



Smoke Control

The Great Black Art

Protecting life, property
and the environment /



**Fire Protection
Association Australia**

Our Platinum Members



Today's Presenters



Ivan Steed - Grosvenor Engineering



Pat McManus - Stokes Safety



Vance Rowe from Holyoake AMS



Please turn off your
mobile phone
or switch to silent.



PART I

Introducing Pat McManus

- Why smoke control is critical in fire scenarios
- Common principles shared across smoke control systems
- Activation, operation, and basic system interfaces
- Typical building applications
- Importance of coordination with fire detection systems

Smoke Control System Types



1. Construction is **simpler** as installation is to the current code.
2. Maintenance is **harder** as you need to know what the systems design is.
3. Testing is the **hardest**, as you need to know the performance requirements of all the codes, standards and the accepted design.

TYPES OF SMOKE MANAGEMENT SYSTEMS

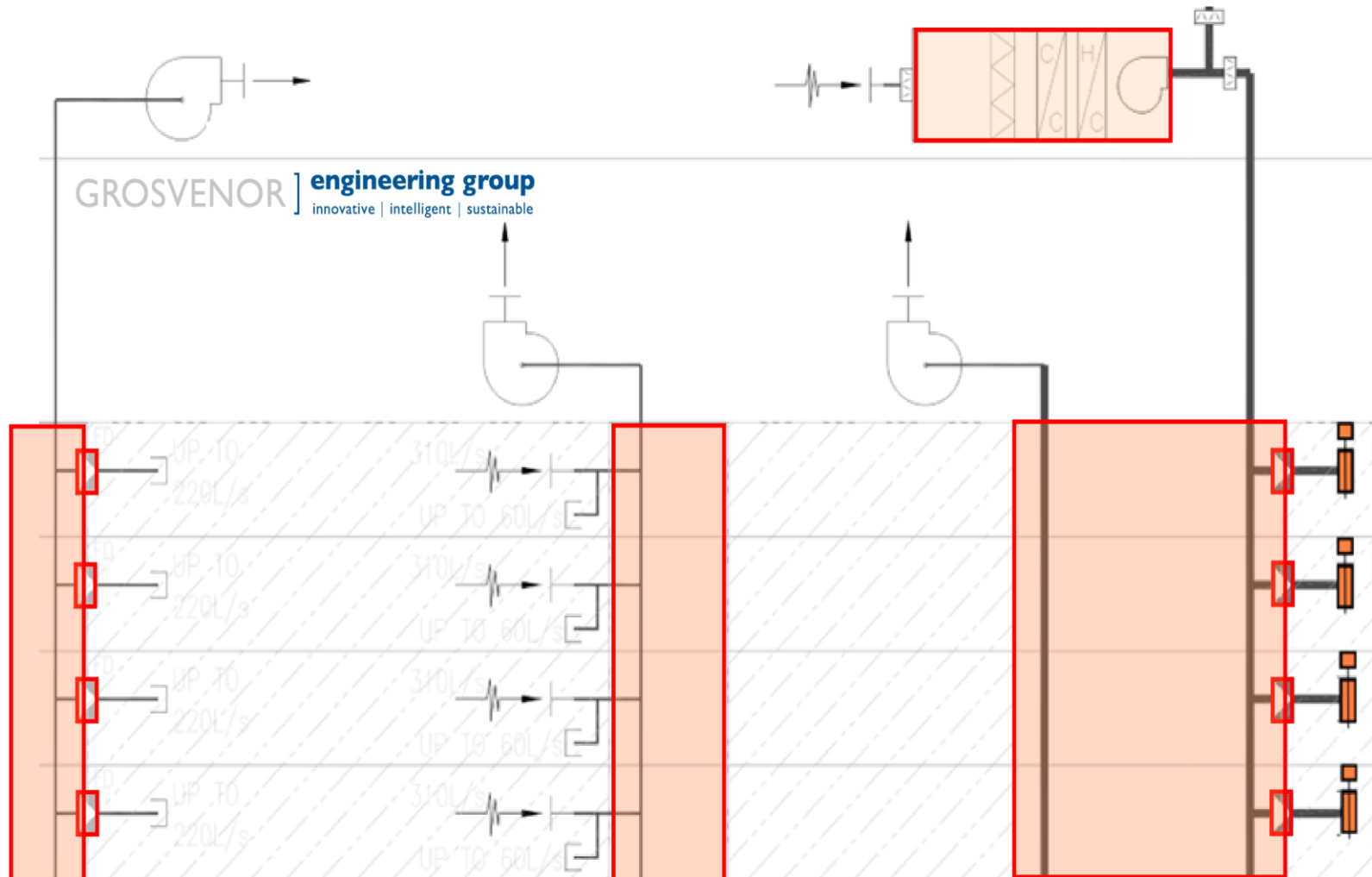
- **Shutdown** – Everything stops and possibly closes
- **Air Purge** – Air onto and off every floor at the same time
- **Zone Pressurization** – Pressurize & depressurise fire compartments
- **Exit Pressurization** – Prevent smoke entering fire isolated exits
- **Stair Relief** – Mechanical exhaust to assist the exit pressurization
- **Stair Relief** – Passive relief openings to assist the exit pressurization
- **Smoke Exhaust** – Atriums e.g. office buildings; Warehouses & shopping centres

System Shutdown



- Purpose of shutting down mechanical systems during fire events
- Preventing smoke spread through ductwork and air handling units
- Typical shutdown triggers and controls
- Relationship with fire compartmentation

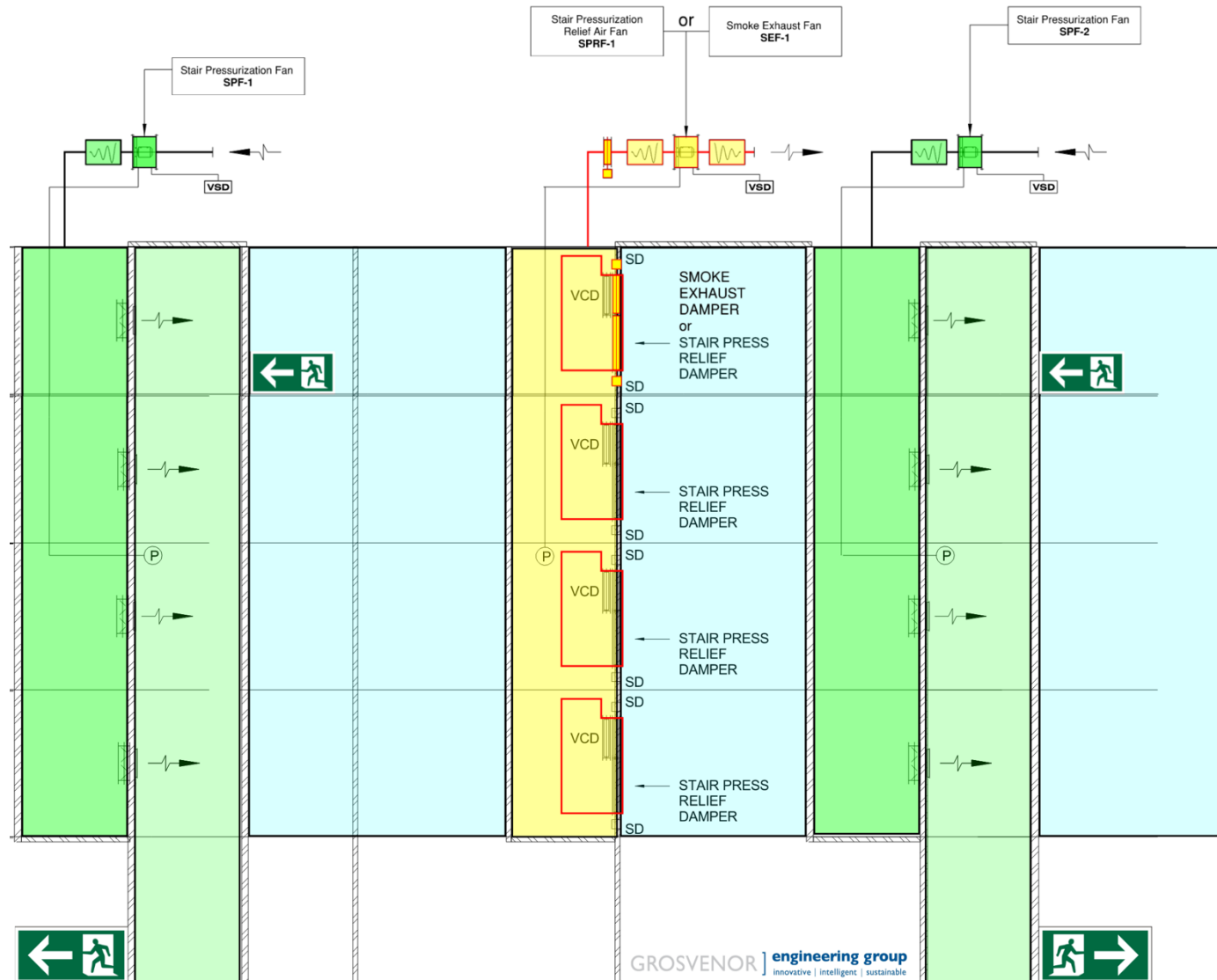
System Shutdown



Fire Isolated Exits – Stair & Passageway Pressurisation

- Importance of keeping exits smoke-free
- How pressurisation supports safe evacuation
- Typical protected spaces (stairs, lobbies)
- Interaction with door opening forces
- Alignment with evacuation strategies

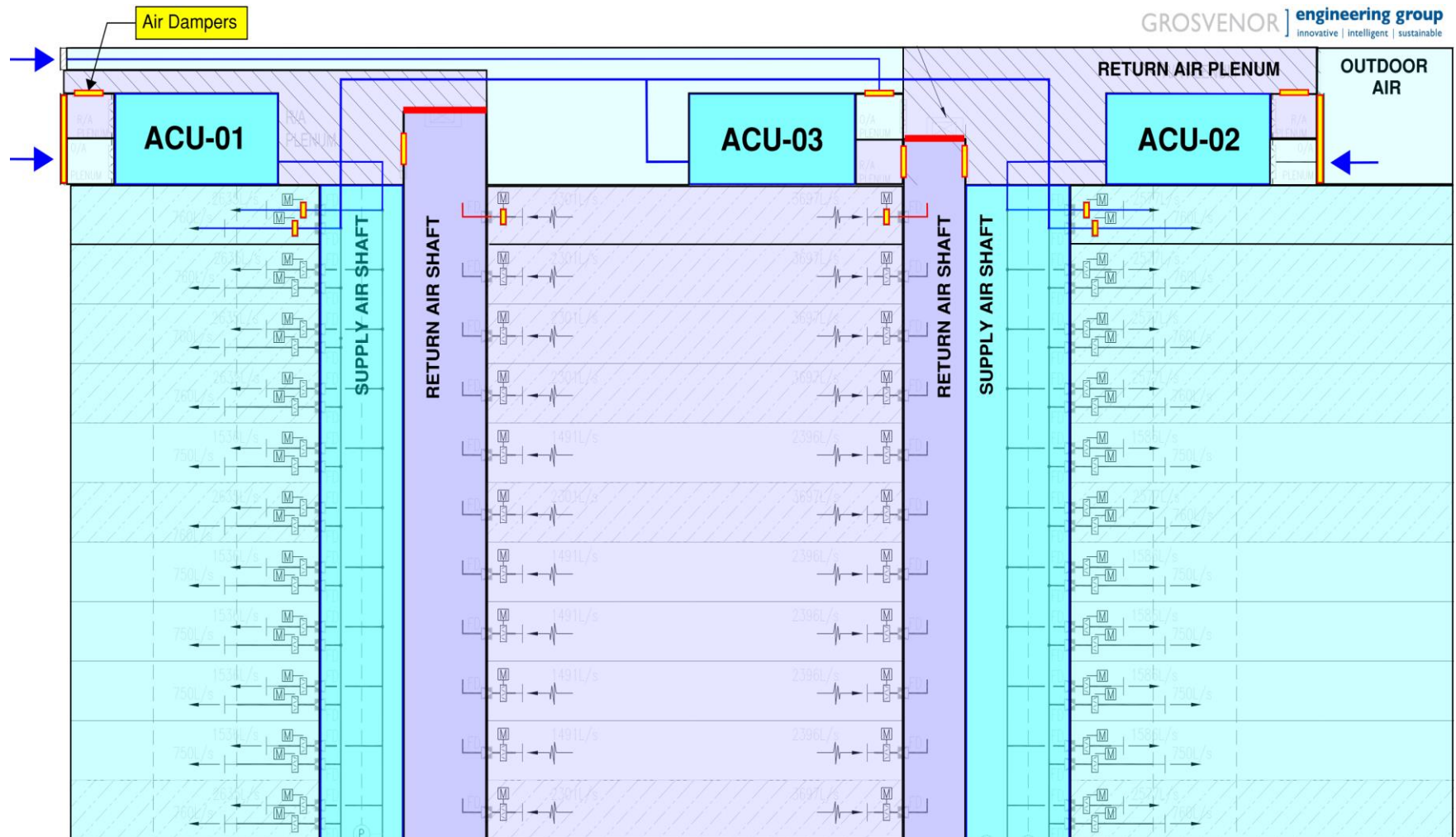
Fire Isolated Exits – Stair & Passageway Pressurisation



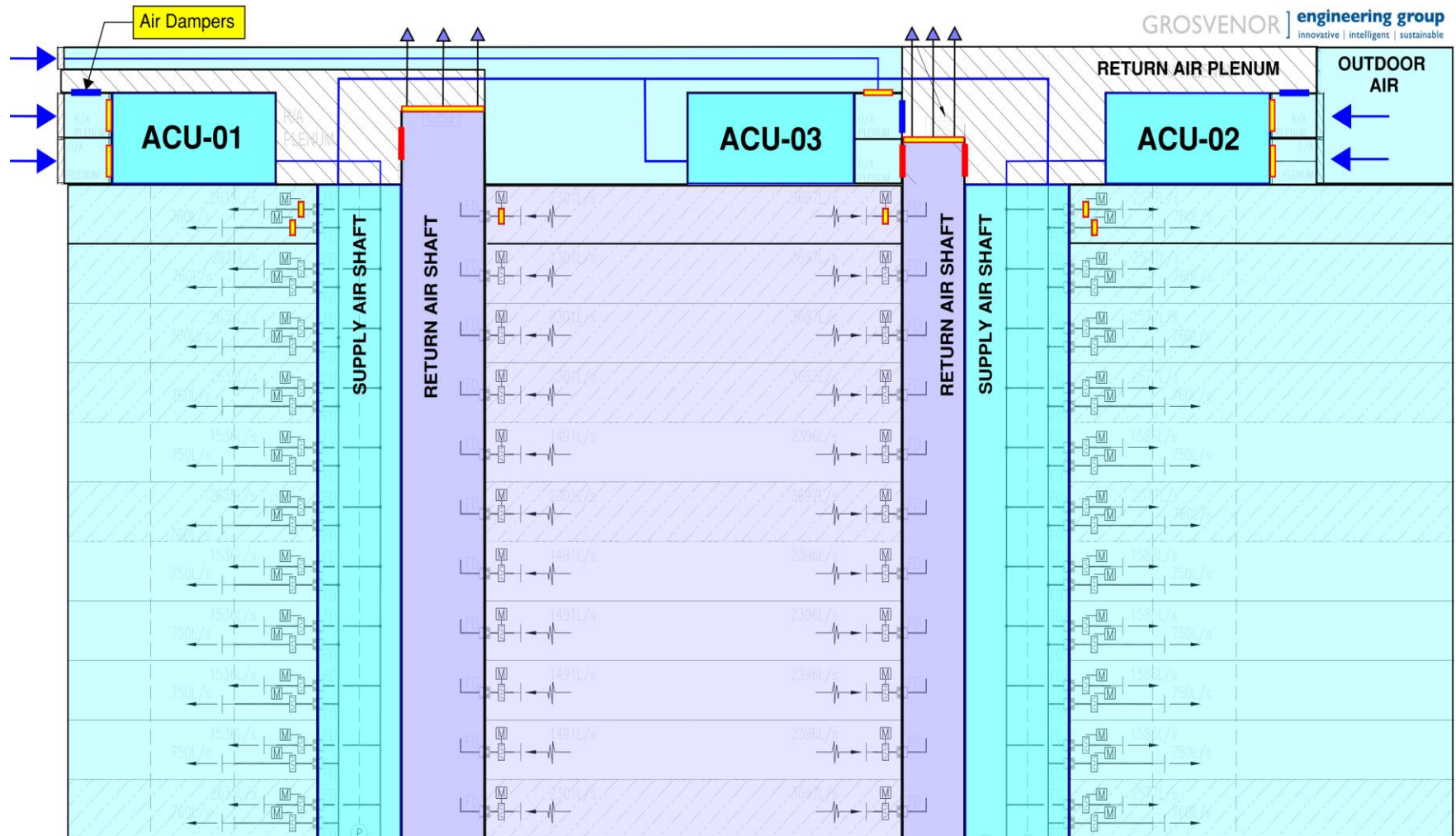
Air Conditioning System Fundamentals



- Minimum Outdoor Air
- Maximum Outdoor Air – Economiser Cycle
- Typical operation during a fire event
- Key compliance considerations



Maximum Outdoor Air



Air Purge Systems

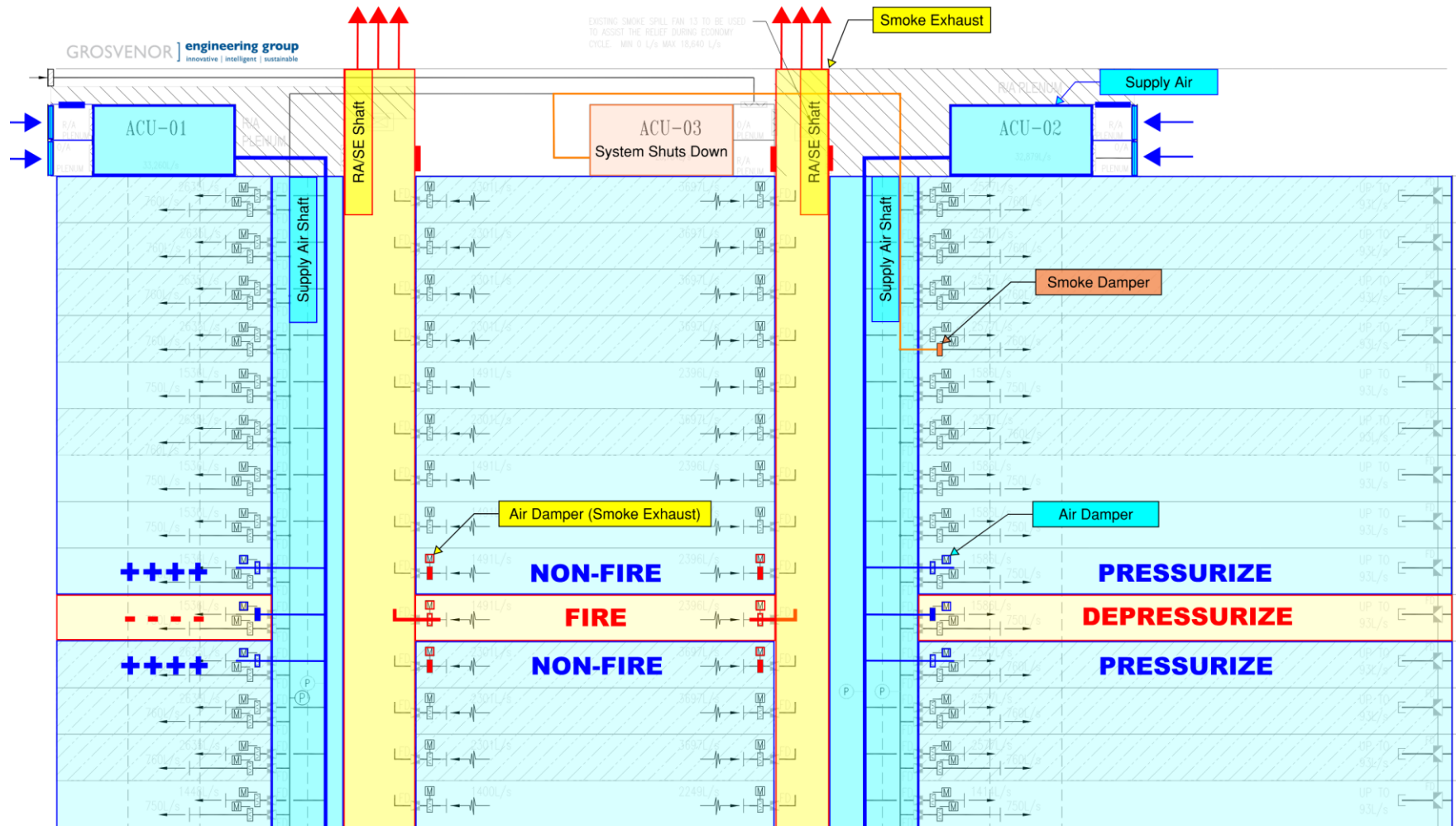
- Legacy systems
- When purge systems were required
- Basic principles of air purge systems
- Typical operation during a fire event
- Key compliance considerations



Zone Pressurisation Systems



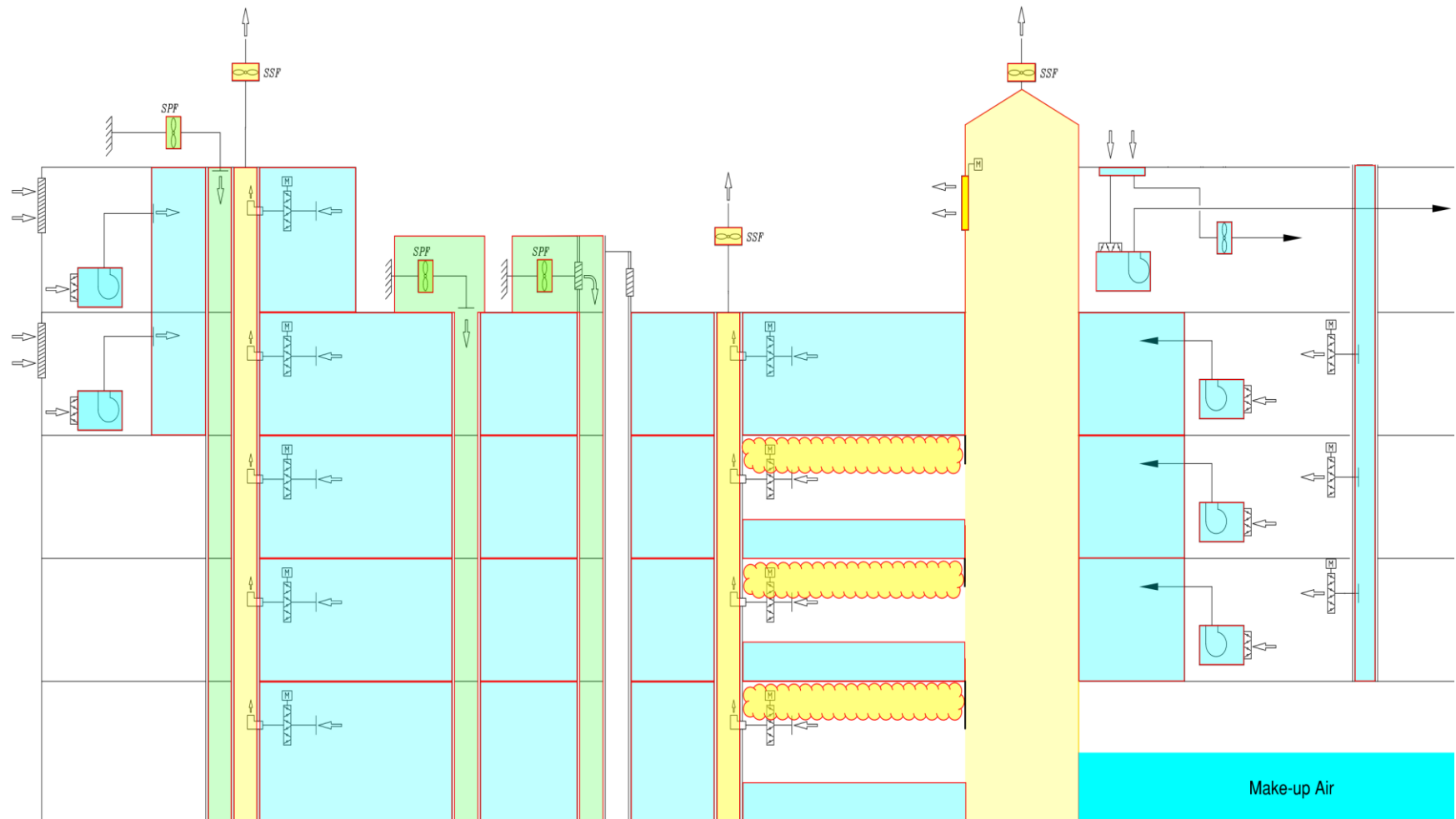
- Basic principles of pressurization and airflow control
- How zone pressurization limits smoke movement
- Typical applications within types of buildings
- Importance of balance and system reliability



Smoke Control & Smoke Exhaust Systems



- What are NCC/BCA smoke control systems
- What are NCC/BCA smoke exhaust systems
- Typical applications such as atria and large spaces
- Natural & mechanical solutions – S&HV's and SEF's
- Design intent versus operational outcomes



Miscellaneous: Car Park Ventilation



- Purpose of car park ventilation in fire and non-fire modes
- Fire mode operation versus day-to-day air quality control
- Typical system operation during a fire event
- Integration with FIP/FFCP systems

END of PART I

Introducing Pat McManus

Occupancy Permit

Essential Service Measure	BCA or other performance provision to which the Essential Safety Measure has been installed and is to operate	Maintenance standards or maintenance type	Maintenance frequency
Table 6 - Air Handling Systems			
Smoke Hazard Management - Miscellaneous air-handling systems covered by Sections 5 and 11 AS1668.1 serving more than one fire compartment.	BCAE2.2 AS1668.1 - 1998 AS1668.1 - 2015 <i>nominates two releases of the same Standard</i>	AS1851 - 2012 Section 13	Frequency as nominated by manufacturer on label attached to equipment in accordance with AS1851 - 2012 Section 13.
Carpark mechanical ventilation systems	BCAF4.11 AS1668.1 - 1998 AS1668.1 - 2015	AS1851 - 2012 Section 13	Frequency as nominated by manufacturer on label attached to equipment in accordance with AS1851 - 2012 Section 13.

Manufacturers' nominate maintenance frequency to satisfy the asset requirement and not Aust Standards. In this instance frequencies are prescribed by the nominated AS1851-2012 Section 13.

Baseline Data

- Operations & Maintenance Manual
- Cause and Effect Chart
- Operational (Test) Matrix
- Description of Operation
- Previous test results
- Fire Engineering Reports

Building Name:																			Sheet No:	
Address:																			Date of Inspection:	
Approved by:																			Date of Approval:	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Mechanical Services Plant Reference (Fan or damper No.)	Location of Zone Serviced	Fire Control Reference	Design Comments	Automatic Operation Normal Mode	Automatic Operation Fire in the Zone	Automatic Operation Fire outside Zone	Manual Control from FFCP	Indication FFCP	Performance Test		Comments on Tests									
				Design Function	Actual Function	Design Function	Actual Function	Design Function	Actual Function	Design		Tested (Note 1)	Tested (Note 1)							
														On	Off	On	Off	Fault		
Smoke Exhaust Fan #1 (SEF 1)	Central Mall (West)	AZF #1 (West Zone) Spr #3	Runs on smoke alarm in Central Mall West Zone only. Runs on Mail Sprinkler alarm.	Stop	Run	Stop	Run	Stop	Run	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	(Indicate here where results of performance tests are available)
Smoke Exhaust Fan #2 (SEF 2)	Central Mall (East)	AZF #2 (East Zone) Spr #3	Runs on smoke alarm in Central Mall East Zone only. Runs on Mail Sprinkler alarm.	Stop	Run	Stop	Run	Stop	Run	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	(Indicate here where results of performance tests are available)
Relief Air Damper #1 (RAD 1)	Smith St. Entrance (Central Mall)	AZF 1, 2 (Central Mall) Sprinkler Pressure Sw.	Opens on any smoke alarm in Central Mall. Opens on Mail Sprinkler alarm.	Closed	Open	Closed	Open	Closed	Open	No	No	No	No	No	No	No	No	No	No	
Relief Louvres (RL 2)	Jones St. Entrance	N/A	Make-up for Smoke Exhaust fans. Must be free of rubbish.																	(Indicate here if louvres were free of leaves, rubbish or other risk of blockages)
Air Handling Unit No. 1 (AHU 1)	Central Mall (West)	AZF #1 (West Zone) Sprinkler Pressure Sw.	Stops on smoke alarm in Central Mall West Zone only. Stops on any Sprinkler alarm.	Run	Stop	Run	Stop	Run	Stop	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
		AHU #1 Supply Air	Stops on smoke detection in Supply Air.	N/A	Stop	N/A	Stop	N/A	Stop	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	(Indicate here if AHU No. 1 Fan stopped on Supply Air smoke detection)
Kitchen Exhaust Fan #4 (KEF4)	Joe's Cafe (Eatery)	AZF #5 (Eatery) Sprinkler Pressure Sw.	Stops on smoke alarm in Eatery Zone only. Stops on any Sprinkler alarm.	Run	Stop	Run	Stop	Run	N/A	No	No	No	No	No	No	No	No	No	No	
Toilet Exh. (TEF5)	Eatery	GFA	Stops on any Fire alarm.	Run	Stop	Run	Stop	Run	N/A	No	No	No	No	No	No	No	No	No	No	
Fresh Air (QAF 2)	Fashion	GFA	Stops on any Fire alarm.	Run	Stop	Run	Stop	Run	N/A	No	No	No	No	No	No	No	No	No	No	

FIGURE 14.1 TYPICAL SMOKE CONTROL SYSTEM FUNCTIONALITY TEST CHART

Maintenance Schedule



MAINTENANCE SCHEDULE

Building Act 1993, Building Regulations 2018, Regulation 222

10

VIC

3047

Building/s or part of building or place [list name and address of buildings/parts below]	Description of use of the building or part of building or place
Ground Floor	Building Classification: 6 (Retail)
Basement Level	Building Classification: 7a (Carpark)

Table 1 – Building/s or Place of Public Entertainment (place) Identification

This schedule has been issued:

(a) at the request of the owner under regulation 220

Occupancy Permit Number	Occupancy Permit Date
12795F6a	4 th August 2006
Certificate of Final Inspection Number	Certificate of Final Inspection Date
12795F7a	12 th December 2006
1585/060633/0	2 nd January 2007
13970F7a	2 nd April 2007
011005_05	12 th July 2009

Maintenance Schedule



MAINTENANCE SCHEDULE

Building Act 1993, Building Regulations 2018, Regulation 222

	Essential Safety Measures <i>(list all ESMs required to be provided by an occupancy permit or maintenance determination or any previous corresponding Act or regulations in chronological order to match the dates in column 2 r222(1))</i>	Date of occupancy permit or maintenance determination for which the ESM is specified in an occupancy permit or maintenance determination relating to the building and/or place. <i>(Insert date that each ESM was required to be provided in chronological order)</i>	Document or legislation which lists ESM and the maintenance requirements for those ESMs relating to a building and/or place. <i>(Insert occupancy permit no., maintenance determination date)</i>	The level of performance that each ESM is required to achieve to fulfil its purpose	The frequency and type of maintenance, testing and inspections required for each ESM
	Building Fire Integrity				
Ground Floor	Building elements required to satisfy prescribed fire-resistance levels, (including walls, columns, beams, floors, ceilings and shafts, etc.)	02/01/2007 30/03/2021 20/11/2023	1585/060633/0 9537736001780 4429437606271	Section C, D2D17	Yearly AS 1851-2012 for unauthorised penetrations, damage, deterioration, or unauthorised alteration
Basement Level	Materials and assemblies required to have fire hazard properties	02/04/2007 09/11/2016 30/03/2021 20/11/2023	13970F7a 19571/008253 9537736001780 4429437606271	C2.D11, C2D11(1), Specification 3, AS 1530.3, AS 9239.1, AS ISO 9705, AS 3837	Yearly Annual inspection for damage, deterioration, or unauthorised alteration
	Elements required to be non-combustible, provide fire protection, compartmentation or separation (including external walls, fire walls, smoke walls, fire resistant exits, and fire-resistant elements such as walls, floors, ceilings, protective coverings, access panels and control joints)	30/03/2021 20/11/2023	9537736001780 4429437606271	C2.D10, C1.D13, C2D14, C3D6 to C3D15, C4D4, C4D12, D2D12, D2D13, E1.D2, G3D4, Specification 21	Yearly Annual inspection for damage, deterioration, or unauthorised alteration
	Fire doors (including sliding fire doors and their associated warning systems) and associated self-closing, automatic closing and latching mechanisms	30/03/2021 20/11/2023	9537736001780 4429437606271	C3D13, C3D14, C4D5 to C4D9, C4D11 to C4D12, D2D12, D3D13, D2D17	- Three-monthly (for sliding fire doors only) - Six-monthly As per AS 1851 – 2012
	Means of Egress				
	Paths of travel to exits	02/01/2007 02/04/2007 09/11/2016 30/03/2021 20/11/2023	1585/060633/0 13970F7a 19571/008253 9537736001780 4429437606271	D2D7 to D2D11	Three-monthly Ensure there are no obstructions and no alterations
	Discharge from exits (including paths of travel from open spaces to the public roads to which	30/03/2021 20/11/2023	9537736001780 4429437606271	D2D12, D2D14 to D2D16, D3D13, G4D3, G4D5, G4D6	Three-monthly Ensure there are no obstructions and no alterations

Testinggaps

TABLE 13.4.2.5
YEARLY TEST AND RECORDS SCHEDULE
FIRE AND SMOKE CONTROL FEATURES OF MECHANICAL SERVICES
SYSTEM CHANGEOVER UNDER FIRE CONDITION

ITEM No.	ITEM	Action required and pass/fail requirement	Records		
			Result	Pass/Fail	Comments
4.1	Three-monthly tests	COMPLETE all three-monthly test activities, as listed in Table 13.4.2.4			
4.2	Simulation (from Detector)	CONDUCT a simulation of a fire/smoke situation (for each system or zone where relevant) to effect changeover from normal mode to fire mode or shutdown as appropriate. CHECK fans, dampers and indicator lamps operate in fire mode (see Appendices H and I) Tests required in Items 4.4, 4.5 and 4.6 are carried out during this simulation test (see Notes 1 and 2).			
4.3	Fans start and stop at Fire Fan Control Panel (FFCP)	OPERATE the manual switches at the FFCP. Check that the fans start and stop and dampers, if applicable, open and close as documented (see Appendices H and I).			
4.4	System shutdown	Where supply air systems are fitted with a smoke detector(s), check system shutdown when the detector is automatically activated as documented (see Appendices H and I). Verify re-start when smoke clears and verify that the FFCP manual override 'ON' operates while the fan has shut down due to supply air smoke detection.			
4.5	Zone smoke control	CHECK zone smoke control system performance criteria as documented (see Appendices H and I).			

Testinggaps

TABLE 13.4.2.5
YEARLY TEST AND RECORDS SCHEDULE
FIRE AND SMOKE CONTROL FEATURES OF MECHANICAL SERVICES
SYSTEM CHANGEOVER UNDER FIRE CONDITION

ITEM No.	ITEM	Action required and pass/fail requirement	Records		
			Result	Pass/Fail	Comments
4.1	Three-monthly tests	COMPLETE all three-monthly test activities, as listed in Table 13.4.2.4			
4.2	Simulation (from Detector)	CONDUCT a simulation of a fire/smoke situation (for each system or zone where relevant) to effect changeover from normal mode to fire mode or shutdown as appropriate. CHECK fans, dampers and indicator lamps operate in			

- 5 Where there have been no changes to the building structure, internal layout and air-handling system in the period since the last test, testing may be limited to simulating fire mode in selected compartments whose performance is at the extremes of the acceptance criteria.

4.3	Fans start and stop at Fire Fan Control Panel (FFCP)	OPERATE the manual switches at the FFCP. Check that the fans start and stop and dampers, if applicable, open and close as documented (see Appendices H and I).			
4.4	System shutdown	Where supply air systems are fitted with a smoke detector(s), check system shutdown when the detector is automatically activated as documented (see Appendices H and I). Verify re-start when smoke clears and verify that the FFCP manual override 'ON' operates while the fan has shut down due to supply air smoke detection.			
4.5	Zone smoke control	CHECK zone smoke control system performance criteria as documented (see Appendices H and I).			

Smoke Detectors



Latching (Brigade calling)

Non-Latching (Smoke Management)



Supply Air



Stair Pressurisation

Fire Fan Control Panel



Located with FIP
Test:

- manual fan control
- indicator lamp
- fault status

Common ... oversights

Stairwell Pressurisation:

- referencing the incorrect AS1668.1
- condemning design:
 - no path for airflow
 - reference point
- incorrect test methodology

General

- dampers:
 - misunderstood
 - missed!
- HVAC Essential Services
 - not tested!

13.4.1	Freq	Routine Service Schedules
13.4.1.1	A	Records of Service & Inspection
13.4.1.2	3M	Fans & motors
13.4.1.3	A	
13.4.1.4	A	Fire & Smoke Dampers
13.4.1.5	6M	Air Control Dampers (Recycle, Relief, Outdoor Air & Smoke Spill)
13.4.1.6	A	
13.4.1.7	6M	Air Control Dampers (Zone Pressurisation: Supply, Return, & Exhaust Air)
13.4.1.8	A	
13.4.1.9	6M	Automatic Smoke Vents
13.4.1.10	A	
13.4.1.11	6M	Fire & Smoke Curtains
13.4.1.12	A	
13.4.1.13	6M	Motorised Relief Openings, Windows & Shutters
13.4.1.14	A	
13.4.1.15	A	Electric Duct Heaters - biennial
13.4.1.16	M	Kitchen Exhaust Systems - canopy
13.4.1.17	A	Kitchen Exhaust Systems - entire
13.4.1.18	M	Outdoor Intakes
13.4.1.19	A	
13.4.1.20	3M	Variable Frequency Inverters/Speed Drives
13.4.1.21	6M	
13.4.1.22	A	
13.4.1.23	3M	Pneumatic Compressor
13.4.1.24	A	
13.4.1.25	A	Motor Control Centres
13.4.1.26	A	Main Switchboards (low voltage)
13.4.1.27	A	FFCP (refer section 6)

Section 6
FIRE DETECTION AND ALARM SYSTEMS
Section: 6.4.1.4
items 3.19 thru 3.27

Common ... oversights

Stairwell Pressurisation:

- referencing the incorrect AS1668.1
- condemning design:
 - no path for airflow
 - reference point
- incorrect test methodology

General

- dampers:
 - misunderstood
 - missed!
- HVAC Essential Services
 - not tested!
 - record keeping!

13.4.1	Freq	Routine Service Schedules
13.4.1.1	A	Records of Service & Inspection
13.4.1.2	3M	Fans & motors
13.4.1.3	A	
13.4.1.4	A	Fire & Smoke Dampers
13.4.1.5	6M	Air Control Dampers (Recycle, Relief, Outdoor Air & Smoke Spill)
13.4.1.6	A	

13.4.2		Test & records
13.4.2.1		Testing completed & records kept
13.4.2.2	3M	Fire Isolated Exit Pressurisation Systems
13.4.2.3	A	
13.4.2.4	3M	System Changeover Under Fire Condition
13.4.2.5	A	
13.4.2.6	3M	Smoke Exhaust Systems
13.4.2.7	A	
13.4.3		Survey & records
13.4.3.2	A	Active Fire & Smoke Control Systems
13.4.3.3	A	Motorised Relief Openings, Windows & Shutters
13.4.3.4	A	Smoke Reservoirs

13.4.1.18	M	Outdoor Intakes
13.4.1.19	A	
13.4.1.20	3M	Variable Frequency Inverters/Speed Drives
13.4.1.21	6M	
13.4.1.22	A	
13.4.1.23	3M	Pneumatic Compressor
13.4.1.24	A	
13.4.1.25	A	Motor Control Centres
13.4.1.26	A	Main Switchboards (low voltage)
13.4.1.27	A	FFCP (refer section 6)

Section 6
FIRE DETECTION AND ALARM SYSTEMS
Section: 6.4.1.4
Items 3.19 thru 3.27

Recommendation



AS 1668.1:2015
(Incorporating Amendment No. 1)

AS 1668.1:2015



**The use of ventilation and air
conditioning in buildings**

**Part 1: Fire and smoke control in
buildings**



AS 1851—2012
(Incorporating Amendment N. 1)

AS 1851—2012



**Routine service of fire protection
systems and equipment**



Primary Aust Standards



AS1668

*The use of mechanical ventilation and air-conditioning in buildings,
Part 1: Fire and smoke control in multi-compartment buildings*

Numerous versions:

1974 & 1979

Fire Precautions in buildings with air-handling systems

1991

*The use of mechanical ventilation and air-conditioning in
buildings*

1998

The use of ventilation and air-conditioning in buildings

TABLE 13.4.2.3
YEARLY TEST AND RECORDS SCHEDULE
FIRE AND SMOKE CONTROL FEATURES OF MECHANICAL SERVICES
FIRE ISOLATED EXIT PRESSURISATION SYSTEMS

ITEM No.	ITEM	Action required and pass/fail requirement	Records		
			Result	Pass/Fail	Comments
2.1	Three-monthly tests	COMPLETE all three-monthly test activities, as listed in Table 13.4.2.2			
2.2	Simulation (from Detector)	SIMULATE a fire/smoke situation from any device such as a sprinkler, heat or smoke detector, to effect operation of the pressurisation and all other systems required to operate in fire mode.			
		CHECK that the following parameters meet the performance requirement (see Appendices H and I, and Notes 1 and 2).			
		(a) Airflow velocity across all required doorways.			
		(b) The force required to open each door.			
		(c) The noise level at typical doorways and those identified as subject to the highest noise level.			
		(d) Time taken for door opening force and airflow velocity to be restored, after opening and reclosing two successive doors adjacent to the test door(s) (to be identified as having the longest restoration time).			
		(e) When smoke is introduced to the supply smoke sensor or any air-pressurisation system, the associated pressurisation fan is shut down.			
		Verify re-start when smoke clears and verify that the FFCP manual override 'ON' operates while the fan has shut down due to the supply smoke detection.			
		(f) Operation of the manual switch provided for fire brigade personnel starts and stops fans supplying air to the pressurised fire-isolated escape routes.			
		(g) Check indicator lamps change status when fan starts or stops.			
2.3		(h) With all air-pressurisation and other systems operating simultaneously, check that any specific air relief is fully operational and enables the required airflow from pressurised areas to be sustained.			
2.4	Revert system to normal.	SWITCH all systems back to 'normal' and check that all equipment and indicator lamps are in the correct non-fire mode. (Refer Appendices H and I).			

TABLE 13.4.2.5
YEARLY TEST AND RECORDS SCHEDULE
FIRE AND SMOKE CONTROL FEATURES OF MECHANICAL SERVICES
SYSTEM CHANGEOVER UNDER FIRE CONDITION

ITEM No.	ITEM	Action required and pass/fail requirement	Records		
			Result	Pass/Fail	Comments
4.1	Three-monthly tests	COMPLETE all three-monthly test activities, as listed in Table 13.4.2.4			
4.2	Simulation (from Detector)	CONDUCT a simulation of a fire/smoke situation (for each system or zone where relevant) to effect changeover from normal mode to fire mode or shutdown as appropriate. CHECK fans, dampers and indicator lamps operate in fire mode (see Appendices H and I) Tests required in Items 4.4, 4.5 and 4.6 are carried out during this simulation test (see Notes 1 and 2).			
4.3	Fans start and stop at Fire Fan Control Panel (FFCP)	OPERATE the manual switches at the FFCP. Check that the fans start and stop and dampers, if applicable, open and close as documented (see Appendices H and I).			
4.4	System shutdown	Where supply air systems are fitted with a smoke detector(s), check system shutdown when the detector is automatically activated as documented (see Appendices H and I). Verify re-start when smoke clears and verify that the FFCP manual override 'ON' operates while the fan has shut down due to supply air smoke detection.			
4.5	Zone smoke control	CHECK zone smoke control system performance criteria as documented (see Appendices H and I).			
4.6	Fire curtains and smoke curtains	CHECK to ensure that the integrity and leakage performance are not compromised by operation of the mechanical systems in fire mode.			

Recommendation

Smoke Control System Functionality Test Chart

Building Name:				Mechanical services Inspected by:												Sheet No:																						
Address:				Fire system Inspected by:												Date of Inspection:																						
				Approved by:												Date of Approval:																						
1	2	3	4	5		6		7		8		9		10		11		12		13		14		15		16		17		18		19		20		21		
Mechanical Services Plant Reference (Fan or damper No.)	Location of Zone Serviced	Fire Control Reference	Design Comments	Automatic Operation Normal Mode		Automatic Operation Fire in the Zone		Automatic Operation Fire outside Zone		Manual Control from FFCCP		Indication FFCCP		Performance Test (Note 1)		Performance Test (Note 2)		Performance Test (Note 3)		Performance Test (Note 4)		Performance Test (Note 5)		Performance Test (Note 6)		Performance Test (Note 7)		Performance Test (Note 8)		Performance Test (Note 9)		Performance Test (Note 10)		Performance Test (Note 11)		Performance Test (Note 12)		Comments on Tests
				Design function	Actual Function	Design Function	Activating Device Note (c)	Actual Function	Design Function	Activating Device Note (c)	Actual Function	Design	Tested	Design	Tested (Note 1)	Design	Tested (Note 1)	Design	Tested (Note 1)	Design	Tested (Note 1)	Design	Tested (Note 1)	Design	Tested (Note 1)	Design	Tested (Note 1)	Design	Tested (Note 1)	Design	Tested (Note 1)	Design	Tested (Note 1)	Design	Tested (Note 1)			
Smoke Exhaust Fan #1 (SEF 1)	Central Mail (West)	AZF #1 (West Zone)	Runs on smoke alarm in Central Mail West Zone only.	Stop		Run			Stop			Yes			Yes																					(Indicate here where results of performance tests are available)		
		Spr #3	Runs on Mail Sprinkler alarm.	Stop		Run			Stop			Yes			Yes																							
Smoke Exhaust Fan #2 (SEF 2)	Central Mail (East)	AZF #2 (East Zone)	Runs on smoke alarm in Central Mail East Zone only.	Stop		Run			Stop			Yes			Yes																					(Indicate here where results of performance tests are available)		
		Spr #3	Runs on Mail Sprinkler alarm.	Stop		Run			Stop			Yes			Yes																							
Relief Air Damper #1 (RAD 1)	Smith St. Entrance (Central Mall)	AZF 1, 2 (Central Mall)	Opens on any smoke alarm in Central Mall.	Closed		Open			Closed			No			No																							
		Sprinkler Pressure Sw.	Opens on Mail Sprinkler alarm.	Closed		Open			Closed			No			No																							
Relief Louvres (RL 2)	Jones St. Entrance	N/A	Make-up for Smoke Exhaust fans. Must be free of rubbish.																																	(Indicate here if louvres were free of leaves, rubbish or other risk of blockages)		
Air Handling Unit No. 1 (AHU 1)	Central Mail (West)	AZF #1 (West Zone)	Stops on smoke alarm in Central Mail West Zone only.	Run		Stop			Run			Yes			Yes																							
		Sprinkler Pressure Sw.	Stops on any Sprinkler alarm.	N/A		Stop			N/A			Yes			Yes																							
		AHU #1 Supply Air	Stops on smoke detection in Supply Air.	N/A		Stop			N/A			Yes			Yes																				(Indicate here if AHU No. 1 Fan stopped on Supply Air smoke detection)			
Kitchen Exhaust Fan #4 (KEF4)	Joe's Cafe (Eatery)	AZF #5 (Eatery)	Stops on smoke alarm in Eatery Zone only.	Run		Stop			Run			No			No																							
		Sprinkler Pressure Sw.	Stops on any Sprinkler alarm.	Run		Stop			N/A			No			No																							
Toilet Exh. (TEF5)	Eatery	GFA	Stops on any Fire alarm.	Run		Stop			N/A			No			No																							
Fresh Air (QAF 2)	Fashion	GFA	Stops on any Fire alarm.	Run		Stop			N/A			No			No																							

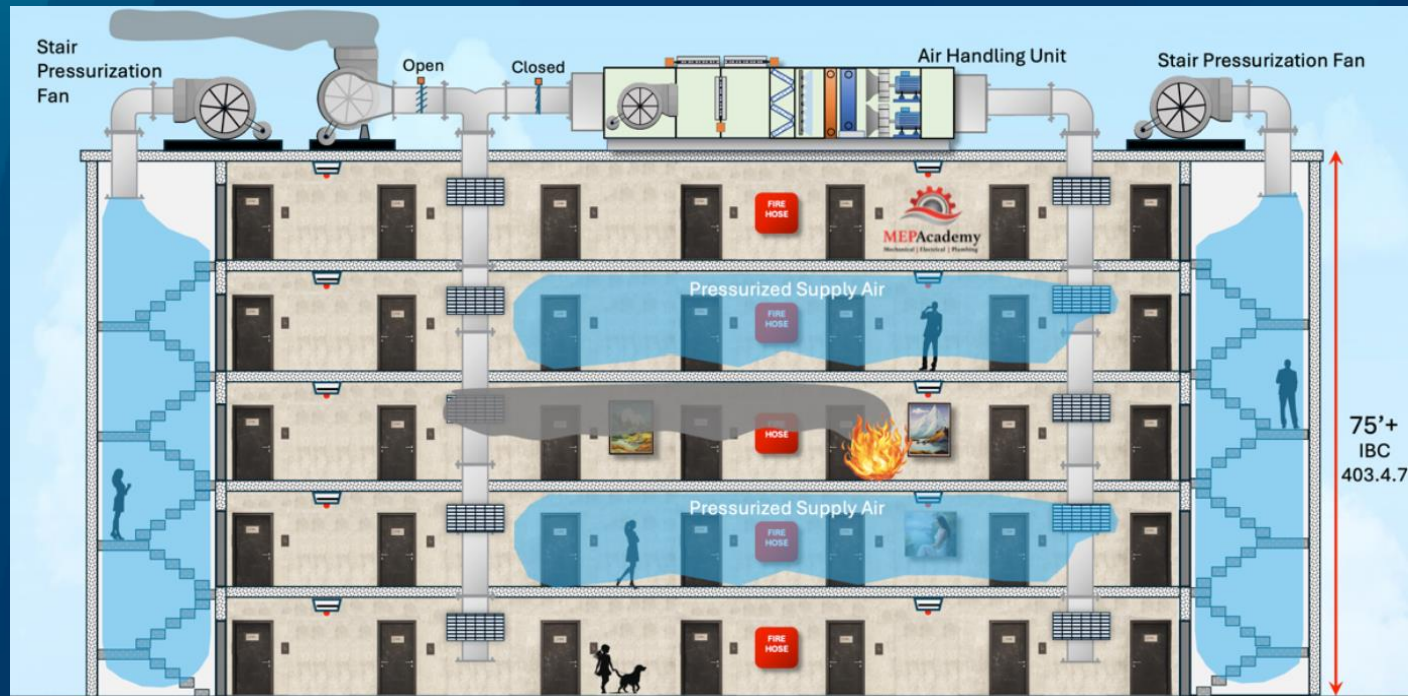
FIGURE 14.1 TYPICAL SMOKE CONTROL SYSTEM FUNCTIONALITY TEST CHART

END of PART II

Introducing Vance Rowe

Dampers & System Control

Dedicated System



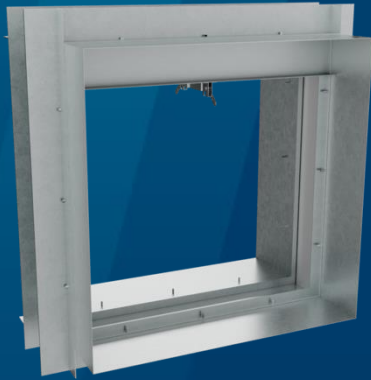
Dampers & System Control

Multipurpose System



- Dampers control air in smoke management systems
- All components of an overall system
- Identification of the dampers' function is critical

Dampers & System Control- components



Fire damper – Stops airflow

Failure mode – closed



Smoke dampers –
Stops airflow

Failure mode closed



Smoke control systems rely on air movement

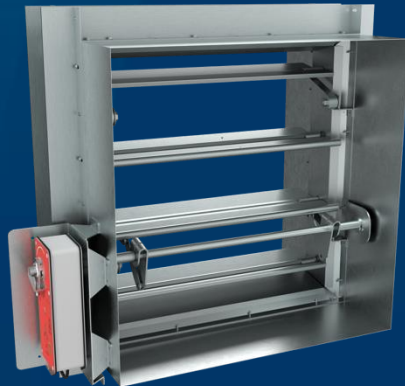
Air Control Dampers



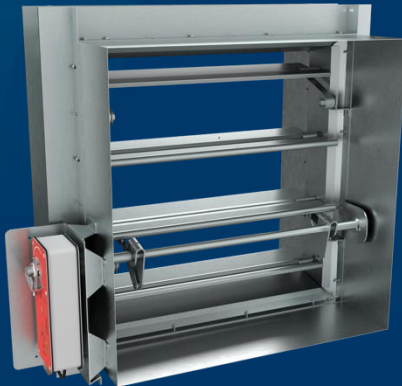
Can be open or closed depending on the function.

Steel or aluminium depending on the temperature requirement.

Within a subduct or a performance solution in a fire barrier



Air Control Dampers – Smoke Exhaust



Can look the same as air control dampers or motorised fire dampers but without fusible links...

Identify by operational function

Standard Failure Positions



- Fire dampers: fire/failure position **CLOSED**
- Motorised Fire Dampers: fire/failure position **CLOSED**
- Motorised Fire/Smoke Dampers: fire/failure position **CLOSED**
- Smoke Dampers: fire/failure position **CLOSED**
- Air Dampers: fire/failure position either **OPEN** or **CLOSED**
- Air Dampers/Smoke Exhaust: fire/failure position - **OPEN**

Smoke Control Issues

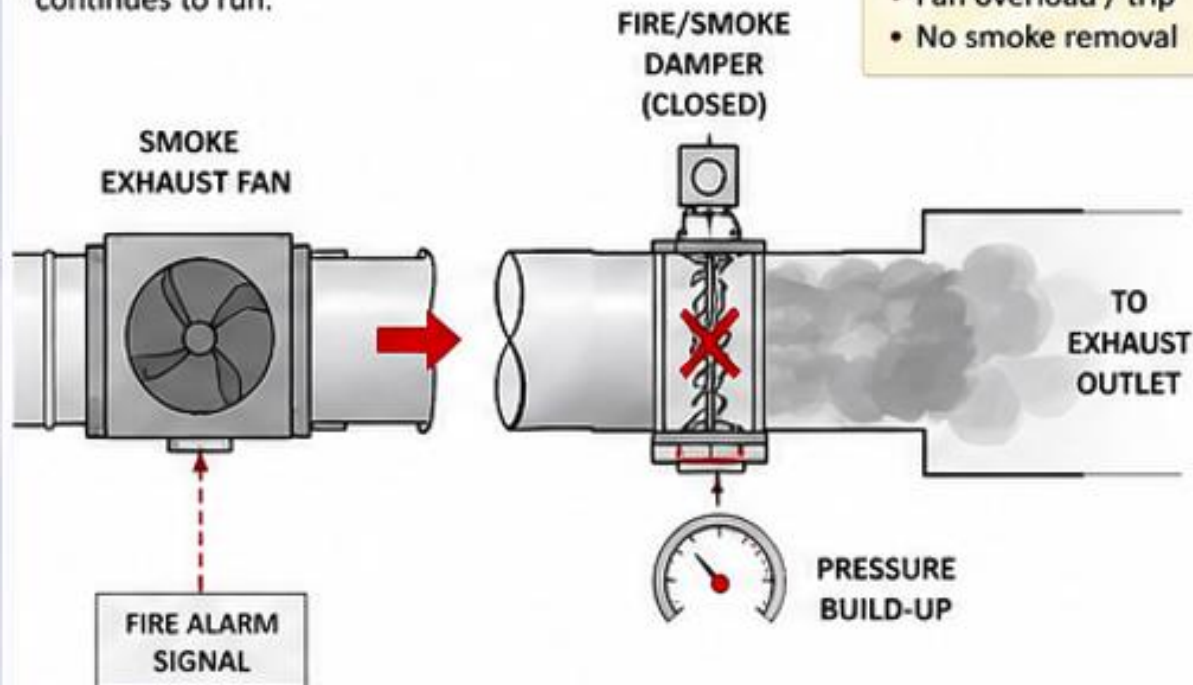
1. DAMPER CLOSES – FAN CONTINUES TO RUN *System Overpressure / Fan Damage / No Smoke Extraction*

SCENARIO

Fire/smoke damper closes (fail closed)
but smoke exhaust fan starts or
continues to run.

RESULT

- System pressurises
- Duct leakage
- Fan overload / trip
- No smoke removal



Smoke Control Issues

2. DAMPER FAILS TO CLOSE – SMOKE SPREAD

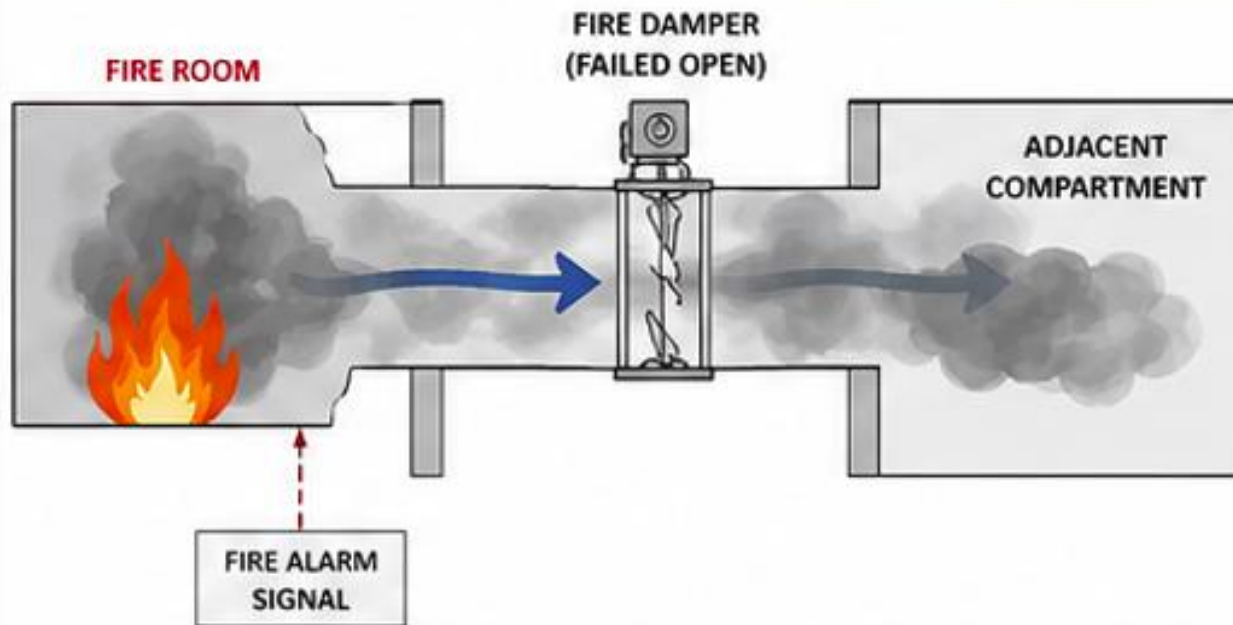
Loss of Compartmentation / Smoke Migration

SCENARIO

Dampers in fire/smoke walls or floors fail to close (mechanical jam, wrong damper, no power).

RESULT

- Smoke moves to other compartments
- Tenability loss
- Increased life risk



Smoke Control Issues

3. SUPPLY AIR OVERPOWERS EXTRACTION

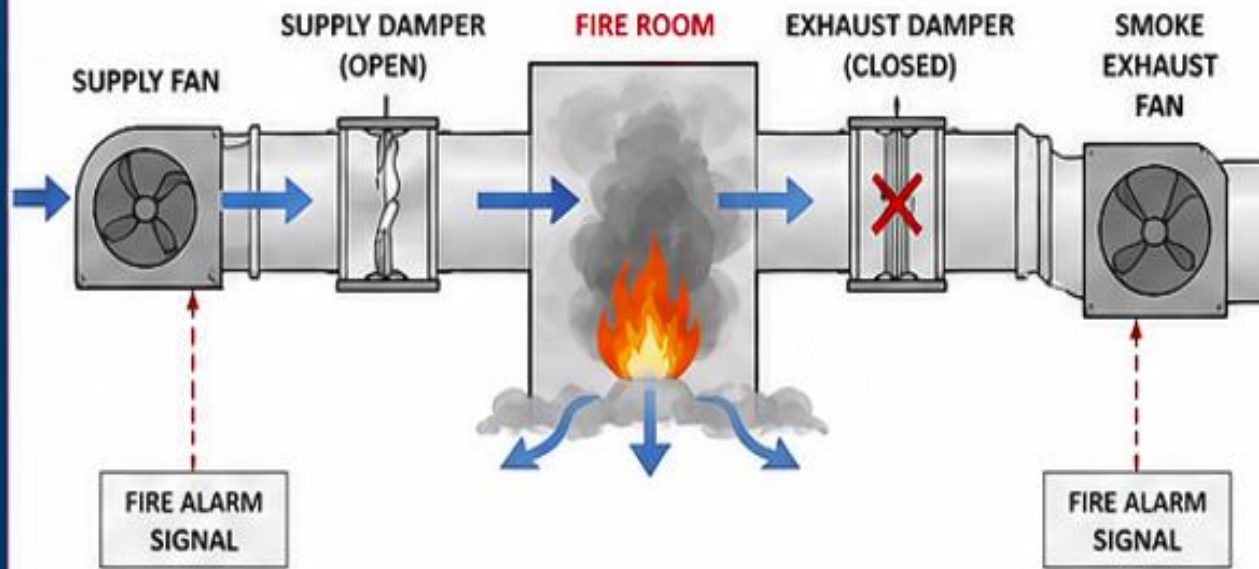
System Reversal / Smoke Pushed into Building

SCENARIO

Supply air conditions change (fan starts or VFD ramps up) while extraction damper is closed or failed.

RESULT

- Positive pressure in fire zone
- Smoke pushed into adjacent areas via supply ducts
- System reversal



4. PARTIAL DAMPER NON-OPERATION

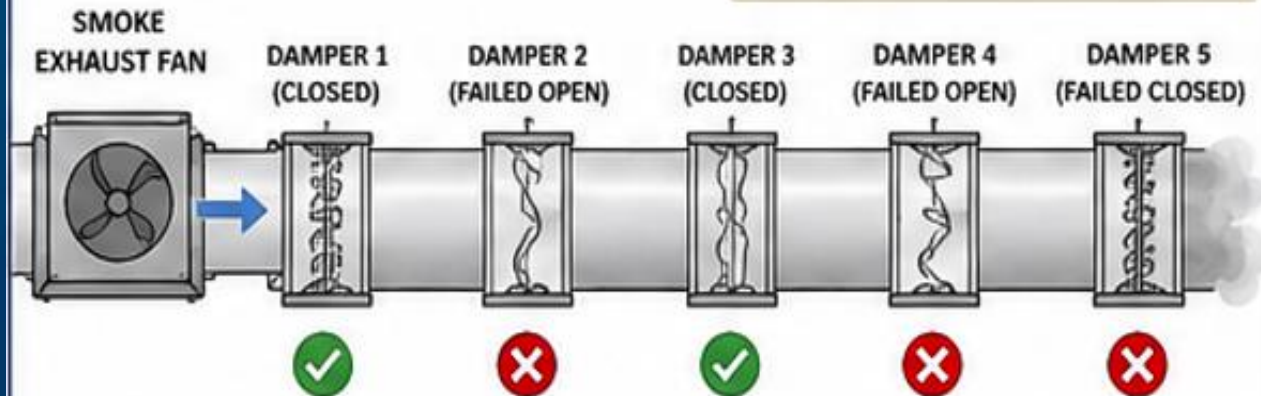
Reduced Effectiveness / Tipping Point Failure

SCENARIO

A percentage of dampers in a system fail to operate (stuck open or closed).

RESULT

- $\geq 20\%$ failure = system failure
- 10–20% failure = partial failure
- Loss of smoke control performance



EXAMPLE

5 dampers in system
2 failed (40%) → **SYSTEM FAILURE**

TYPICAL RELIABILITY FINDINGS (RETURN AIR SYSTEMS)

- $\geq 20\%$ dampers failed to close = Complete System Failure
 - 10–20% dampers failed to close = Partial System Failure
- (Ref: FCRC TR-98-05)

Smoke Control Issues

5. INCORRECT DAMPER TYPE / INSTALLATION

Damper Cannot Perform in Fire / Early Failure

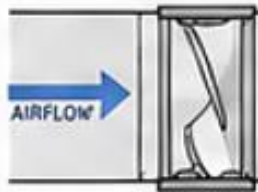
SCENARIO

Wrong type of damper used, or incorrect installation (backwards, upside down, no access, etc.).

RESULT

- Damper fails to operate
- Does not achieve fire rating
- Compartment breach

INSTALLED BACKWARDS



Blades close in wrong direction



INSTALLED UPSIDE DOWN



Actuator / linkage does not operate correctly



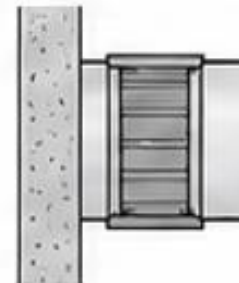
WRONG DAMPER TYPE



Non fire rated damper used in fire rated wall



NO ACCESS / MAINTENANCE



Cannot inspect, test or maintain



6. CONTROL LOGIC CONFLICT

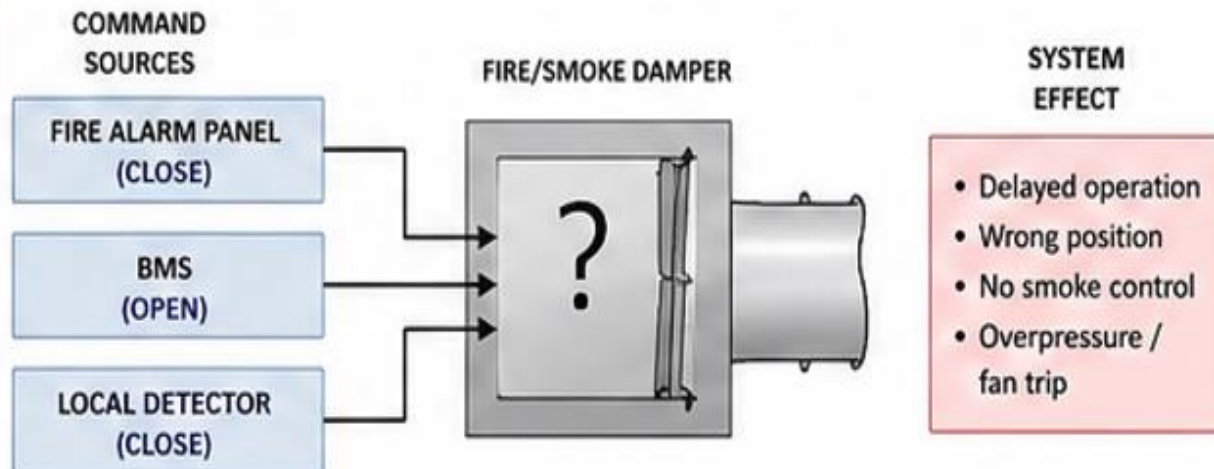
Dampers Receive Conflicting Commands

SCENARIO

Multiple systems (BMS, Fire Panel, Local Detectors) send different commands to the damper.

RESULT

- Incorrect damper position
- Fans operate against dampers
- Smoke control strategy fails

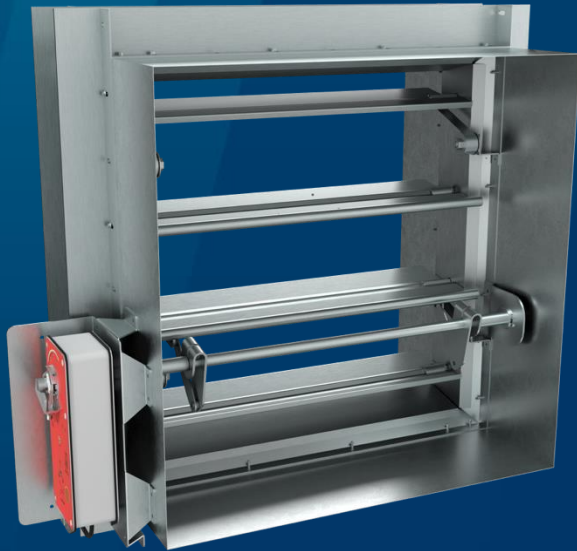


Design & Commissioning Essentials

- ✓ Define system intent and damper operation (normal/fire/smoke modes).
- ✓ Coordinate fan and damper sequences.
- ✓ Use the correct damper type and fire rating.
- ✓ Standardise naming conventions (AS1682.1:2015), labelling and documentation
- ✓ Test integrated systems – not just individual components.
.... this applies to maintenance too.
- ✓ Maintain and regularly test dampers.

Smoke Control Systems ...

... are independent



A single damper that does not do what it should can compromise an entire system

END of PART III

.... any Questions?

Questions and answers

