What is a Smoke Control System?

2018 International Building Code, Section 909.1 defines a smoke control system as:

- A system designed to provide a tenable environment for the evacuation or relocation of occupants.
- 909.16.1 - Fans within the building shall be shown on the FSCS panel. A clear indication of the direction of airflow and the relationship of components shall be graphically displayed.
- It is not intended for the preservation of contents, the timely restoration of operations or for assistance in fire suppression or overhaul activities.
Codes and Standards Governing Smoke Control Systems

- 2018 IBC Section 909 Smoke Control Systems
- NFPA-92, Standard on Smoke Control Systems
- Underwriters laboratories, UUKL, Fire Fighters' Smoke Control Station - Includes requirements of ANSI/UL 864 Control Units for Fire-Protective Signaling Systems.
Smoke Control System Required
Covered mall buildings with an atrium connecting 3 or more stories (IBC, Section 402.7.2)
Smoke Control System Required
High-rise buildings 75 feet and higher (IBC, Section 403.4.7)
Smoke Control System Required
Atriums (IBC, Section 404.5)
Smoke Control System Required
Underground buildings having a floor level more than 30 feet below ground (IBC, Section 405.5)
Smoke Control System Required
Group I - 3 buildings - Detention Facilities (IBC, Section 408.9)
Smoke Control System Required
Stages larger than 1,000 square feet or greater than 50 feet high (IBC, Section 410.2.7.2)
Smoke Control System Required
Special amusement buildings with an occupant load of 50 or more (IBC, Section 411.1)
Smoke Control System Design

Rational Analysis (IBC, Section 909.4.1 through 909.4.7)

- Smoke control system design starts with the rational analysis
  - Types of systems to be employed
  - Methods of Operation
  - Supporting Systems
  - Method of Construction
- Prepared by a Fire Protection Engineer

- Design considerations include:
  - Stack effect
  - Temperature effect of fire
  - Wind effect
  - HVAC systems
  - Climate
  - Duration of operation
  - Smoke control system interaction
Smoke Control System Design

Dedicated or Non-Dedicated Smoke Control

Dedicated System
A smoke control system designed for the sole purpose of controlling smoke within a building.

- In this case, equipment is not linked to building HVAC controls.
- This is accomplished by forming a system of air movement that is separate and distinct from the building's HVAC system and only operates to control smoke.

Non-Dedicated System
A smoke control system that shares components with other air moving equipment. When the smoke control mode is activated, the operating of the building's air moving equipment changes to accomplish the objectives of the smoke control design.
Smoke Control System Design

Dedicated

- Fans and dampers used exclusively for smoke control
- Equipment is only activated automatically when there is a fire or manually from firefighter smoke control panel.
- Automatic weekly test required to assure equipment is operable.
Smoke Control System Design
Non-Dedicated

- Fans, air handling units, and dampers used on a daily basis for temperature control of building.
- A failure of this equipment will likely be reported.
- No Automatic Weekly Test Required.
Methods of Operation – Passive

IBC, Section 909.5 - Walls and Floors Constructed as Smoke Barrier

Openings required to be protected with automatic closing devices, such as fire dampers and doors:

Fire Doors

Smoke and Fire Dampers
Methods of Operation – Mechanical

Smoke Control Definitions

- Pressurization (IBC, Section 909.6)
  - Stairwell and Shaft Pressurization

- Airflow (IBC, Section 909.7)
  - Zoned Smoke Control Systems

- Exhaust (IBC, Section 909.8)
  - Smoke Purge / Exhaust / Evacuation
Methods of Operation
IBC, Section 909.6 - Pressurization IBC

- Primary mechanical means of controlling smoke across smoke barriers.
- Minimum pressure difference across smoke barriers = 0.05 inch water gage
- Maximum fire door opening force = 30 pounds to start, 15 pounds to open
- Has to meet NFPA 92 requirements
Smoke Control System Design

Shaft or Floor Protection

Shaft Protection
- Provides for smoke movement in stair towers and elevator hoist ways in either a dedicated or non-dedicated system environment.
- Most common is dedicated fans and dampers
- Common in high-rise applications (ex: Stair Pressurization– SPF-xx)

Floor Protection
- Floor protection systems limit the flow of smoke through shafts and cracks in floors or partitions in either a dedicated or non-dedicated system environment.
- Can be an entire floor or multiple zones on each floor
Pressurization is employed by creating pressure differences across partitions that separate the smoke zone from other areas. This can be accomplished by making pressure in the area surrounding the smoke zone higher than pressure in the smoke zone itself (refer to Figure 1.2.1.1).

Airflow through construction and door cracks prevents the movement of smoke to the high-pressure side. The pressure difference must be enough to contain the smoke in the smoke zone and at the same time allow doors leading to exit routes to be opened.

Fan Pressurizes Stairwell to prevent smoke from entering the space.
Smoke Control System Definitions

Examples of Shaft Protection

Figure 1.4.2.1 Single and Multiple Injection Stairtower Pressurization Systems

Figure 1.4.2.3 Elevator Smoke Control Using Shaft Protection
Zoned Smoke Control Systems

- Buildings can usually be divided into several smoke control zones where each zone can be separated from the smoke zone to prevent the movement of smoke.
- The smoke control zone boundaries are usually partitions, floors, and doors that can be closed. Often each floor of a building is chosen as a smoke control zone boundary.
- However, a smoke control zone can consist of more than one floor, or a floor can contain more than one zone. Also, all non-smoke zones can be pressurized, or just those surrounding the smoke zone.
Smoke Control System Definitions

Zoned Smoke Control Systems

- Smoke is exhausted from the fire floor.
- The floor above and below the fire floor are pressurized to prevent migration of smoke to those areas.
Smoke Control System Definitions

Examples

Figure 1.4.4.2 Zoned Smoke Control using the HVAC System Normal Operation (a) and Smoke Control Operation (b)
Smoke Control System Definitions

Examples

Smoke Control Zone Every Floor

Three Smoke Control Zones Per Floor

Fire Floor
Methods of Operation

IBC, Section 909.8 - Exhaust Method

- Used to exhaust smoke from large enclosed volumes, such as atriums or malls
- Smoke level must be at least 6 feet above a walking surface used for egress
- Must be approved by the fire code official
- Has to meet NFPA 92 requirements
Fire detection systems providing control input or output signals to mechanical smoke control systems shall:

- Comply with IBC Section 907
- Be ANSI/UL 864 listed
- Be listed as smoke control equipment (UUKL)

Includes:
- Types of systems to be employed
  - Passive (Isolates the smoke zone)
  - Mechanical (Moves air around)
- Methods of operation
- Supporting systems
- Methods of construction
Smoke Control System Verification
IBC, Section 909.12.1 - Verification

- Applies to mechanical smoke control systems

- Requires positive confirmation of:
  - Actuation
  - Testing
  - Manual override
  - Presence of power downstream of all disconnects
Smoke Control System Verification

IBC, Section 909.12.1 - Weekly Self Test

- A preprogrammed weekly test sequence of all devices, equipment and components used for smoke control is required.
- Must indicate abnormal conditions audibly, visually and by printed report.
- Not required when verification of individual components will interfere with normal building operations
Smoke Control System Verification
Smoke control fans and dampers are equipped with status switches

- Validation/positive feedback for fans required in 60 seconds.
- Validation/positive feedback for dampers required in 75 seconds
- Status switches monitored by contact input module

**Damper Status - Limit/Position Switch**

**Fan Status - Differential Pressure Switch**
Managed Equipment Control

Damper
Firefighter’s Smoke Control Panel
FSCP or FSCS

- Required by IBC, Section 909.16
- Fire department emergency use only
- Must have manual control or override of automatic control for mechanical smoke control systems.
- Located in the fire command center or approved location next to the fire alarm control panel.
- Requirements vary widely between jurisdictions
FSCS - Control Functions

The FSCS must provide control over each individual piece of equipment that can also be controlled from other sources within the building:
Smoke Control Panel UUKL
UUKL Listing

- Must be a UUKL Listed FSCS
- Locations to install the FSCS
  - Fire Command Center (FCC)
  - AHJ Approved location (Lobby)
  - Next to the FACP

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Smoke Control Panel UUKL

UUKL Listing ID Card

UUKL-S3616
Smoke Control System Equipment

See General Information for Smoke Control System Equipment

H R KIRKLAND CO INC
UNIT 13
4935 ALLISON ST
ARVADA, CO 80002 USA

Investigated to UL 864 (10th edition)

Firefighter’s Smoke Control Station Model(s) BGRA (a), BGRA-D- X, BGRB (a), BGRB-D-X, CEF (a), RSA (a), RSB (a), RSC (a), RSO-D- X, RSD (a), RSE (a), RSF (a), RSG (a), RSH (a), RSX-GR (a)

(a) Requires graphic styles GP4 or GP6. May contain -WP suffix identifying suitable for outdoor use.

X - Length

Last Updated on 2018-10-16
Firefighter’s Smoke Control Station

Includes:

- Graphic representation of the Smoke Control System, direction of airflow and relationship of components in Riser format.
- Provide LED status indicators for all managed smoke control equipment (fans, dampers, and other equipment)
  - White: Normal status
  - Red: Off/Closed
  - Green: On/Open
  - Amber: Fault status
- 3 position switches for manual control of fans/dampers
- Manual control enable key switch (when applicable)
- Lamp Test
- Power On LED
Firefighter’s Smoke Control Station

Includes:

- LEDs indicate the status of the fan or damper
  - **White: Normal status**: fan or damper in Auto position and ready for automatic activation.
  - **Red: Off/Closed**: Fan is turned Off or Damper is set to Close.
  - **Green: On/Open**: Fan is On or Damper is Open. Green LED lights only when positive feedback of activation is received.
  - **Amber: Fault status**: No positive feedback turned On or damper Opened.

- LEDs are controlled with the LED driver module

- 3 position switches provide manual control of fans/dampers
  - **Auto**: Switch in Auto position fire alarm controls fan or damper activation
  - **On / Open**: Manually turns fan On or Opens damper.
  - **Off / Closed**: Manually turns fan Off or Closes damper

- The ON/Open and OFF/Closed position of each switch is monitored with contact input modules. When switch is not ON or OFF panel assumes it is in the Auto position.
Firefighter’s Smoke Control Station

Control Functions

The FSCS must provide control over each individual piece of equipment that can also be controlled from other sources within the building:

- **On-Auto-Off**
  - Stairway pressurization fans
  - Smoke exhaust fans
  - Air handling system supply, return, and exhaust fans
  - Elevator shaft fans

- **Open-Auto-Close**
  - Dampers directly related to smoke control
  - Dampers that are also controlled from other sources within the building.

- **On-Off or Open-Close**
  - Other critical equipment that can only be controlled from the FSCS (smoke/fire dampers, lobby doors, etc.)

- **Complex systems can be combined so that all elements of a smoke zone can be controlled and status indicated as a unit**
Smoke Control Panel

Example

- Pressurize & Exhaust Control
- Dampers Auto Configured
- 4 LED’s per switch
  - Green = Press/Open/On
  - White = Auto
  - Red = Evac/Close/Off
  - Yellow = Fault
Smoke Control Panel

Control Priorities

SCP: Highest Priority
Smoke Control Panel

FAS: 2nd Priority
Fire Alarm System

BMS: Lowest Priority
Building Automation System
Smoke Control Panel

Control Priorities

- SCP Control Actions have priority over all other control points
- Control actions shall not require the smoke control system to assume more than one configuration at any one time (IBC Section 909.16.3.1)
- Auto position of SCP control switches shall allow automatic or manual control action from other control points in the building.
- When in the auto position, actual status of equipment is displayed (on, off, open, closed) by status indicators (IBC Section 909.16.3.2)
System Response Time

- Governed by IBC Section 909.17
- Smoke control system activation initiated immediately after receipt of automatic or manual command
- Equipment to be activated in sequence to prevent damage to components

- Response times vary.
  - Required to be set to allow for full operational mode to be achieved before conditions in the space exceed the design smoke condition
  - Response times shall be detailed in the rational analysis
Acceptance Testing

- Requirements listed in IBC, Section 909.18
- Shall include verification of the correct operation of all components of the smoke control system, including:
  - Smoke detectors
  - Airflow in Ducts
  - Dampers
  - Fans
  - Smoke barriers
  - Controls

- Must be performed by a special inspector (IBC, Sections 909.3 and 1705.18) and the authority having jurisdiction
- Special inspections must be performed by an independent agency
- Specific requirements vary by jurisdiction
Components must be maintained in accordance with manufacturer’s instructions

Written schedule is required and records must be kept

Semiannual Testing is required for:
- Dedicated smoke control systems (stairway pressurization, atrium exhaust, etc.)
- Systems or components bypassed by a preprogrammed weekly test

Annually
- Non-dedicated smoke control systems (air handling units, economizer dampers, etc.)
- Smoke control systems must be tested under standby power conditions
Question

A smoke control system is designed and intended for the preservation of contents and a building?

Answer

False - A smoke control system is designed to provide a tenable environment for the evacuation of occupants and a building.
Question

Who is responsible for designing the FSCS display?

Answer

Mechanical Engineer and Fire Protection Engineer
A smoke control system will be required when the construction is ___ feet or more below grade.
Question

True or False - Can you have multiple smoke zones on a floor, or a floor can contain more than one zone?
Smoke control system design starts with the:

A. Rational Analysis
B. Fire Alarm Riser
C. Mechanical Riser
Question

False. A dedicated smoke control system shares components with other air moving equipment designed for the sole purpose of controlling smoke within a building with dedicated air moving equipment.
A Mechanical Method of Operation includes which of the following?

A. Pressurization - Stairwell and Shaft
B. Fire Alarm Riser - Zoned Smoke Control Systems
C. Exhaust - Smoke Purge / Exhaust / Evacuation
D. All of the above
The Firefighters Smoke Control Station (FSCS) must meet which listing requirement?

A. UOXX  
B. UUKL  
C. All of the above
**Question**

Which control panel has the highest level of priority in a smoke control design:

A. Fire Alarm Control Panel (FACP)  
B. Firefighter’s Smoke Control Station (FSCS)  
C. Building Automation System (BAS)
Question

Find the discrepancy >
Additional Questions?

Feel free to email ben@hrkirkland.com
Thank you for joining today.

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