

Thank you for your co operation & Patience!  
Please wait for others to join!  
We will start as per Scheduled time

# Mind Challenging Webinar from



**\*\* Note: To All Attendees,  
Please fill in a short survey thru  
the MS Team Chat link & on  
completion you will get a link to  
download today's presentation  
material immediately!**

## Online Continuous Learning Series

APAC Webinar:

### Understanding Smoke Control Methodology

Date: 24th March, 2021

Time: 15:00 - 16:00 (Singapore Time)

By Alan Ang

<https://simplex-fire.com/>



<https://www.autocall.com/>



The power behind your mission





# JOHNSON CONTROLS



# The JCI Story

- 1885 JCI Started with Warren Johnson
- 1940 Johnson Service Goes Public
- 1978 Acquired Globe Union - Battery
- 2005 Acquires York International
- 2005 Acquires Delph Battery Business
- 2014 Shanghai HQ – Growth Global
- 2014 Focus on Multi Industry Strategy
- 2016 Spin off Automatic Seatgan

130+ YEARS OF INNOVATION

117,000 EMPLOYEES

316,000+ VOLUNTEER HOURS  
Recorded in 2015

4+ MILLION CUSTOMERS GLOBALLY

\$30 BILLION ANNUAL REVENUE

MORE THAN 8,700 ACTIVE PATENTS

LEADER

- Building Products, Technologies & Integrated Solutions
- Energy Storage

\$78 MILLION IN CHARITABLE CONTRIBUTIONS in the Past 5 Years

PAID CONSECUTIVE DIVIDENDS SINCE 1887

HEADQUARTERS:

Cork, Ireland  
Milwaukee, WI, USA  
Shanghai, China

NEARLY 2,000 LOCATIONS WORLDWIDE

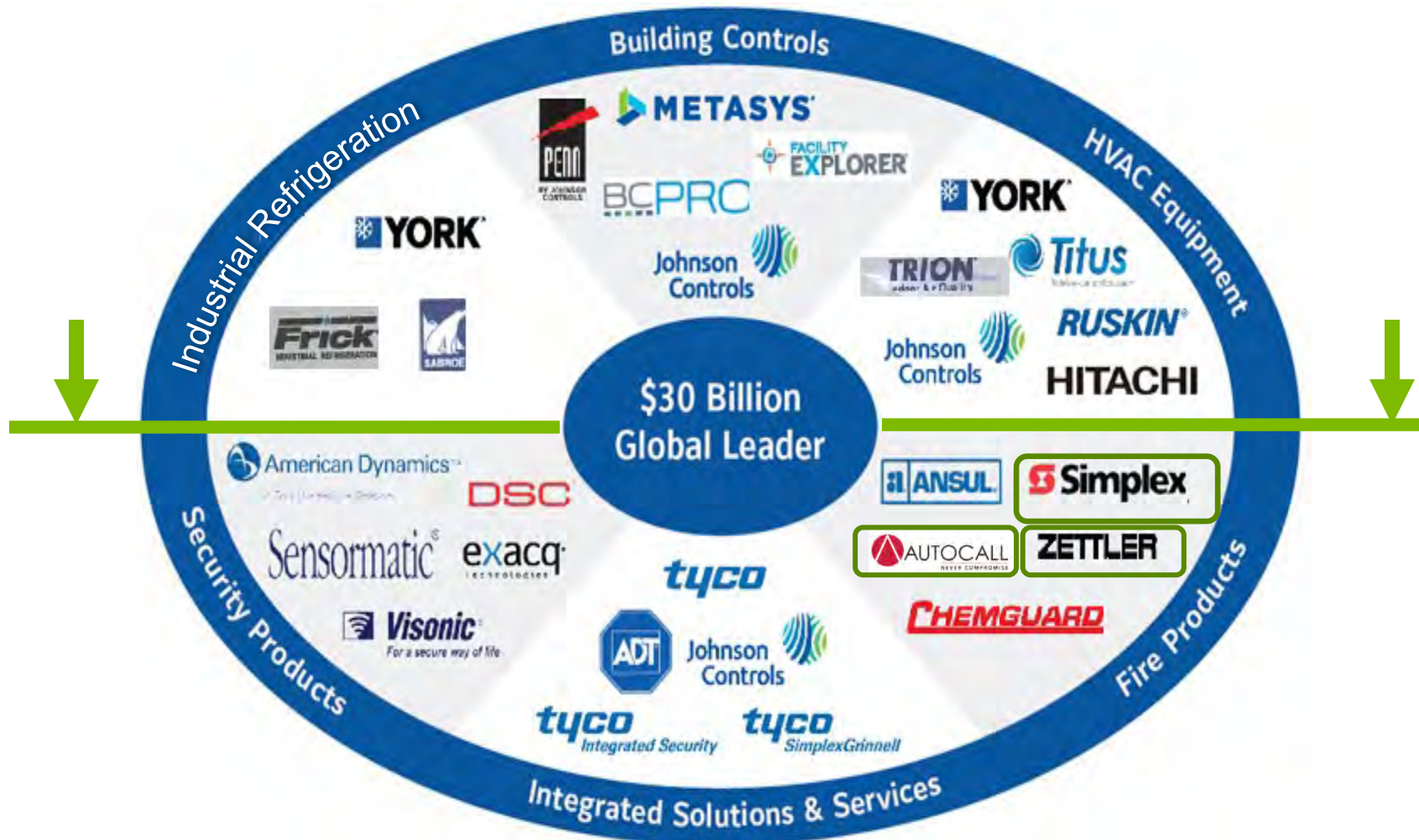
SERVING CUSTOMERS IN 150+ COUNTRIES

2016 Merger of Johnson Controls & Tyco 2016

# The Tyco Story

- 1892 Grinnell Fire Protection Started
- 1960 Tyco founded as Research lab
- 1975 Tyco Acquires Grinnell Fire
- 1997 Tyco and ADT Merge
- 2001 Tyco Acquires Simplex
- 2002 Corporate Governance started
- 2007 Spin off Healthcare & Electronics
- 2012 Split 03 Group, Dedicated fire & Security

# Leading Brands Across a Comprehensive Portfolio of Products and Services



**#1 in HVAC, Controls, Fire Detection and Protection, Security and Power Solutions**

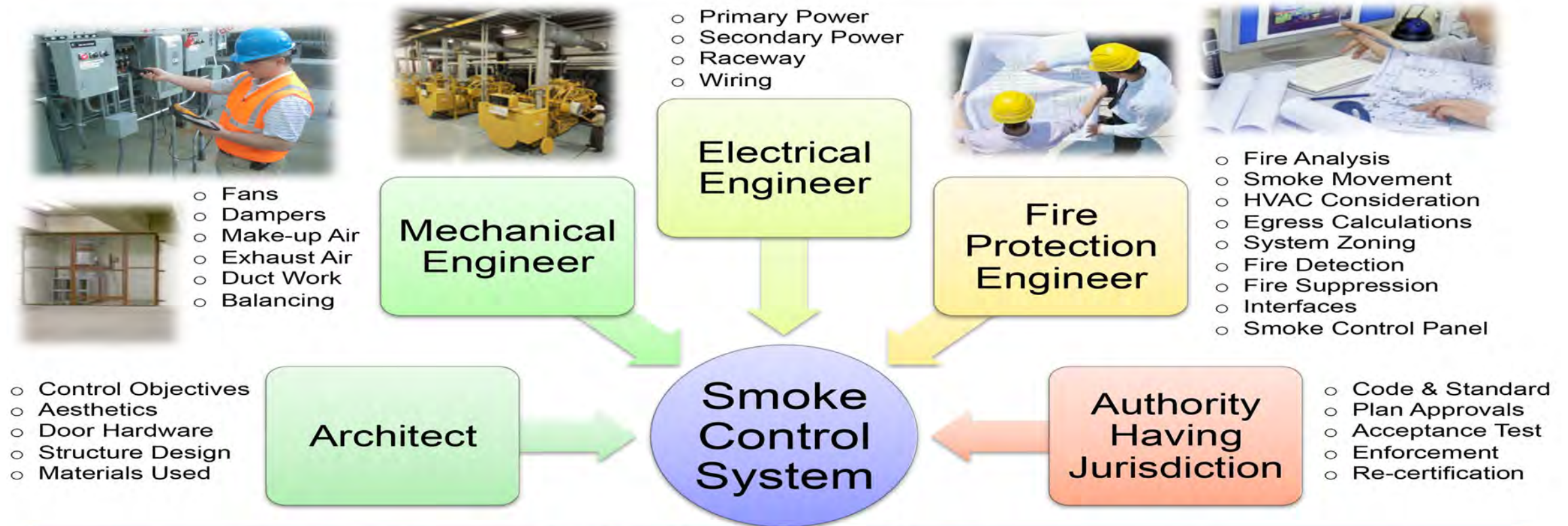




# INTRODUCTION TO UL 864 UUKL 10<sup>TH</sup> EDITION

## Smoke Control

# Design Responsibilities?



Mechanical



Electrical



Fire Alarm/Spklr



Custom SCP



17

\*\*Note: Picture taken from Space age electronics article, subjected to copyright

\*\*Note: This webinar focus on solutions thru NFPA standards and Codes and reference to IBC & IFC. European Standards on Smoke controls works on a different philosophy and base on EN1201 Standards.

# Linking all the different element for Smoke Controls

## Part 1 Webinar

## Part 2 Webinar

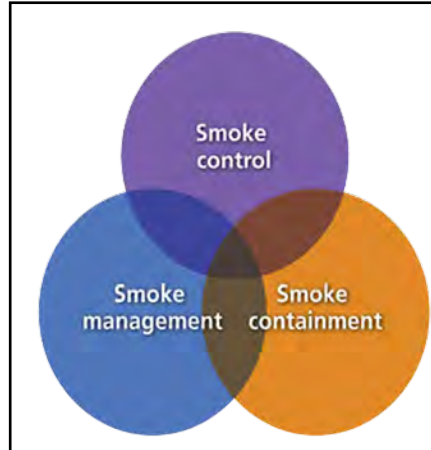
Interfacing Equipment from HVAC or Others

Mix of Smoke Controls Required for Building

Type of FCSC Selected, Product Listing Performance and Accepted by Local Authorities

Codes to Comply to?

Standard or Standards to Comply to?



Traditional Hardware & hardwired

Multiplex FCSC Fire Panel

UUKL Smoke Control Product Listing to ensure tested performance

IBC – International Building Codes

IFC: International Fire Codes

Your Country Local Codes

NFPA 92a

NFPA 101

NFPA 72

NATIONAL FIRE ALARM and SIGNALING CODE

Your Country Local Standards

Local Codes

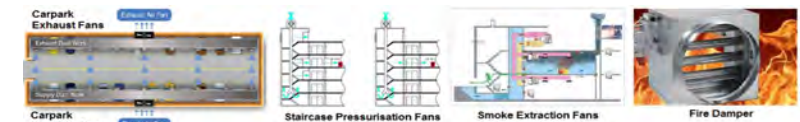
Consultant & Owner Acceptance on Budget and Smoke Control Solutions

Part 2 Webinar

Developed Check List

Customised Cause and Effects

Final Solutions Submitted to Local Authorities

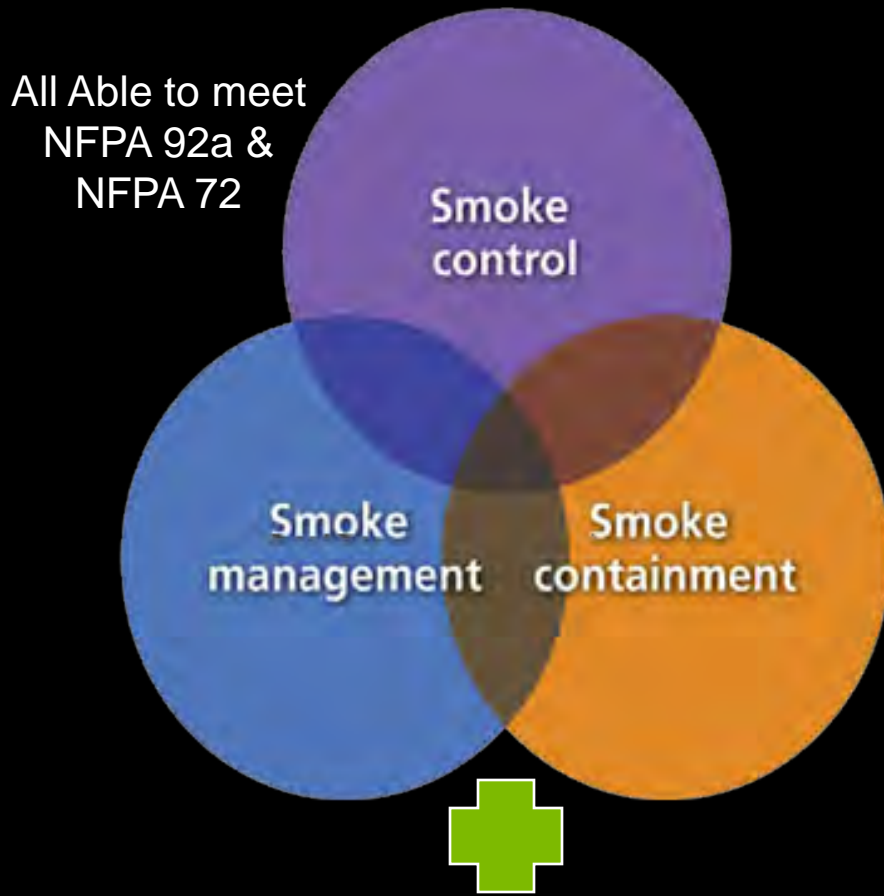


# Introduction to Smoke Control Methodologies





# Smoke Controls Methodology and Basic Requirements



## Fire Fighter Smoke Control Station

- Hardwired or
- Multiplex (UUKL Listed Products)

**Smoke control systems methodology** they are one of the most complicated and often misunderstood systems within a facility, and rightfully so. ...

There are three Category of Smoke Controls Design and depending on the building architectural, occupants, usage , it could comprise of one or more of the following:

- Smoke Control.***
- Smoke Management.***
- Smoke Containment.***

And all of these must have a Fire Fighter Smoke Control Station Interface whether a Hardwired or a Modern Multiplex Panels in order to be able to monitor and override manually as needed.

The whole objective is to remove smoke for evacuation, for post fire usage, for certain sensitive facilities e.g. Hospital , Airport to contain the smoke within the Zone.

# Usage and objective of different Smoke Control Methodology

## Smoke Controls

Smoke Control System manages the medium of smoke in order to increase egress times so that occupants can escape safely e.g. Floor Zone Smoke Control combine with Staircase pressurization Control.

## Smoke Management

Conversely, Smoke Management Systems are used during post fire events to remove smoke from a facility and/or restrict smoke from entering specific area's of a facility during general evacuation. Unlike Smoke Control, these could be manually triggered to managed the Unwanted smoke. This involved Atrium Control, Carpark Control, stairwells and elevator shaft..etc

## Smoke Compartmentation

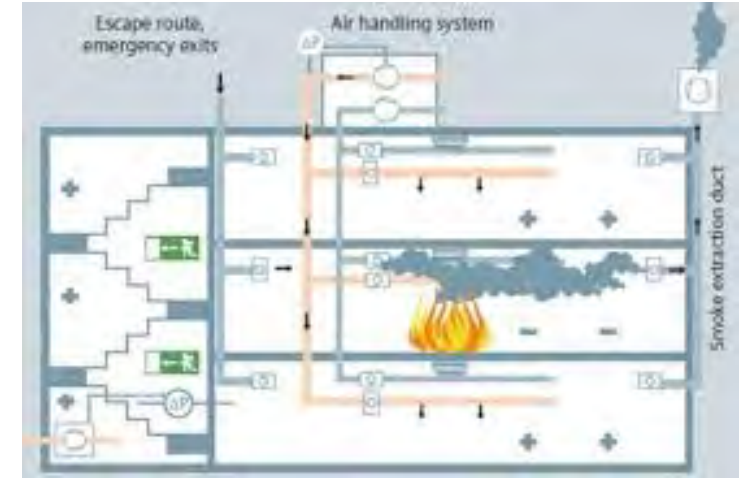
Occupancy types that specifically require fire compartmentation in buildings include educational occupancies, hospitals, detention and correctional facilities, and hotels, dormitories, and apartment buildings. Additional areas that are commonly required to be protected by fire-rated construction within various occupancies include stairwells, corridors, and hazardous locations (such as electrical rooms). The occupancy-specific sections of code will determine the minimum fire-resistance rating that is required for each area. This will help to create Area of Refuge.

Smoke  
Controls



# Defining Smoke Control :

- A Smoke Control System can be defined as an engineered electro-mechanical system that uses mechanical fans and dampers in cooperation with electronic monitoring and controls to produce pressure differences across smoke barriers which inhibit or facilitate smoke movement.



- A smoke-control system is used to achieve one or more of the following design objectives:
  - ✓ Inhibit smoke from entering stairwells, means of egress, areas of refuge, elevator shafts, or similar areas
  - ✓ Maintain a tenable environment in areas of refuge and means of egress during the minimum required evacuation time
  - ✓ Inhibit the migration of smoke from the smoke zone
  - ✓ Provide conditions outside the fire zone that enable emergency response personnel to conduct search-and-rescue operations and to locate and control the fire
  - ✓ Contribute to the protection of life and to the reduction of property loss



## Smoke Controls

- **WHAT IS BEHIND SMOKE CONTROL SYSTEMS?**
- **WHAT ARE THE TYPES INVOLVED FOR A BUILDING?**
- **WHAT ARE THE TYPICAL APPLICATIONS?**
- **WHAT IS THE OBJECTIVE?**



Fire Damper

## Dedicated Systems



Fire Fans

## Non Dedicated Systems

# What is Dedicated Systems?



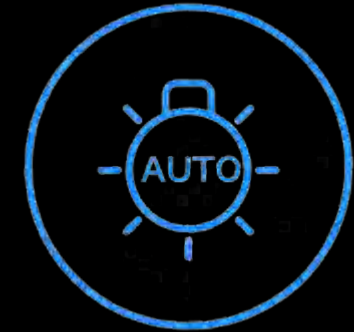
Fire Damper



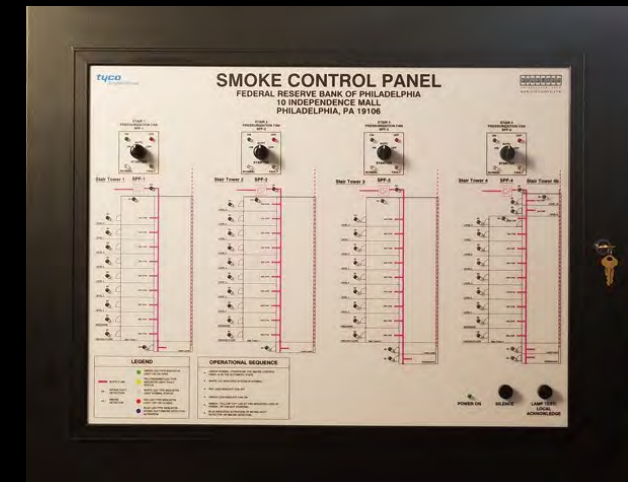
Fire Fans

- Fans and Dampers used Exclusively for Smoke Control

- Equipment Activates automatically during Fire or Manually from Fire Fighter Smoke Control Panel(FSCS)



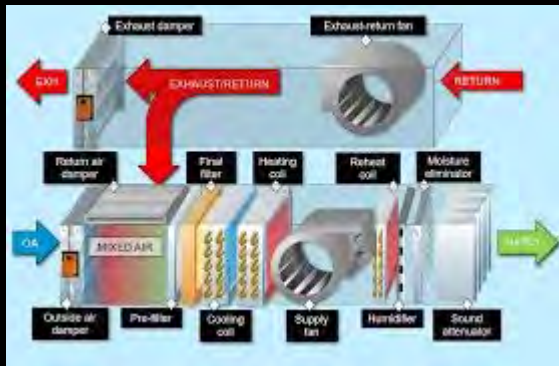
- **A Weekly Self Test Required**



# What is Non Dedicated Systems?



Fans

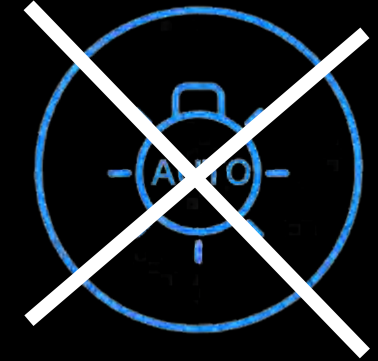


Air Handling Unit

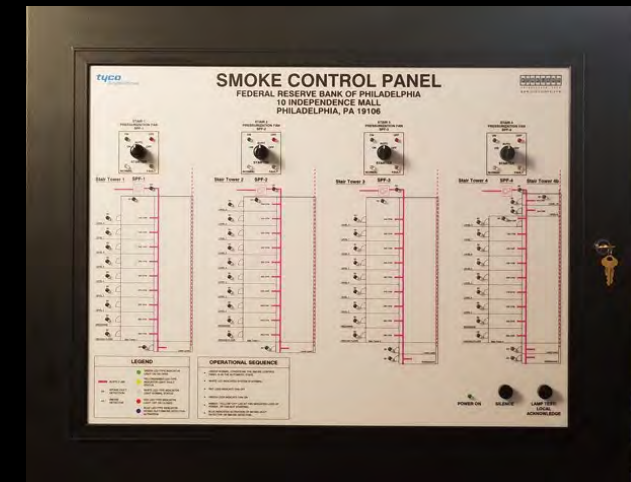


Damper

- Equipment used on a Daily Basis for Temperature control of Building.

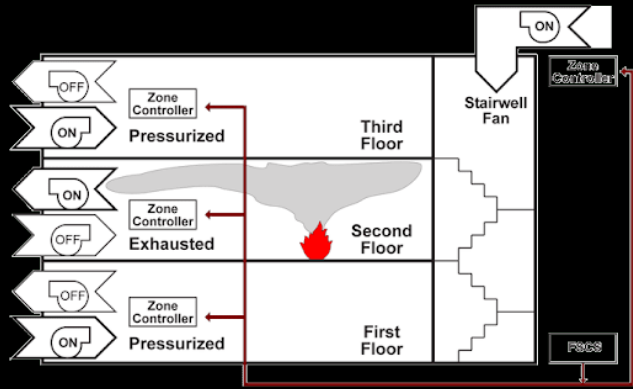


- Equipment Failure will likely be reported
- **Dedicated Weekly Test NOT Required**

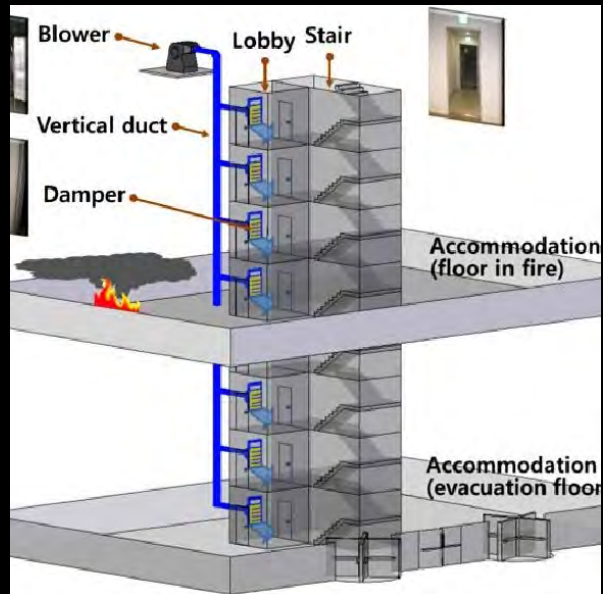




# Two Common Smoke Control Applications

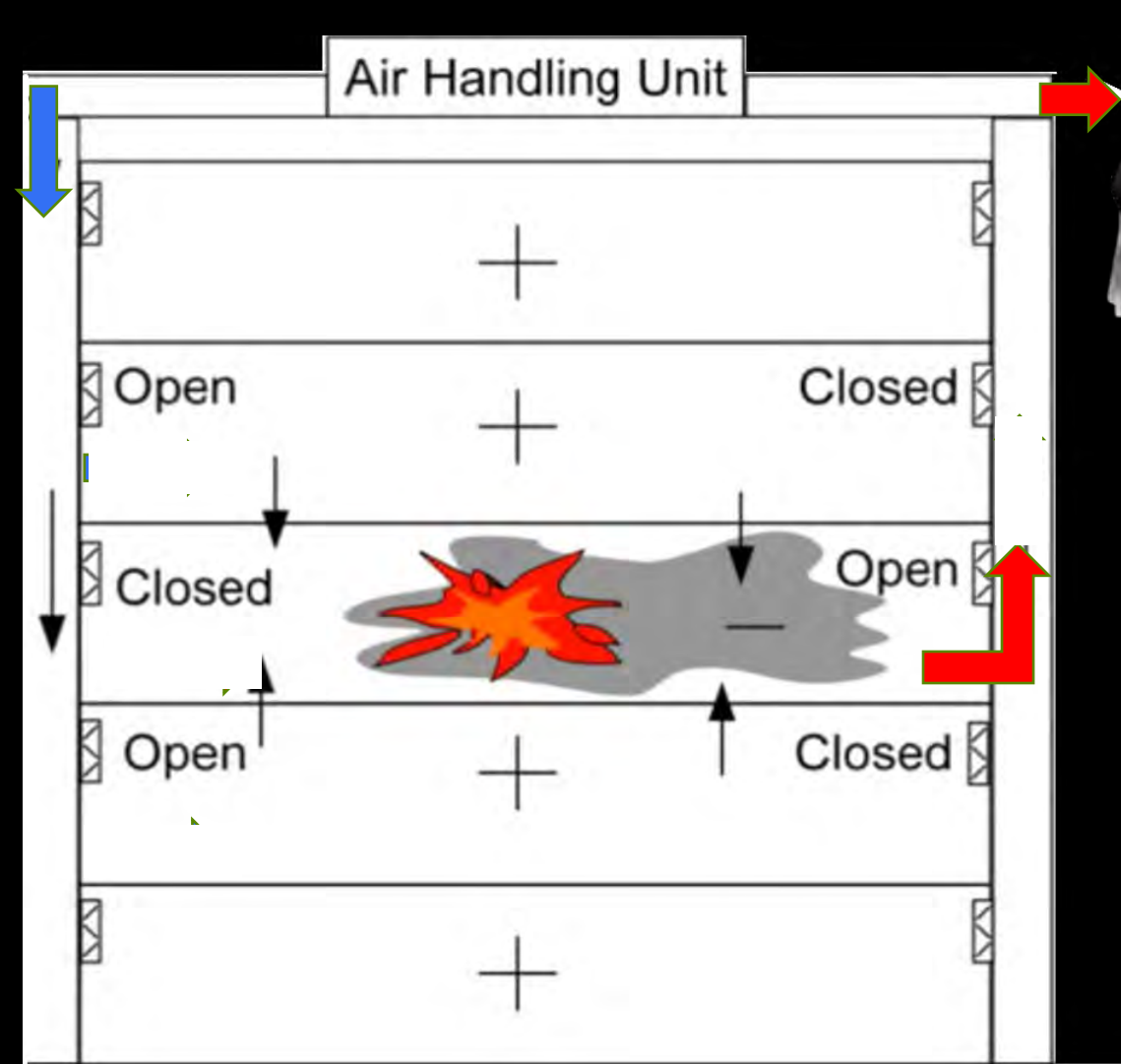
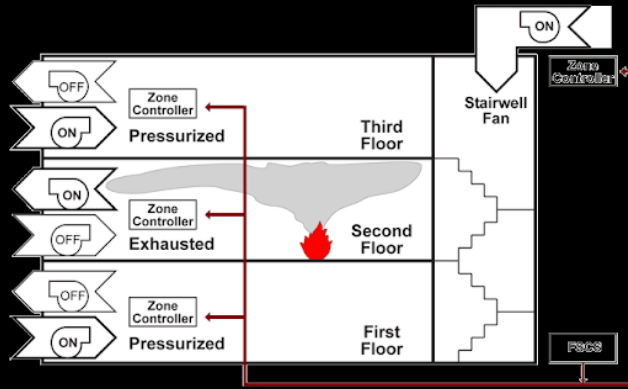


## Zone Smoke Controls



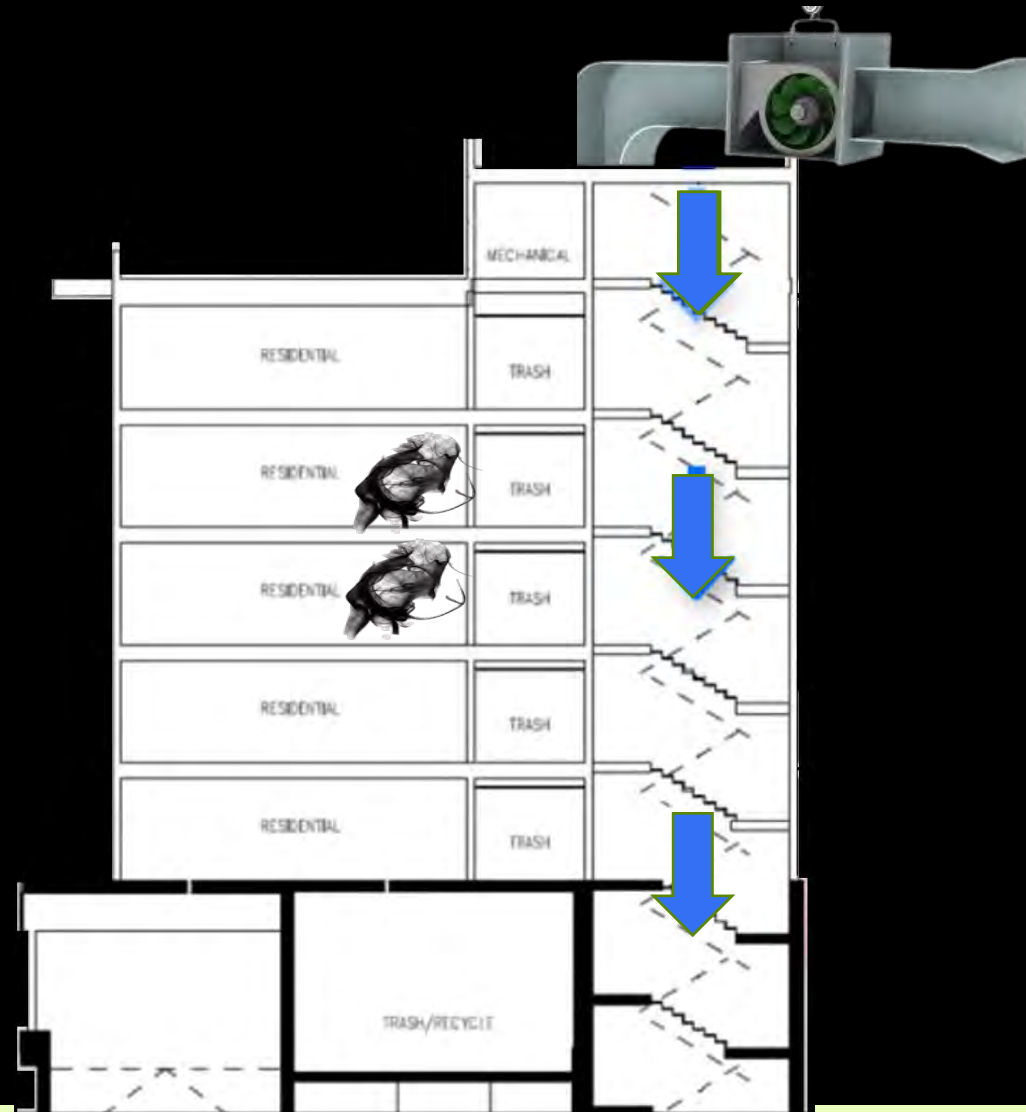
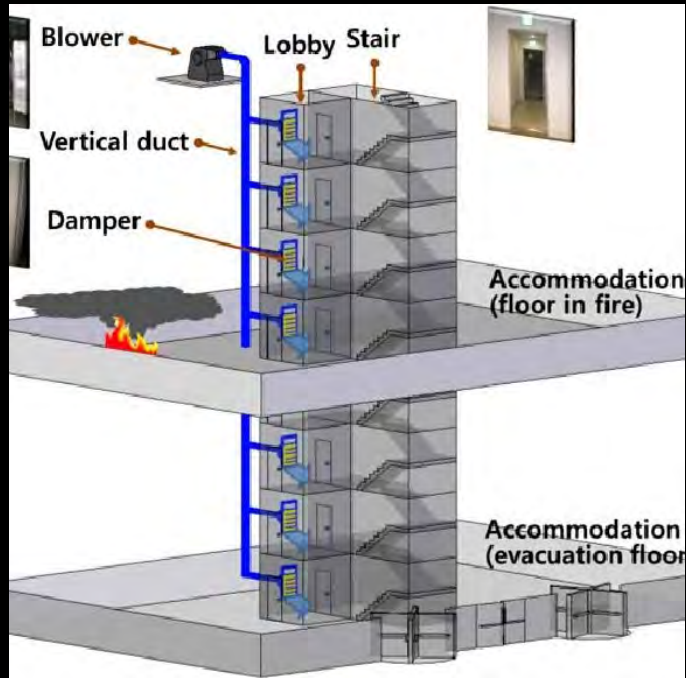
## Staircase Pressurisation Controls

# Floor Above and Below Zone Controls



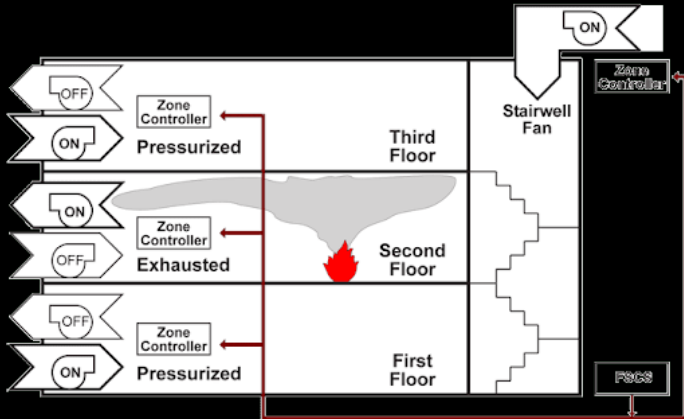
**Zone  
Smoke  
Controls**

# Stair Case Pressurisation Fan Controls



# Objective of Smoke Controls

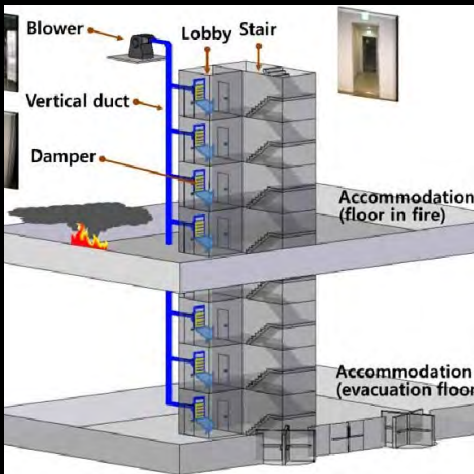
## Zone Smoke Controls



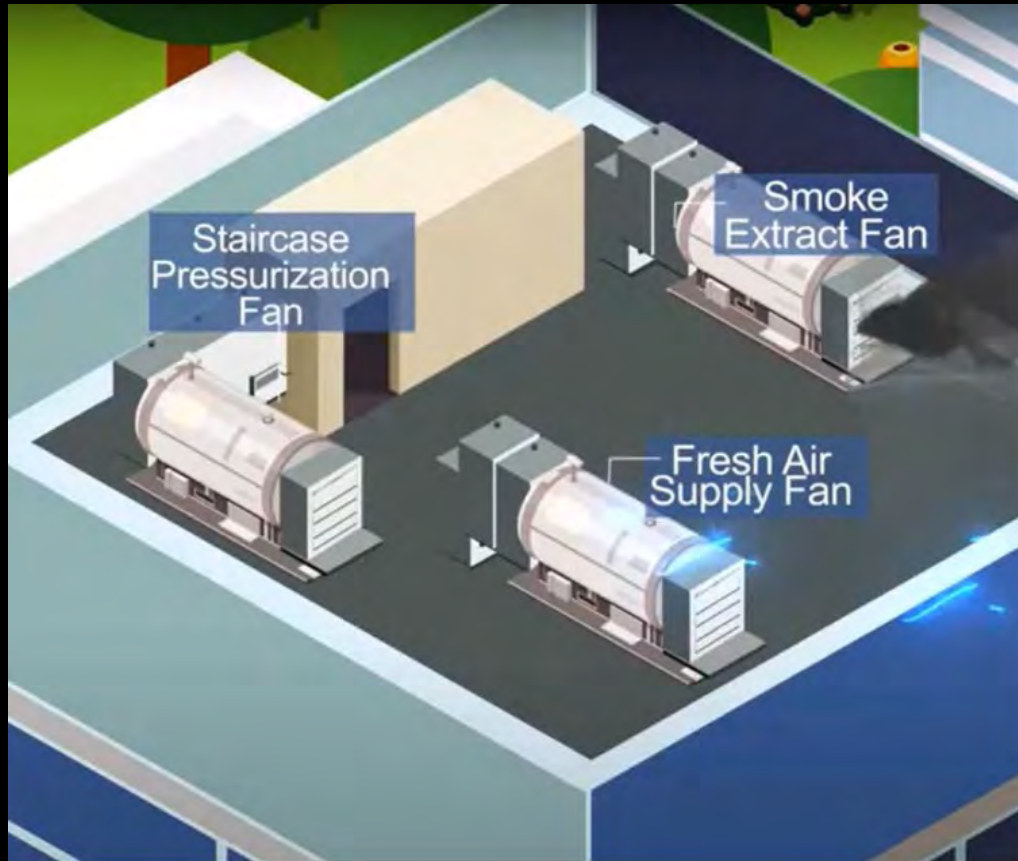
## Smoke Free Evacuation Path



## Staircase Pressurisation Controls



# Smoke Control and Stair case Pressurisation Animation



This demonstrate the combination of Smoke Control to keep the evacuation area within the floors clear as well as keeping the smoke out by Staircase pressurization to have smooth evacuation.

**Smoke  
Manage  
ment**



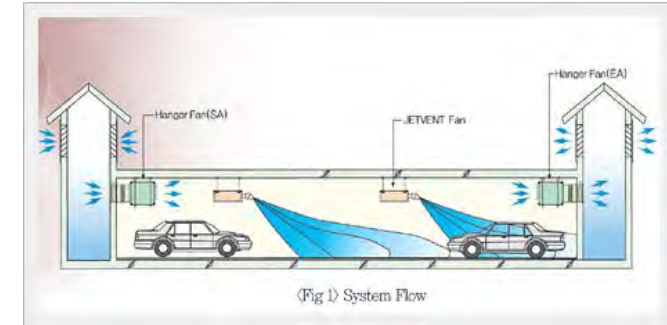
**SMS**  
SMOKE MANAGEMENT SYSTEMS

The logo features four icons in a row: a gear, a flame, a fan, and a wrench.

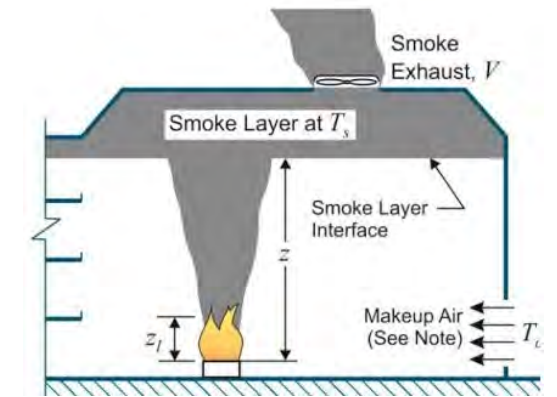
# Defining Smoke Management:

## Smoke Management

A Smoke Management System can be defined as an engineered mechanical system that, based on its intended purpose, uses mechanical fans, dampers and other methods to **remove smoke** from a facility **under post fire condition**.



- A smoke management system is applied to one or more of the following intended uses:
  - ✓ **Roof hatch ventilation** for smoke removal in high atrium spaces
  - ✓ **Smoke exhaust fans** in parking garages
  - ✓ **Pressurization fans** in stairwells and/or elevator shafts



- Understanding the Smoke Control design and installation process can be difficult with challenges at each phase of the project.
- These systems are generally code mandated based on occupancy type, architectural construction methods, occupancy loads and a variety of other factors.
- With no single entity or trade being solely responsible for the entire solution, the interdependency across all professional engineering and installation trades is critical for a successful project.

# Smoke Management: Roof hatch ventilation for smoke removal in high Atrium spaces



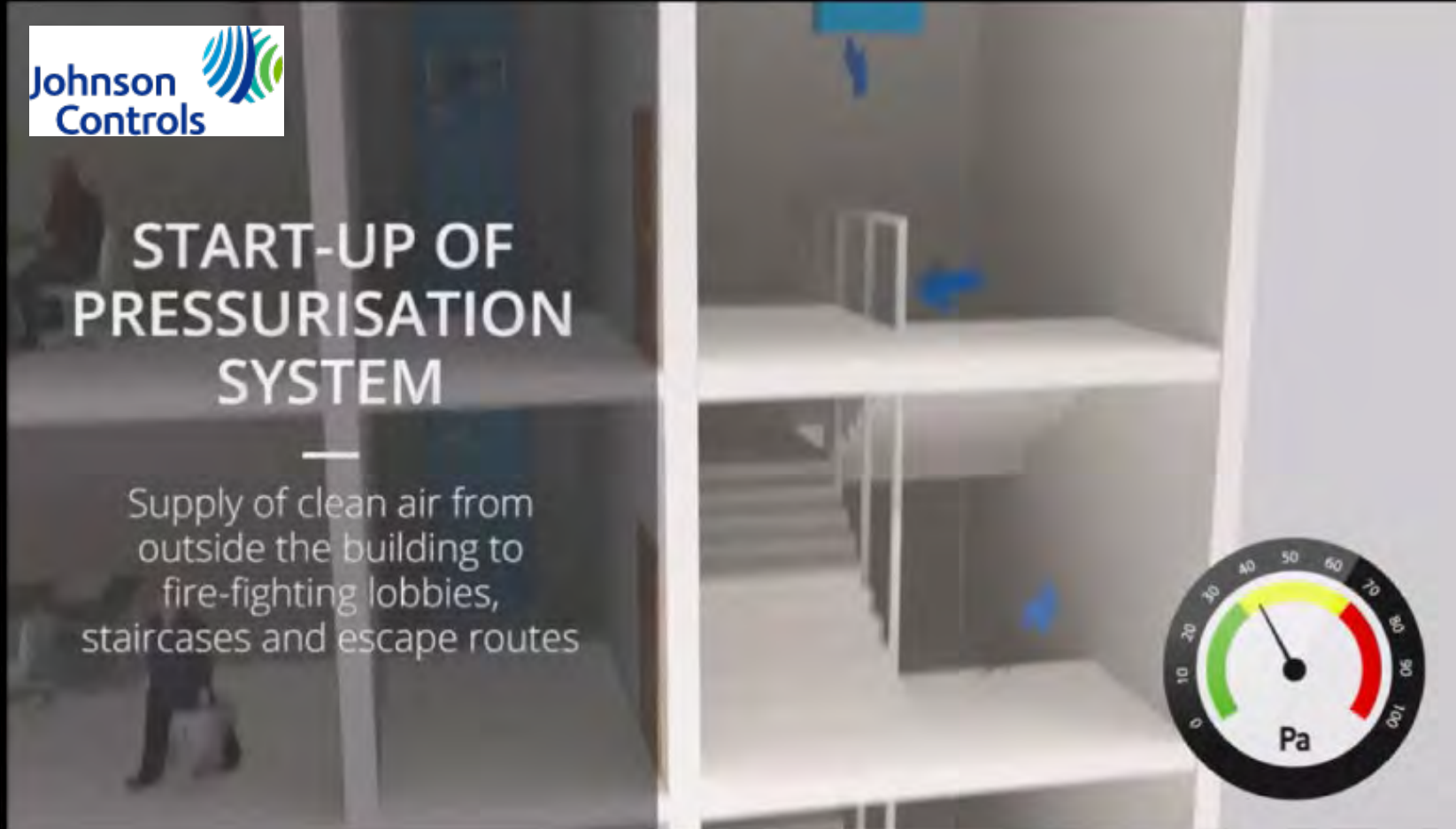
# Smoke Management: Car Park Ventilation Fan

Smoke  
Manage  
ment



# Smoke Control/Management: Stairwell Pressurisation Fan

Smoke  
Manage  
ment



The image is a composite graphic. On the left, there is a blurred photograph of a staircase with blue arrows pointing upwards, indicating the direction of air flow. The Johnson Controls logo is in the top left corner. The text 'START-UP OF PRESSURISATION SYSTEM' is centered in large white letters. Below it, a horizontal line is followed by the text 'Supply of clean air from outside the building to fire-fighting lobbies, staircases and escape routes'. On the right side, there is a circular pressure gauge with a scale from 0 to 100 Pa. The needle is positioned at approximately 45 Pa. The gauge has a color-coded scale: green for 0-30 Pa, yellow for 30-60 Pa, and red for 60-100 Pa.

Johnson Controls

## START-UP OF PRESSURISATION SYSTEM

Supply of clean air from outside the building to fire-fighting lobbies, staircases and escape routes

Pa

Smoke  
Compartmentm  
entation



# Defining Smoke Containment:

- **Smoke containment systems** take the form either of physical barriers such as Ceiling Fire Barrier, Smoke curtains, or as Pressure differential systems, also known as pressurisation systems.
- If a fire breaks out, smoke containment systems prevent the movement of smoke and heat from one area to another. Usually they are designed for use as part of an overall smoke control system.
- If smoke is allowed to spread, damage can occur to other parts of the building and there is a risk of it becoming smoke-logged. However, with a well-designed smoke containment system, the smoke layer will remain relatively hot and buoyant, allowing more effective ventilation.

## Passive Fire Barrier.

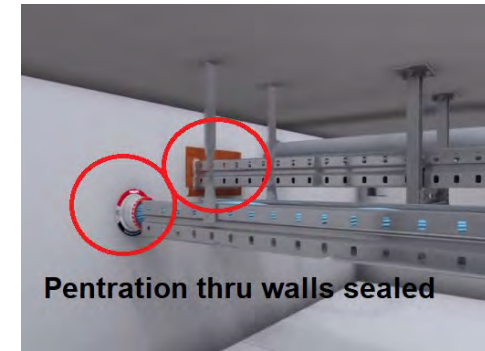
- These are usually to seal the ceiling in between compartment to control the smoke.
- These will need advance planning as it have to comes with smoke extraction as well as the necessary extinguishing protection. These could also be installed between floors especially riser.

## Standby Smoke curtains:

- Physical barriers in the form of curtains can be either fixed or movable.
- Movable systems have the advantage that since they are held retracted at high level, they are virtually invisible until needed. They roll down when required.

## Fire curtains:

- Where it is necessary to contain the fire as well as smoke, a fire curtain may be used for containment pf fire instead of smoke curtains, typically it may be used to protect a lift door or an escape route through an open plan dwelling.



Passive Fire Barrier



Smoke Curtains



Lift Fire Curtains



Area Fire Curtains

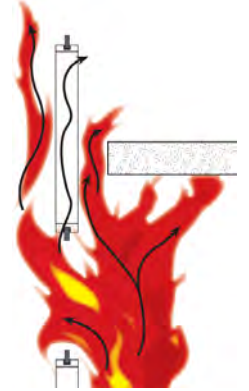
# Smoke Containment with Compartmentation Solution

Compartments are constructed of fire-resistance-rated materials and assemblies which are tested and approved by ASTM International, formerly known as American Society for Testing and Materials. These fire-resistance-rated walls and barriers can be rated for the following time periods which indicate how long they survive according to standard fire tests:

- 3 hour
- 2 hour
- 1 hour

Compartmentation is only complete with Dampers and smoke exhaust shaft located within the compartment area to draw out the smoke.

All of these are considered passive construction that needs to be built into the building and active part involved the interlocking with the Fire Detection System.



Passive Protection Materials



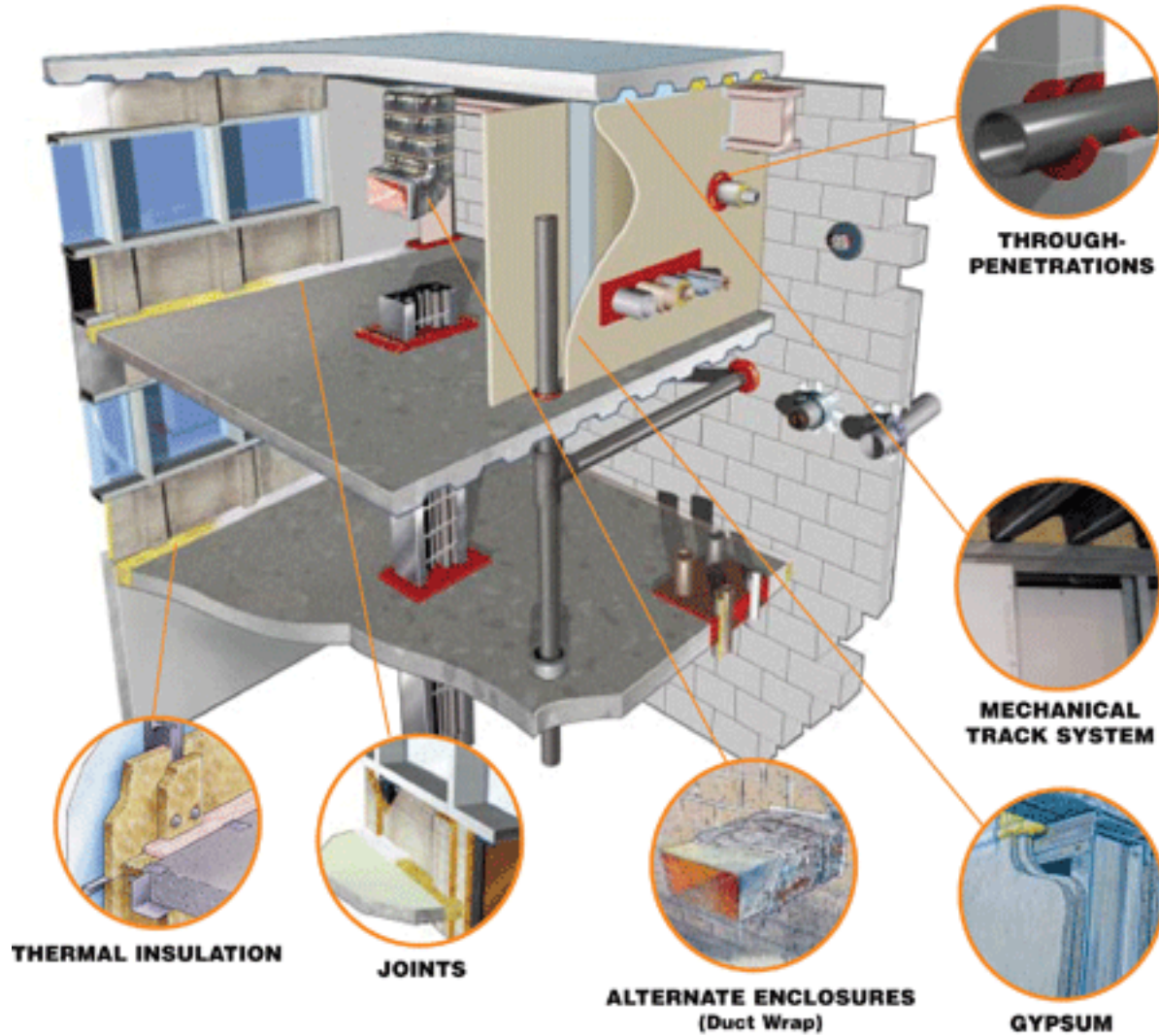
Active Smoke Extraction



Sprinkler Extinguishing Solution

# Other Examples of Passive Fire Protection Barriers

## Other Example of Building Passive Barriers



## Combining Passive and Active Fire Protection

# Defining Smoke Containment:

- Smoke containment systems take the form either of physical barriers such as Ceiling Fire Barrier, Smoke curtains, or as Pressure differential systems, also known as pressurisation systems.
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## Passive Fire Barrier.

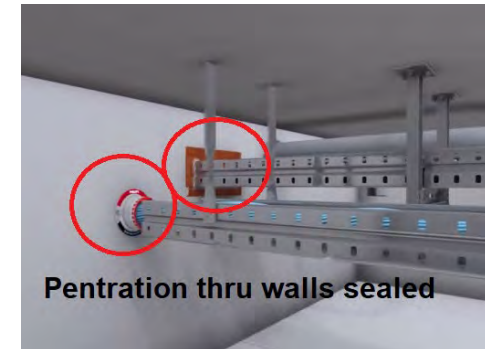
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Passive Fire Barrier



Smoke Curtains



Lift Fire Curtains



Area Fire Curtains

# Smoke Curtains Definition – On Standby

## What Are Smoke Curtains and How Do They Work?

- They are located within the ceiling above the opening and are deployed downwards to prevent smoke from spreading through the building.
- These curtains help to divide the building into smaller spaces and contain smoke to individual rooms.
- Elevator Smoke and fire Curtains are the solution to protect an elevator opening from the threat of smoke and fire.
- The IBC requires buildings with four or more stories, to have a barrier at the elevator shaft on each floor to prevent the spread of smoke.





# Smoke Curtains Definition

## The role of a fire curtain

A fire curtain is, in simple terms, a highly robust piece of **fire-resistant material** that remains discretely suspended from a ceiling, lobby or doorway, until it is lowered when the smoke or fire alarm within a building is triggered.

At that point, the curtain becomes a barrier between the fire and the escape routes that building occupants are expected to use during an evacuation. In that respect, it is crucial for the compartmentation or prevention of flames spreading, either laterally or vertically, and putting people's lives at an increased risk.

One of the main benefits of fire curtains as part of a building's safety regime is that they can be, and generally are, located in several areas throughout a building.

A fire curtain can be used to **replace a non-load bearing wall and fire rated glazing**, for example, which in turn allows **open plan building designs** to meet the relevant regulations. Similarly, elevators and lobbies can be protected by vertical curtains, which prevent the spread of smoke and flames through the elevator shaft.





Fire Detection Interface Devices Product  
Performance Requirement – UL864 10<sup>th</sup>  
Edition UUKL Listing

# What is UUKL? Part 1 of 2

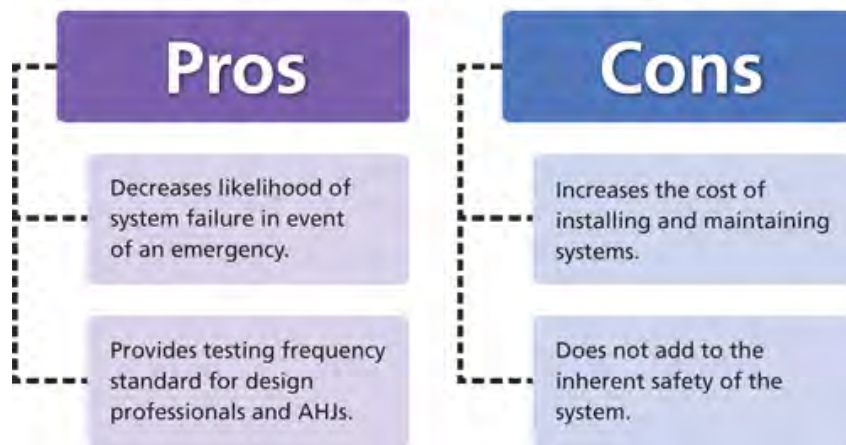


UL's UUKL listing is a category under UL 864, Control Units and Accessories for Fire Alarm Systems. UUKL is for products covered under the description "Smoke Control Equipment." Equipment that receives UL's UUKL rating has been tested for integrity and long term reliability.

1. The purpose of the enclosed **UL 864 UUKL Smoke Control Compliance** is to provide a record of those elements of **NFPA** (National Fire Protection Association) **92A** .
2. UUKL is an identifier created by UL to identify those **products Listed** under UL 864 as Smoke Control Equipment- e.g. FSCS Interface components, Field Modules, Dampers, ....etc.
3. It should be recognized that the UUKL Listing is based on a **supplement to UL 864**, rather than part of the formal standard.
4. That supplement is based on **NFPA 92A**, which is a Recommended Practice rather than a Code or Standard. Products covered by this Listing are intended to be installed in conjunction with Heating, Ventilating, and Air Conditioning (**HVAC**) equipment to form a system for **controlling the flow of smoke in a building during a fire condition** in accordance with NFPA Recommended Practice 92A.

5. Since the UUKL Listing is based on a Recommended Practice, which is **less stringent and less binding** than an NFPA Standard, a considerable amount of latitude is granted to the designer of the smoke control system. For example, the designer may choose to implement some of the elements identified in the
6. Smoke Control Compliance , such as **positive damper position annunciation from two end switches**, while choosing not to provide other elements, such as the **FSCS (Fire Fighter's Smoke Control Station)** annunciator.
7. This is acceptable **as long as there is agreement** with the local Authority Having Jurisdiction (**AHJ**) regarding the configuration.

## UUKL certification for smoke control systems

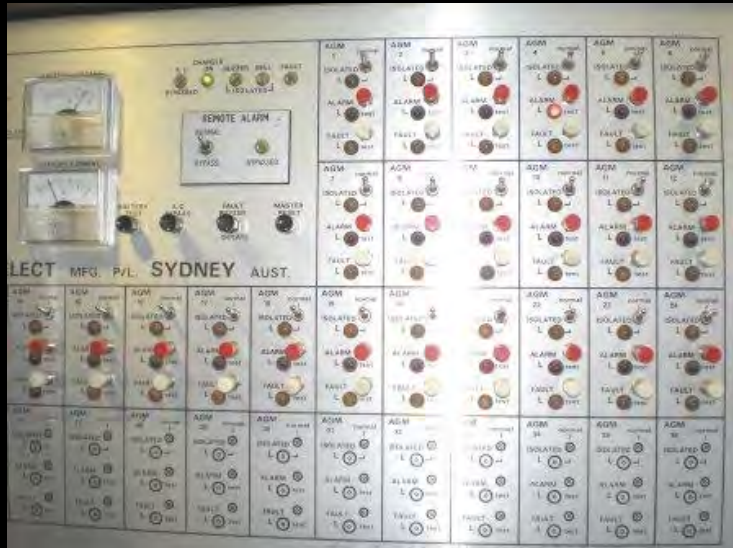


This illustrates the advantages and disadvantages of UUKL certification

- For smoke control systems.
- For Smoke Management Systems
- For smoke-containment systems, the design approach includes one or more of the following: stairwell pressurization, zoned smoke control, elevator pressurization, vestibule pressurization, and smoke refuge area pressurization.

## All About Fire Fighter Smoke Control Panel

# FSCS Traditional Fan/Damper Control Switches



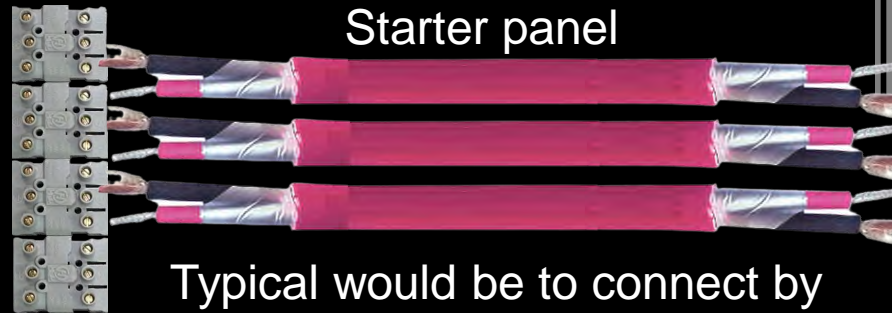
Starter Panel

- 1. ON
- 2. OFF
- 3. AUTO
- 5. TRIP



Air Flow Switch

MultiCore Fire Rated Cables  
Run from FSCS to remote Fan  
Starter panel



- 1. ON
- 2. OFF
- 3. AUTO
- 4. STATUS
- 5. TRIP

Typical would be to connect by  
Zone of which will compromise  
the Control Integrity

4. STATUS



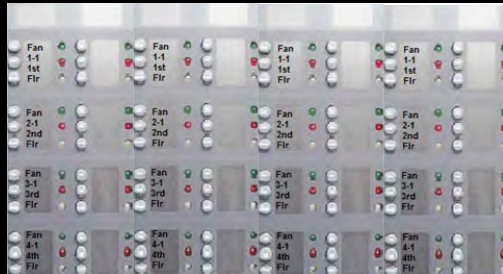
Fan



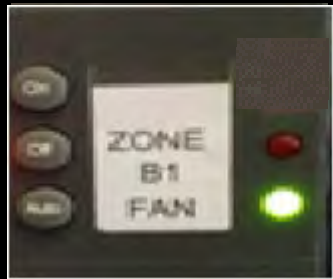
# FSCS Full Multiplex Fan/Damper Control Switches



Multiplex Main FSCS Control Room  
(UL864 10<sup>th</sup> Edition UUKL Listed)

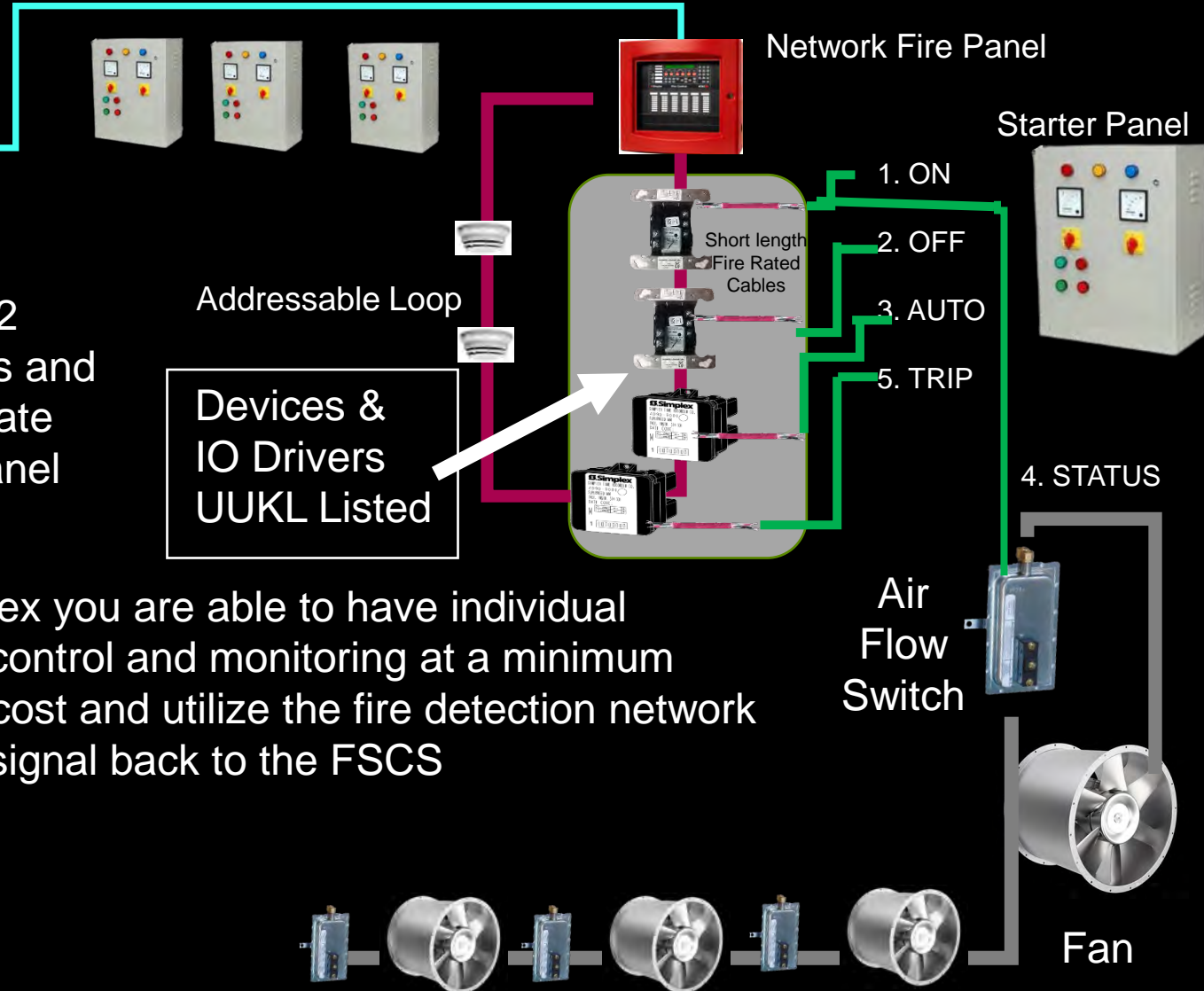


One Bay can house 32 Fan/Dampers Controls and can easily accommodate 160 Devices for 02 Panel enclosure.



- 1. ON
- 2. OFF
- 3. AUTO
- 4. STATUS
- 5. TRIP

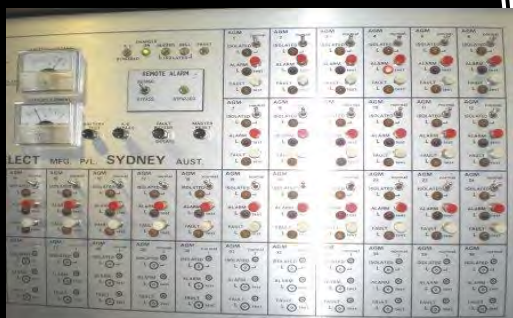
With Multiplex you are able to have individual equipment control and monitoring at a minimum installation cost and utilize the fire detection network to transmit signal back to the FSCS



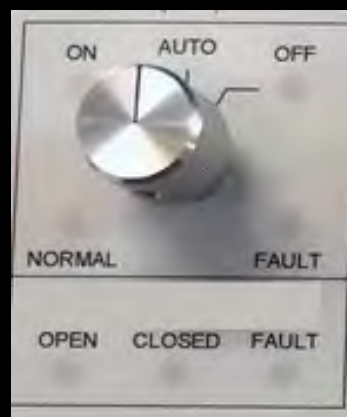
# FSCS Semi Multiplex Fan/Damper Control Switches



24I/O UUKL listed

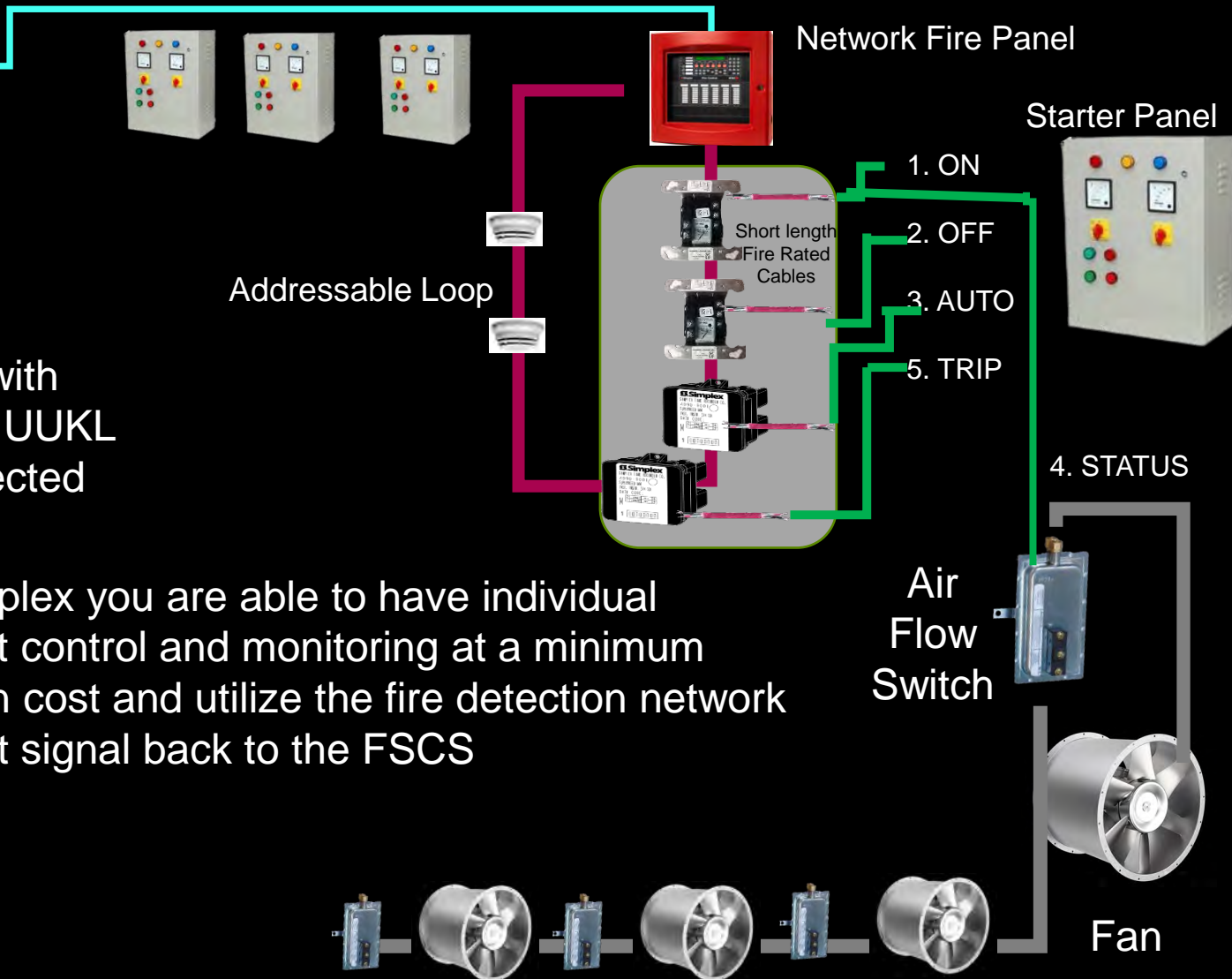


Alternate can have customized Mimic with switches driving by UUKL 24I/O drivers connected to the main panel.



- 1. ON
- 2. OFF
- 3. AUTO
- 4. STATUS
- 5. TRIP

With Multiplex you are able to have individual equipment control and monitoring at a minimum installation cost and utilize the fire detection network to transmit signal back to the FSCS





# The Recommended Approach on determining the right Smoke Methodology for your Building

- Once the requirement for a smoke control system is established, the first step is to **consult NFPA 92** and determine whether the system should be based on the **smoke-containment** concept or the **smoke-management** concept.
  - ✓ Smoke management generally is used for ***large multistory spaces, such as atriums.***
  - ✓ Smoke containment, achieved using pressurization, is used for ***elevators, stairways, and zoned smoke systems.***
  - ✓ Additionally, a building may include smoke management as well as a smoke containment; the two methodologies are **not mutually exclusive systems** and both are often found in the same building.
  - ✓ After the design methodology and smoke control objectives are identified, the design approach(es) should be selected.
  - ✓ Smoke-management systems **apply within large-volume spaces** and their respective communicating spaces.

# The Recommended Approach on determining the right Smoke Methodology for your Building

The design approaches can include one or more of the following:

- **Natural smoke filling** and calculating/modeling of smoke layer descent to determine at what point occupants will be exposed if their egress inhibited.
- **Mechanical smoke-exhaust capacity** to remove enough smoke to maintain the **smoke layer above the height** where it affects occupants' ability to egress.
- **Mechanical-exhaust capacity** to remove smoke to slow the rate of **smoke layer descent** for a period that allows adequate time for occupants to egress.
- **Gravity smoke venting** to maintain the smoke layer interface at a predefined height for a design time.
- **Gravity smoke venting** to slow the rate of smoke layer descent for a period that allows occupants to egress.
- **Opposed airflow** to prevent smoke movement between a large-volume space and communicating space.

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Keeping the design basis in mind, the smoke control approaches should be **clearly defined and documented from the beginning.**

- The report should also document the next step, establishing the design criteria.
- The criteria may apply to one or both of the smoke control methodologies and can help assess the effectiveness of a smoke control system; they can be found in Section 4.4 of NFPA 92.

Once the general design requirements are established, the next step is to **perform the design calculations.**

- Special consideration should be given to the design fire, including likely fuel materials, location, intensity, and growth.
- It often helps to develop several fire scenarios to determine a conservative, yet reasonable, fire situation and ensure the smoke control system can operate effectively under a variety of circumstances.
- Chapter 5 of NFPA 92 outlines the calculation procedures related to smoke management.
- It is important to note that NFPA 92 does not provide guidance for design calculations for smoke-containment systems

# Check List Table to be downloaded at the end of the Part 2 Webinar on completion of Survey(Includes Codes & Standards Response time)

Table 1 lists general requirements for UL 864 UUKL Listing compliance.

Mark Yes/No for compliance and initial each item that was verified.

**Table 1: General UUKL Requirements**

S/N	Requirement	Y/N N/A	Person Verifying
1	Communication links between buildings are fiber optic cable or copper cable buried in a conduit separate from power wiring.		
2	Each Output Contacts used for pressurization and exhaust control outputs is configured with its own feedback binary input. The feedback binary input monitors the associated controlled equipment status (both open and closed, on and off, etc.). For smoke control dampers, there is a pair of feedback binary inputs for two damper end switches.		
3	For fans there is positive indication of air flow and/or on/off status of fan. Manual operations occurring from a non-UUKL Listed OWS (Operator Workstation) isolated from the Listed segment of Controlling System do not have priority over automatic smoke control sequences by normal system operators or those initiated manually from the manual override station.		
4	The Weekly Testing of Dedicated Stairwell Pressurization Fans application is used on all dedicated smoke control systems.		
5	Output Contacts have Priority 2 commands and all other non-smoke control logic use lower command priorities.		
6	Automatic activation of any smoke control sequence of operation has priority over any non-smoke control manual commands and any automatic environmental control strategy, when an auto smoke control sequence is initiated. High and low temperature protection devices and return and exhaust air-duct smoke detectors are bypassed.		
7	Response time for individual smoke control fan to commanded state is no more than 60 seconds.		
8	Response time for individual smoke control dampers to commanded state is no more than 75 seconds.		
9	Fire alarm system manual pull stations do not initiate automatic smoke control sequences.		
10	Smoke detectors are used to initiate a smoke control strategy.		
11	All Application Specific Controls (ASCs) that monitor or control smoke control equipment are UUKL Listed.		
12	The Operator Terminal on a BMS/PLC Network is not used for smoke control.		
13	Transient protection for device as required		
14	The system is configured to record all smoke control system alarm and trouble messages on the external printer.		
15	Electrical disconnects, overloads, duct static pressure limits, and supply air duct smoke detectors are not overridden by manual or automatic smoke control strategies.		

# Questions and Answers

<https://simplex-fire.com/>



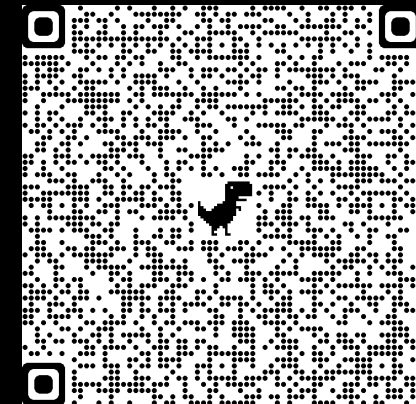
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