	3-400/690V-50Hz
FLC	20,0 A / 11,6 A
IP Rating	IP55
Motor insulation class	H
Motor Certification	F300
Motor Efficiency	IE3
Starting Current	160 A

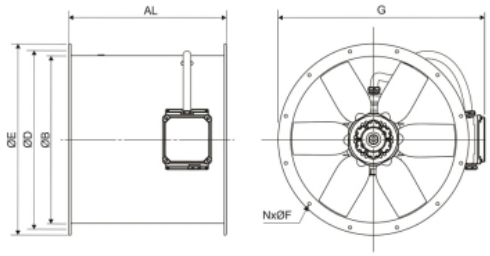
Performance Chart



Sound Performance

	63	125	250	500	1k	2k	4k	8k	Overall
Inlet (LwA)	65	81	91	98	99	96	90	82	103
Inlet LpA @ 3m	44	60	70	77	78	75	69	61	82

Drawing



AL	B	D	E	F	N	G
700	630	690	725	12	12	795

LGAI
LGAI Technological Center, S.A.
Campus UAB s/n
Apartado de Correos 18
E - 08193 Bellaterra (Barcelona)
T +34 93 567 20 00
F +34 93 567 20 01
www.applus.com

Applus laboratories

Bellaterra:	06 of February of 2017
Fan range:	THGT
Range report:	12/4372-1471
Date of range report:	28 of June of 2013
Test sponsor:	SOLER I PALAU SISTEMAS DE VENTILACIÓN C/ Llevant nº4, Parets del Vallès 08150 Barcelona (Spain)

Applus LGAI TECHNOLOGICAL CENTER, S.A. has carried out the range report to the following THGT fan models:

- **Leroy Somer and ABB motors (400 V, 50 Hz), F300/1H**
  Range between sizes 400-630.

- **WEG motors (400 V, 50/60 Hz), F300/2H**
  Range 400-1000 60 Hz 4 poles and 1250 60 Hz 6 poles.
  Range 400 -1250 50 Hz 2 poles up to 630 and 4 poles up to 1250.

The fans were tested with the following accessories:

- Back draft shutter clar (test f400)
- Outlet guard protection (test f400)
- Inlet guard protection (test f300)
- Kit box (test f400)
- Machining flange (test f400)
- Flexible connection (test f400)
- Support feet (test f300)
- Antibrivation mount (test f400)
- Insulator (until 63A 6P86+2P 60 Hz) (test F400)
- Variable speed VSD CFW -700 and CFW -09 used only 60 hz
- Terminal box&block WEG until 15 KW (test f400)
- Circular Sound attenuator (test f400)

CONCLUSION

As indicated in the technical justification section and after performing the tests according to the UNE EN 12101-3:2002 "Smoke and heat control systems- part 3: Specification for powered smoke and heat exhaust ventilators", the fan range reference THGT, manufactured by SOLER & PALAU, can be classified as:

"THGT" range by Soler i Palau tested with LEROY SOMMER and ABB motors.
(400V 50 HZ)
300ºC/1h
CLASS F 300, 60 minutes

"THGT" range by Soler i Palau tested with WEG motors.
(400V 60 HZ-50 HZ)
300ºC/2h
CLASS F 300, 120 minutes

Fans placed inside and outside of the furnace

- Dual purpose ventilator
- For use outside and inside the smoke reservoir
- Inlet and the outlet air's flow in horizontal direction
- Snow kind not applicable

The range classification obtained is valid in accordance to standard EN 12101-3:2015. The different test reports that make up the range have been evaluated and checked on 06 of February of 2017 in accordance to standard EN 12101-3:2015, satisfying the samples selection requirements, the test requirements and the classification criteria.

Quim Vilar
Fire Safety Engineer
Fire Safety Engineering Department
Applus - LGAI Technological Center, S.A.

S&P Sistemas de Ventilación S.L.U.

Declaration of performance - Powered Smoke and Heat Exhaust Ventilator

0370-DOP-0742

1. Unique identification code of the product-type:

Cylindrical cased axial flow fan
THGT F300

2. Type, batch or serial number or any other element allowing identification of the construction product as required pursuant to Article 11(4) of Regulation (EU) No 305/2011:

Cylindrical cased axial flow fan
THGT F300 , 400-450-500-560-630-710-800-900-1000-1120-1250-1409-1609

3. Intended use or uses of the construction product, in accordance with the applicable harmonised technical specification:

To be installed as part of a powered smoke and heat control ventilation system.

4. Name, registered trade name or registered trade mark and contact address of the manufacturer as required pursuant to Article 11(5) of Regulation (EU) No 305/2011:

S&P SISTEMAS DE VENTILACIÓN, S.L.U.
C/Llevant, 4
08150 Parets del Vallès (BARCELONA)
SPAIN

5. Where applicable, name and contact address of the authorised representative whose mandate covers the tasks specified in Article 12(2) of Regulation (EU) No 305/2011:

N/A

6. System or systems of assessment and verification of constancy of performance of the construction product as set out in Annex V:

System 1

7. The declaration of performance concerning a construction product covered by a harmonised standard:

APPLUS(Notified Product Certification Body no 0370), based on the following items of system 1 system of assessment and verification,

i. Determination of the product type on the basis of type testing (including sampling)
ii. Initial inspection of the manufacturing plant and of factory production control
iii. Continuous surveillance, assessment and evaluation of factory production control

has issued the certificate of constancy of performance of the product no 0370-CPR-0742.

S&P Sistemas de Ventilación S.L.U.

Declaration of performance - Powered Smoke and Heat Exhaust Ventilator

8. Declared Performance

Essential Characteristics	Performance	Harmonised Technical Specification
Response delay • Opening under wind load within a given time • Opening under snow load within a given time	NPD* NPD*	EN 12101-3: 2015
Opening under snow load within a given time • Application categories • Motor rating	Dual Purpose / Emergency H, 105K	
Effectiveness of smoke / hot gas extraction Gas flow and pressure maintenance during smoke and heat extraction test	+/- 10%	
Resistance to fire	F300 F200	
Ability to open under environmental conditions: • Opening under wind load within a given time • Opening under snow load within a given time	NPD* NPD*	
Durability of operational reliability	H, 105K	

*NPD: No Performance Determined

9. The performance of the product identified in points 1 and 2 is in conformity with the declared performance in point 8.

This declaration of performance is issued under the sole responsibility of the manufacturer identified in point 4.

Signed for and on behalf of the manufacturer by;

Carlos Campderròs,

Parets del Vallès, March 2016

S&P Sistemas de Ventilación S.L.U.

EU Declaration of Conformity (DoC)

The manufacturer	S&P Sistemas de Ventilación S.L.U
	C/Llevant , 4
	08150-Parets del Vallès-Barcelona

declares that the DoC is issued under its sole responsibility and belongs to the following product:

	CYLINDRICAL CASED AXIAL FANS
Tipo	THGT F300
Serial number	All Manufactured
CE mark date	08

The object of the declaration described above is in conformity with the relevant Union harmonization legislation: Machinery Directive 2006/42/EC, Commission Regulations (EU) No 327/2011 implementing ErP Directive 2009/125/EC with regard to eco-design requirements for fans driven by motors with an electric input power between 125W and 500kW and RoHS Directive 2011/65/EU.

The following harmonized standards and technical specifications have been applied:

EN 12101-3:2015 // EN 60204-1:2006 // EN 62311:2008 //

EN ISO 12100:2010 //EN ISO 12499:2008 //EN ISO 13857:2008 //

By affixing the CE marking we take the responsibility for the conformity of the product under the Construction Products Regulation nº 305/2011 with the Declaration of Performance nº 0370-CPR-0742

The object of the declaration described only lacks the necessary protective means or safety components for avoiding the following hazards: contact with a rotating shaft or impeller, object being drawn into the fan inlet and ejected at fan discharge, even when the fan is switched off, and access through an unauthorized opening of connecting ductworks. The manual instructions provides safety measures that are still necessary on installation to ensure the compliance with EN ISO 12499. Compliance with EN ISO 13857 refers to safety devices when supplied, and installed, with the product. The responsibility for compliance with EN ISO 13857 is the installer of the system where the product is applied.

The Technical Director is the person authorized to compile the technical file in accordance with Annex VII part A.

Additional Information:

The product design is inherently benign, and fulfills the requirements of the EMC Directive 2014/30/EU with regard to emission and immunity to electromagnetic levels.

Signed by

Carlos Campderrós

S&P Sistemas de Ventilación S.L.U

Marzo 2018

8.3 LD Damper

The Be Safe Direct Lobby Damper (LD) fire and smoke damper has been designed to satisfy smoke vent applications and is particularly suited for fire rated mechanical smoke extraction shafts in multi-storey buildings.

The LD damper on the active level is designed to open in emergency to exhaust smoke. All the dampers on the other levels will remain closed to ensure fire compartmentation of the active level and riser.*

The damper has been fire tested to the latest European Fire Damper Test Standard (EN1366-2) and achieved a 2 hour fire resistance performance to ES120.

Throughout the test, a 300Pa pressure differential is applied across the damper, and leakage measurements taken.

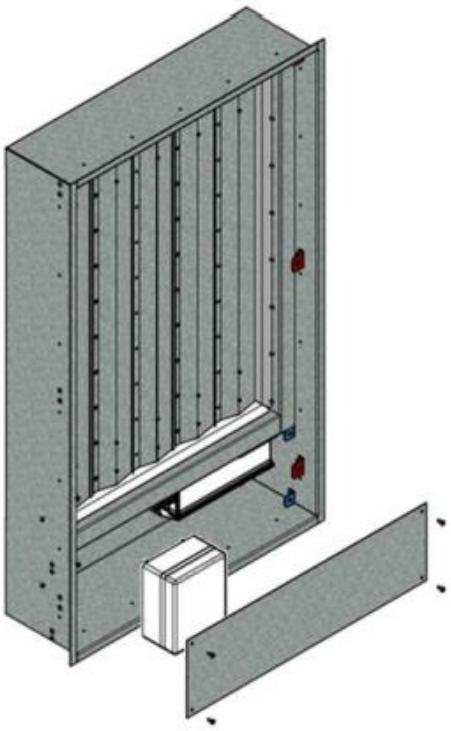
* *from a control input instruction*

Damper Specification

- 1.5mm galvanised (BS EN10142 DX51D +Z275) steel frame with fully seam welded corners along the entire depth to produce a rigid and air tight construction.
- Vertical "opposed motion" damper blades to enhance air entrainment being 'pulled' into in smoke shaft.
- 0.7mm galvanised (BS EN10142 DX51D +Z275) double skin airfoil 100mm pitch damper blades with interlocking engagement when damper is closed.
- 0.40mm type 301st/stl (1.4310 BS EN 10088-2:2014) peripheral gasketing around entire perimeter.
- 'Out of airstream' actuator and linkage mechanism.
- Ambient leakage conforms to class ES of EN1366-2 / ISO10294-2 (200m^3/hr/m^2 - 55 l/s/m^2)
- Pre-punched damper sleeve fixing holes

Damper Features

- Longevity cycle tested for 100,000 fully open closed operations.
- Able to respond to smoke alarm inputs.
- 24V ac/dc Belimo BE motor open/motor closed actuator
- Actuator is on lobby side, hidden from view behind painted cover plate and can be manually operated if needed.
- Easy access to actuator by simple removal of cover plate behind grille.
- Volt Free Monitoring contacts.
- Can also be used for environmental control.
- Simple to install and audit

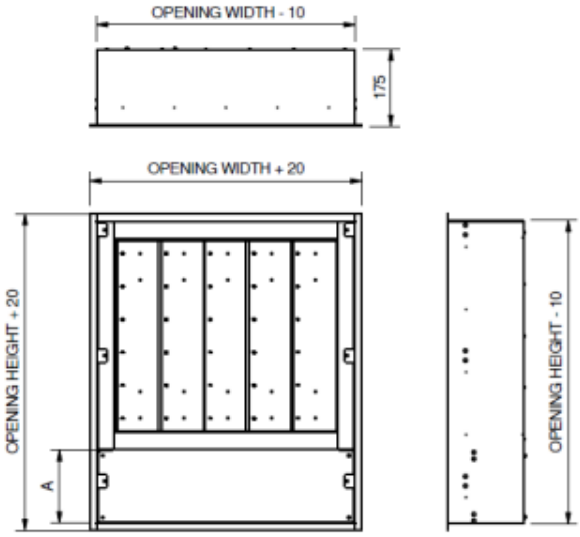


View of damper without grille fitted, with cover plate removed to show actuator and terminal box.

Size Range

- From 400mm x 400mm up to 1200 x 1500mm. Available in 100mm increments.
- All sizes refer to 'opening size' This is the nominal size (w x h)
- Actual damper (overall sleeve) size is 10mm below nominal size. This allows 5mm clearance for all 4 sides

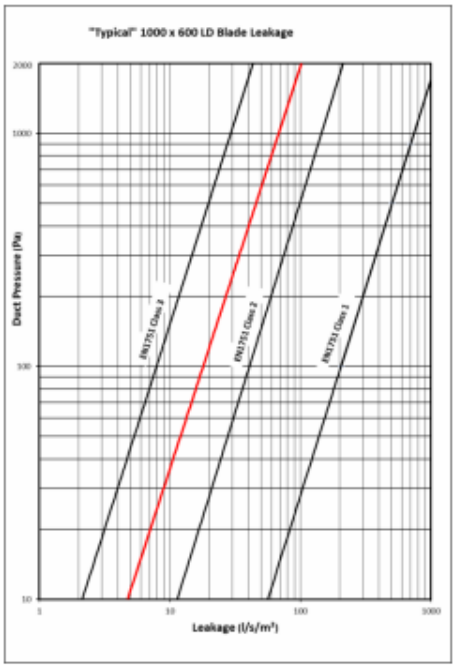
Dimensions



A = 166mm for dampers 500mm wide and above
249mm for dampers below 500mm wide

Damper and Grille assembly

- Grille and grille assembly kit supplied with damper.
- Grille colour RAL9010 white supplied as standard. Other colours available on request.
- Grille fixing screws colour matched to grille
- Entire 'inside' of damper behind grille is spray painted matt black with environmentally friendly matt black paint



DECLARATION OF PERFORMANCE

DOP-LD-03 Lobby Damper (LD)

1. Name address and identification number of notified product certification body:
   BRE Global Assurance (Ireland) Ltd, DCU Alpha, Old Finglas Road Glasnevin, Dublin, D11 KXN4 Ireland. ID no: 2831
2. EC certificate of conformity: certificate no. 2831-CPR-P0017.
3. Name and address of manufacturer:
   BSB Engineering Services Ltd,
   Unit 56, Mill Way, Trinity Trade Centre, Sittingbourne, Kent, ME10, 2PD.
4. Description and use of product:
   Smoke Control Damper, designated Lobby Damper (LD) damper and LD Grille.
   To be used in conjunction with walls/partitions to be used in smoke control systems in multi-compartment applications at fire temperatures, or in single compartment applications at temperatures up to 600°C.
5. Provisions to which the product complies: Annex ZA of EN12101-8.
6. Particular conditions applicable to the use of the product:
   Damper is normally closed, maintaining compartmentation and will open under instruction for smoke extraction.
   Damper including grille tested for maintenance of opening.
7. System or systems of assessment and verification of constancy of performance of the construction product as set out in the Construction Products Regulation (CPR - Regulation (EU) no 305/2011):, Annex V: System 1
8. Declared performance according to:
   EN 12101-8 (Smoke and heat control system Part 8: Smoke control dampers).

Essential Characteristics (in accordance with EN12101-8)

Fire resistance according to EN 1366-10 & 1366-2 and classifications according to EN 13501-4:

Range (w x h)	Type	Supporting construction	Classification report	Classification (BS EN 13501-4)
400 x 600mm up to 1200 x 1425mm	LD	Drywall Partition	18/17538-1479-1	E (120Vew i→o) S 1000 C $_{10,000}$ AA Multi
400 x 600mm up to 1200 x 1425mm	LD	Masonry Wall	18/17538-1479-1	E (120Vew i→o) S 1000 C $_{10,000}$ AA Multi

		Performance	Harmonised technical specification: EN 12101-8
Nominal activation conditions/sensitivity:	4.2.1.3	Automatic activation - passed	
Response delay (opening response time)	4.2.1.4	Automatic activation - passed	
Operational reliability	4.4.2.2	10,000 cycles - passed	
Integrity (E)	4.1.1.a	E 120	
Leakage (S)	4.1.1.c	ES 120 1000 (pressure level 2 -1000Pa to +500Pa)	
Insulation (I)	4.1.1.b	NPD* (not referenced in ADB vol II)	
Mechanical stability (under E)	4.1.1.d	Passed	
Maintenance of Cross Section (under E)	4.1.1.e	Passed	
Durability of response delay:			
Opening response time	4.4.2.1	Passed	
Durability of operational reliability:			
- open and closing cycle tests	4.4.2.2	10,000 cycles <120s - passed	

* NPD = no performance declared

Signed for and on behalf of BSB by:

Date: 6th Oct 2020

Mike Backham
Technical Director
BSB Engineering Services Ltd

CE

8.4 Day Vent Dampers

Environmental Ceiling Damper (ECD

Technical Data

- Motorised Fire Damper tested to EN1366-2
- Damper classified to EN 13501-3
- Cyclic tested for 10,000 operations
- Unducted easy fix install from one side
- Actuator hidden from view on non-access side
- Complete with optional grille

Introduction

This Fire damper is designed for use within ceiling voids to allow the movement of air typically between the occupied area and extraction riser and is intended as an unducted installation.

It comes complete with optional purpose designed non-vision grille.

Fixed to the wall, it maintains fire compartmentation in the event of a fire. It requires access for installing on the single side only.

The ECD damper has been successfully tested to EN1366-2:2015 Fire Damper Test Standard and has achieved a 2 hour fire resistance performance to ES120. Throughout the test, a 300Pa pressure differential is applied across the damper and leakage measurements taken. To achieve the ES leakage class, a maximum leakage of 200m^3/hr/msq must not be exceeded. The leakage limit also apples to the smallest damper size.

Size range (mm)

- Minimum 200W x 175H
- Maximum 1000W x 300H

Design

The ECD damper assembly consists of a base damper housed within a fully welded galvanised steel sleeve. Its peripheral flange allows it to be fitted flush into the builder's aperture using side fixings only. Thermal fuse fixing bracket integral with damper sleeve. (requires site fixing to prevent possible transport/storage damage).

Function

A BSB PML-TF actuator (spring return closed, c/w 72˚C thermal fuse) is used to drive the damper blades to the open position for every day environmental ventilation. It will fail-safe spring closed upon removal of power or if the thermal fuse operates due to local temperature rise due to a fire.

Mid set-point option between 30˚ to 90˚ is built into the actuator to allow the damper to be set for every-day system air balancing. The grille has been designed to offer full non-vision aspect preventing the damper being seen, RAL 9010 white is offered as a neutral standard colour with other RAL colours to order.

Actuator

PML-TF actuator (motor open spring fail-safe closed).

- 71˚C thermal fuse.

Actuators are supplied in easy identifiable differing coloured housings.

- Grey Housing – 24 volt option
- Orange Housing – 230 volt option

The PML-TF actuator allows mid-point setting of the damper blades during commissioning of the system via its mechanical stop. Dampers can be set so that the open blade position is restricted between 30˚ and 90˚ (60˚ range) whilst still retaining fail safe spring closure in an alarm condition or power failure.

- Responsive to inputs from control detection system.
- Auxiliary contacts for position monitoring
- Actuator hidden from view with easy access for maintenance.
- 1m power and signal cables are provided. (See page 4 for wiring diagrams).
- The actuator thermal fuse cable length is 500mm.

Grille

The Stand-Off Grille has been designed to perfectly fit over damper flanges lining up with pre-punched damper flange holes and comes complete matching colour fixing screws.

Grille colour RAL9010 white supplied as standard. Other colours available on request.

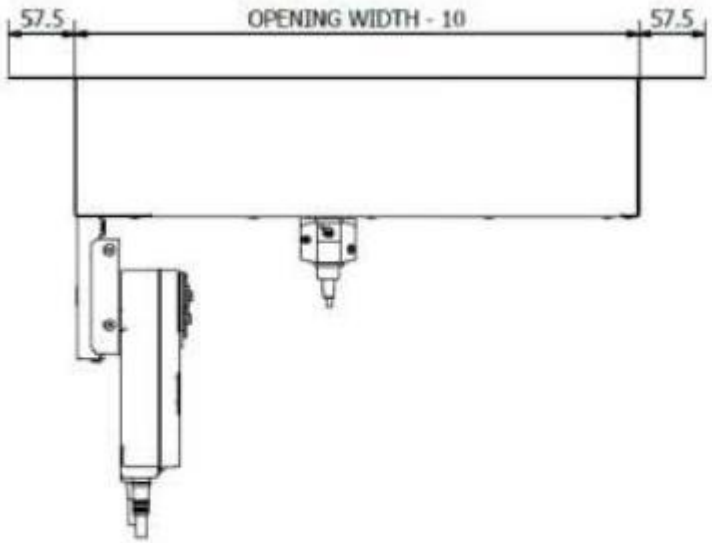
Compliance

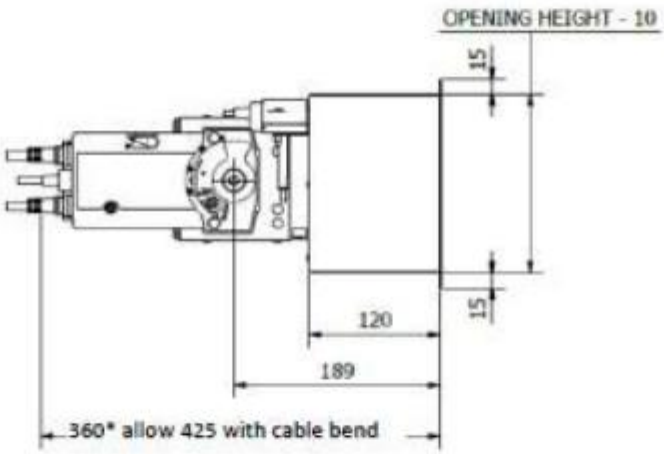
- Damper tested to EN1366-2
- Damper classified to EN 13501-3
- Achieving: E (120 Ve i->o) S

Shown with mid set-point feature.
(This is an optional extra , see page 5)

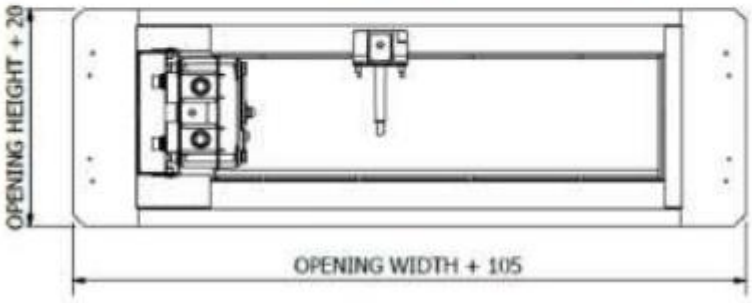
Damper Specification

- 1.2mm galvanised (BS EN10142 DX51D+Z275) steel frame with fully seam welded corners along the entire depth to produce a rigid and airtight construction.
- All welds are coated with environmentally friendly water-based corrosion resistant paint finish.
- 0.7mm galvanised (BS EN10142 DX51D+Z275) double skin airfoil 100mm pitch damper blades with "opposed motion" interlocking engagement when damper is closed.
- 0.40mm type 301st/stl (1.4310 BS EN 10088-2:) peripheral gasketing around entire blade perimeter.
- 'Out of airstream linkage mechanism.
- Ambient leakage conforms to class ES of EN1366-2 / ISO10294-2 (200m^3/hr/m^2 – 55 l/s/m^2).
- Pre-punched damper flange fixing holes.
- Motorised operation – 24v ac/dc 230V a/c motor open, spring closed operation.
- Supplied with PML-TF actuator*
- *The PML actuator has mechanical limitation available as standard to set mid-point damper open position if required.
- Actuator has less than 60 second motoring time and <30s fail-safe spring return time.
- All actuators are factory fitted and the damper/actuator assembly is mechanically tested at final assembly.





View from actuator side (non-access)-side



Grille

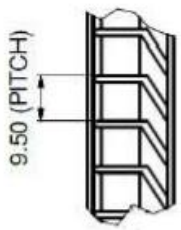
ECD Grilles are available as optional extra to the damper if required.

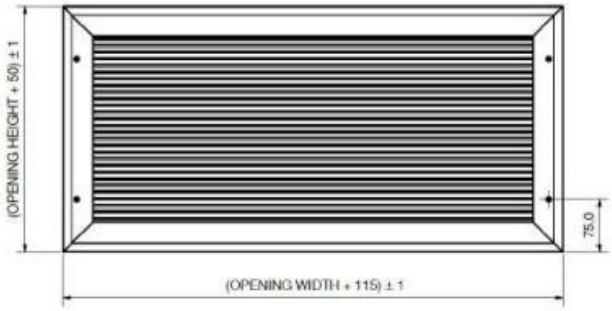
Grille fixing holes line up with pre-punched damper flange holes to allow grilles to be screwed directly into wall.

For ECD dampers up to 800mm wide, there are 2off fixings per vertical side. Above 800mm wide, an additional central top/bottom fixing is present.

Grilles are powder coated polyester paint and RAL9010 white is supplied as standard. Other colours available on re-quest.

Grille fixing screws are colour matched to grille.





8.5 Auto Changeover

ATyS t M - ATyS g M

Automatic Transfer Switching Equipment

from 40 to 160 A

Transfer switches

The solution for

- High-rise buildings
- Data centers
- Healthcare buildings

Strong points

- Fast commissioning
- ATyS d M with an integrated controller for dedicated mains/mains or mains/genset functions
- Secure programming

Conformity to standards

- IEC 60947-6,-1
- IEC 60947-3
- GB 14048.11

Approvals and certifications(1)

(1) Product references on request.

Function

ATyS t M and **ATyS g M** are modular automatic transfer switches with positive break indication. ATyS t M are 4 pole (three-phase) devices and ATyS g M are 2 or 4 pole (single or three-phase) devices.

They have all the functions of the ATyS d M together with an integrated controller, giving them automatic features dedicated to mains/mains (ATyS t M) and mains/genset (ATyS g M) applications. They are intended for use in low voltage power supply systems where a brief interruption of the load supply is acceptable during transfer.

Advantages

Quick start

ATyS t M and g M transfer switches offer significant time saving during commissioning (the process takes 2 to 3 minutes). Thanks to the design that allows commissioning through just one potentiometer (4 on the ATyS g M) and four DIP switches, a screwdriver is all that is required to configure the parameters.

ATyS g M: dedicated to mains/genset applications

In addition to its single-phase and three-phase voltage & frequency monitoring for both incoming sources, the product's integrated controller also features functions that are specific to mains/genset applications (genset control, test on load, etc.).

ATyS t M: dedicated to three-phase mains/mains applications

The ATyS t M integrated controller has been designed to provide all the functions necessary for these applications (operation with or without priority, preferred source selection) together with the monitoring of the voltage and frequency of both sources for three-phase networks.

Secure programming

To ensure that the correct configuration is maintained an optional sealable cover can be fitted in order to avoid any unintentional modifications to the programming.