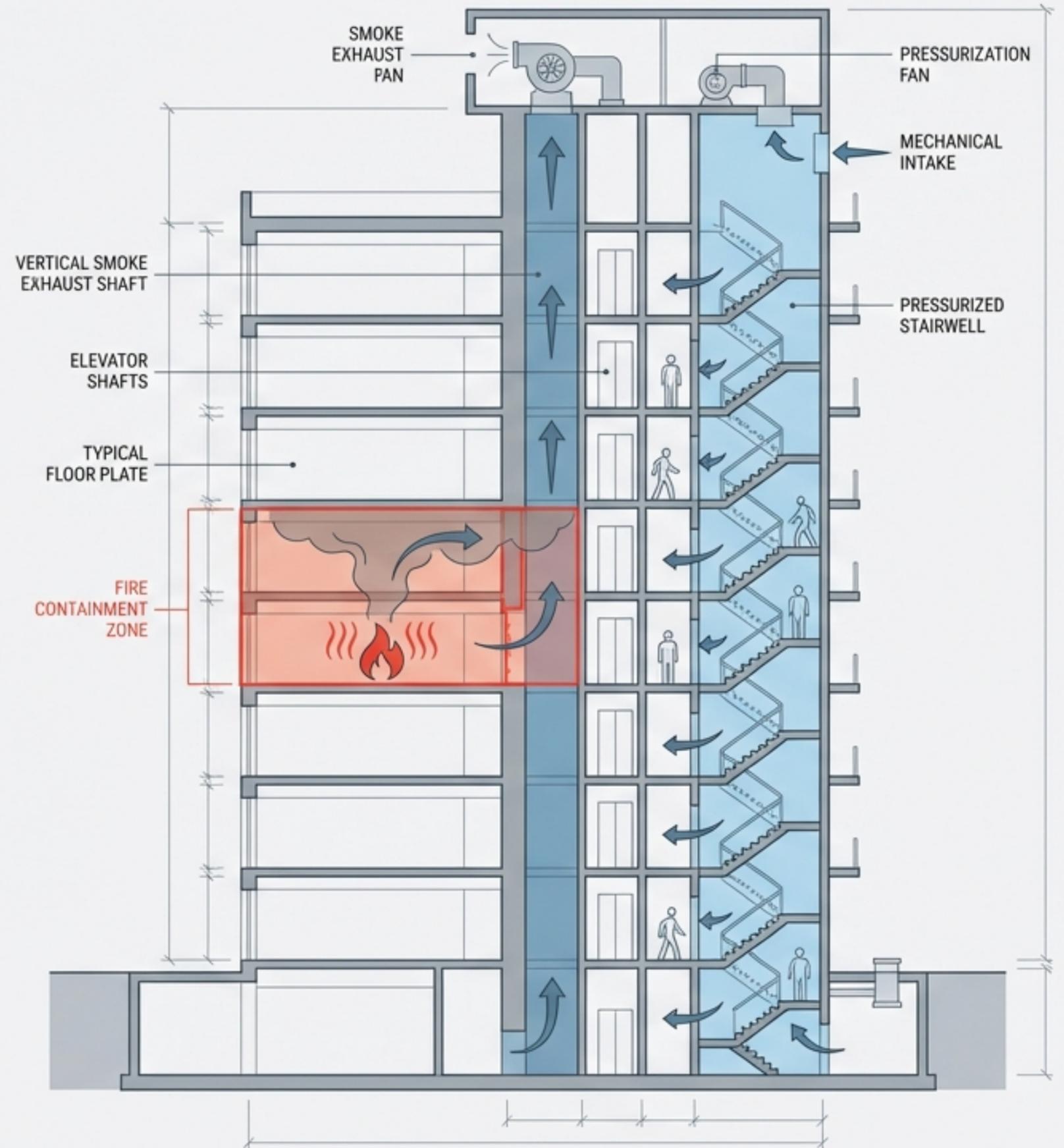


# Designing for Survivability

A Comprehensive Guide to Section 513 Smoke Control Systems  
(2023 Florida Mechanical Code)



# The Mission is Evacuation, Not Preservation

Smoke control systems are strictly intended to provide a tenable environment for the evacuation or relocation of occupants. They are not designed for the preservation of contents, timely restoration of operations, or assistance in fire suppression (513.1).



## General Design

Must comply with Section 909 of the Florida Building Code and well-established engineering principles. Construction documents must include detailed analysis (513.2).



## Special Inspections

Final installed conditions require rigorous commissioning based on published standards to verify proper operation (513.3).

# Core Variables of the Rational Analysis



## Stack Effect

Account for altitude, elevation, weather history, and interior temperatures to prevent normal/reverse interference (513.4.1).



## Wind & Climate

Consider wind-loading provisions, low-temperature effects, and ensure air inlets/exhausts prevent snow or ice blockage (513.4.3, 513.4.5).



## HVAC Interaction

Include all permutations of HVAC system status and the effects of fire on HVAC transport (513.4.4).



## System Duration

Active systems must operate for  $\geq 20$  minutes OR 1.5 times the calculated egress time—whichever is greater (513.4.6).



## System Interaction

Analyze the interaction effects of multiple smoke control systems operating simultaneously (513.4.7).

# Modeling the Design Fire



## Heat-Release Data

Utilize best available data from approved sources without excessively stringent limits on combustible material (513.9.3).

## Load & Behavior

Calculate total fuel load and determine whether the fire state is likely steady or unsteady (513.9.1).

## Fuel Characteristics

Determine fuel type, spacing, and configuration (513.9.2).

## Critical Threshold: Sprinkler Effectiveness

A documented engineering analysis is required if the design assumes fire growth is halted at the time of sprinkler activation (513.9.4).

# Maximum Allowable Leakage Areas for Smoke Barriers

Total leakage area (A) is the gross area times the ratio, plus gaps around doors and operable windows (513.5, 513.5.1). Compliance requires achieving a minimum air pressure difference across the barrier (513.5.2).



Walls

$$A/A_W = 0.00100$$



Interior exit stairways, ramps,  
and passageways

$$A/A_W = 0.00035$$



Enclosed exit access stairways,  
ramps, and all other shafts

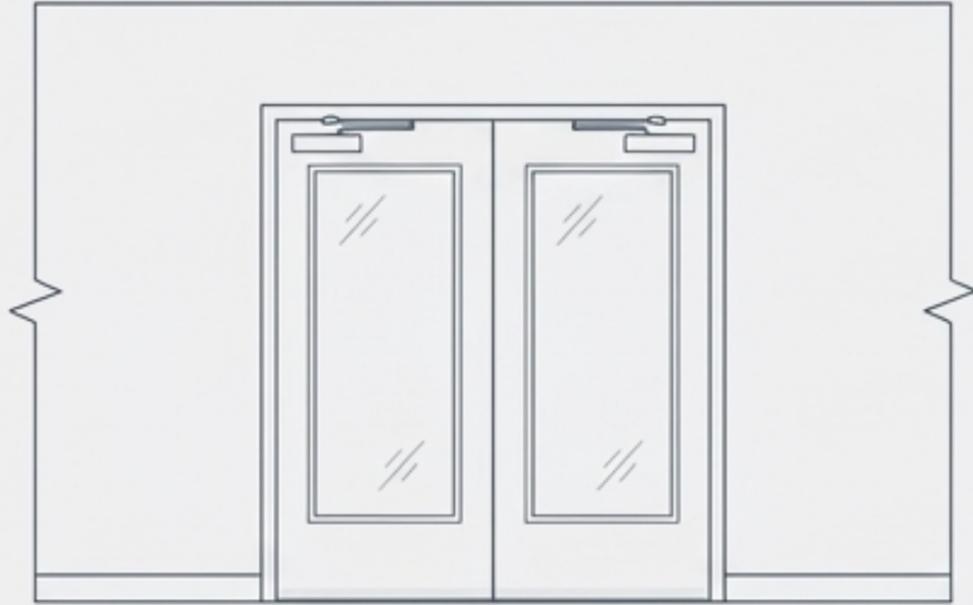
$$A/A_W = 0.00150$$



Floors and roofs

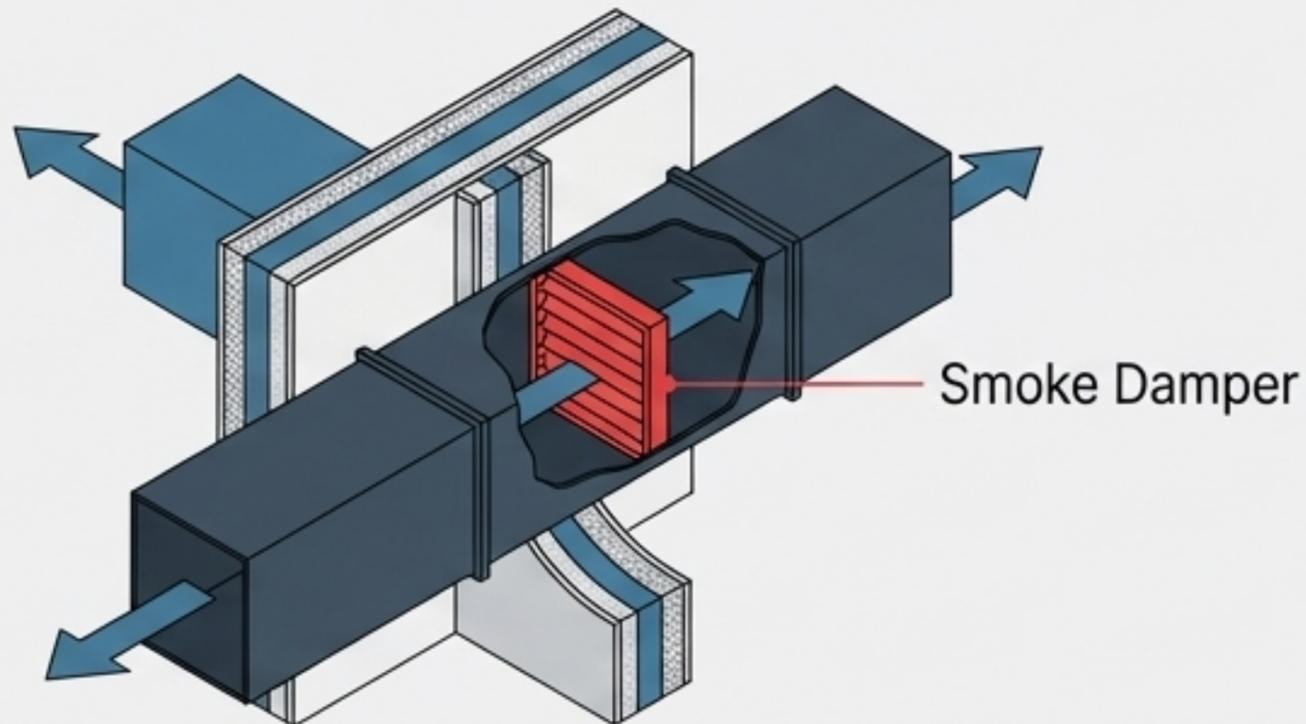
$$A/A_F = 0.00050$$

# Protecting Openings and Air Transfers



**General Rule:** Openings require automatic-closing devices actuated by mechanical smoke control controls (513.5.3).

**Institutional Exceptions (Group I-1 Cond 2, I-2, Ambulatory):** Opposite-swinging corridor doors do not require standard protection if they are close-fitting, have no center mullion, have max 3/4-inch (19.1 mm) undercuts, and utilize automatic closing by smoke detection with approved vision panels (513.5.3, Exception 3 & 513.5.3.1).

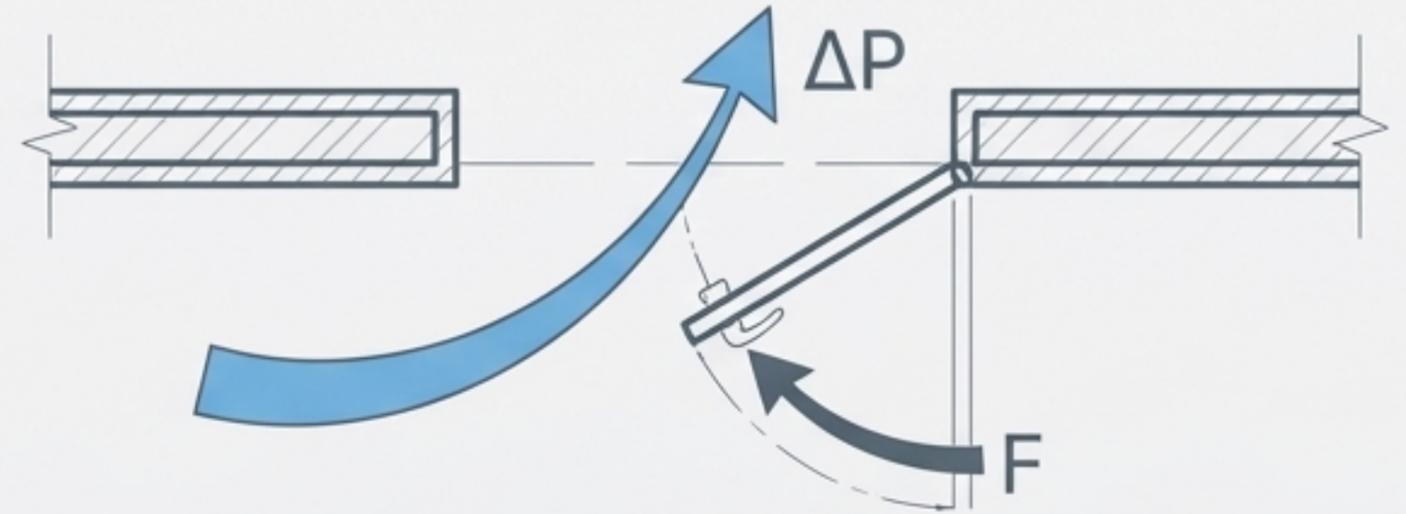


**Ducts & Air Transfers:** Must be protected with a minimum Class II, 250°F (121°C) smoke damper (513.5.3.2).

# Method 1: The Pressurization Method

**Pressure Baselines:** The primary mechanical means of controlling smoke. Minimum pressure difference is 0.05-inch water gage (12.4 Pa) in fully sprinklered buildings. In unsprinklered buildings, it must be  $\geq 2x$  the maximum calculated pressure difference of the design fire (513.6.1).

**Maximum Limits:** Maximum pressure is dictated by the force required to open/close doors.

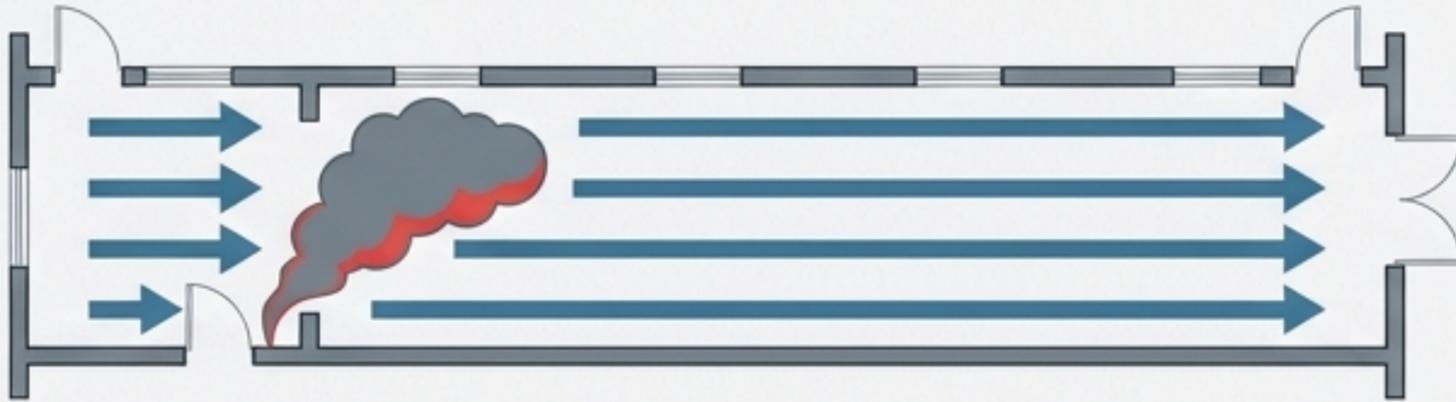


$$F = F_{dc} + \frac{[K (A) (\Delta P)]}{2(W - d)}$$

A = Door area  
d = Distance from handle to latch  
F = Total opening force

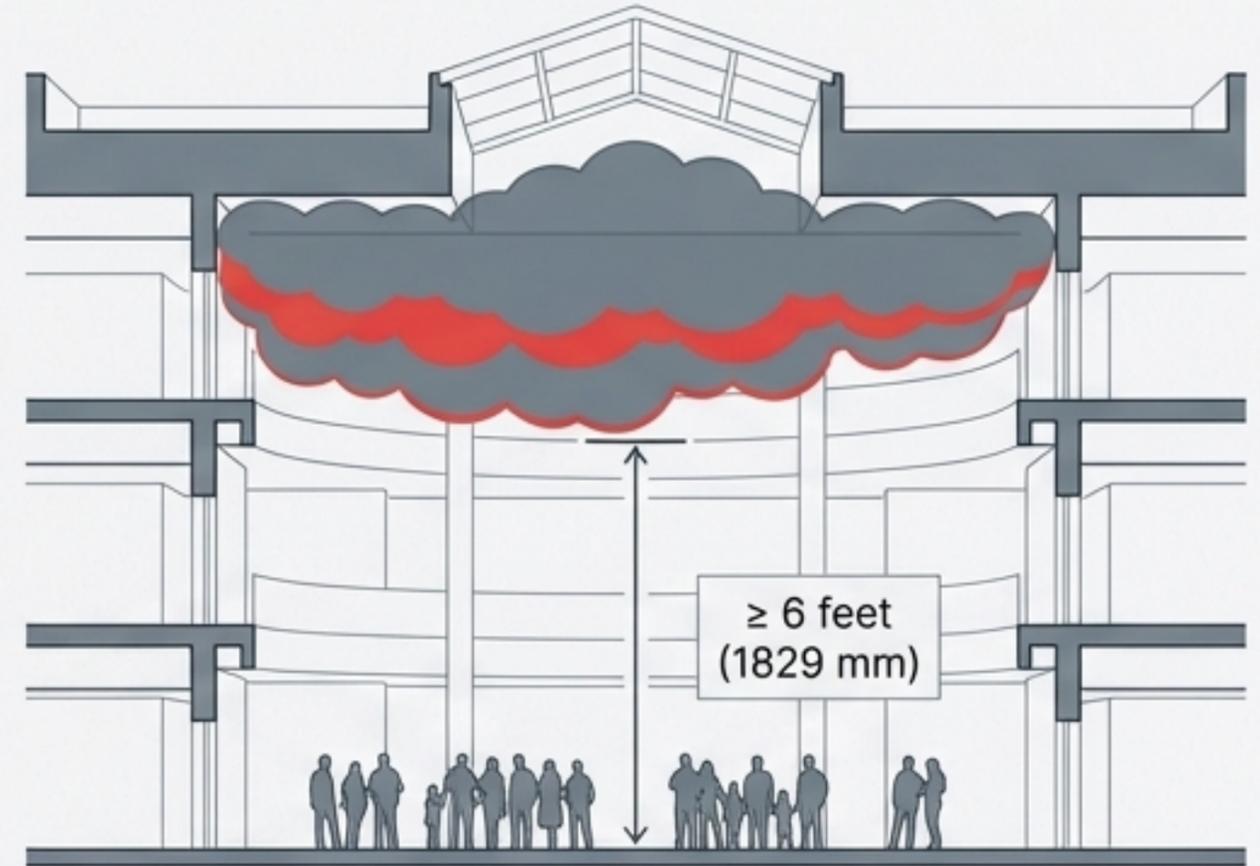
$F_{dc}$  = Closing device force  
K = Coefficient 5.2  
W = Door width  
 $\Delta P$  = Design pressure difference

# Methods 2 & 3: Airflow and Exhaust



## Airflow Method

- Used for fixed openings between zones to limit smoke migration.
- Strict Limit: Airflow toward the fire cannot exceed 200 feet per minute (1.02 m/s). Exceeding this prohibits the use of the airflow method (513.7.1).
- Must consider geometry to prevent flow reversal from turbulence (513.7).



## Exhaust Method

- Applied to large enclosed volumes like atriums or malls.
- Strict Limit: The lowest horizontal surface of the accumulating smoke layer must be maintained at least 6 feet (1829 mm) above any walking surface forming a required egress system (513.8.1).

# Equipment and Duct Construction Standards

## Structural Support

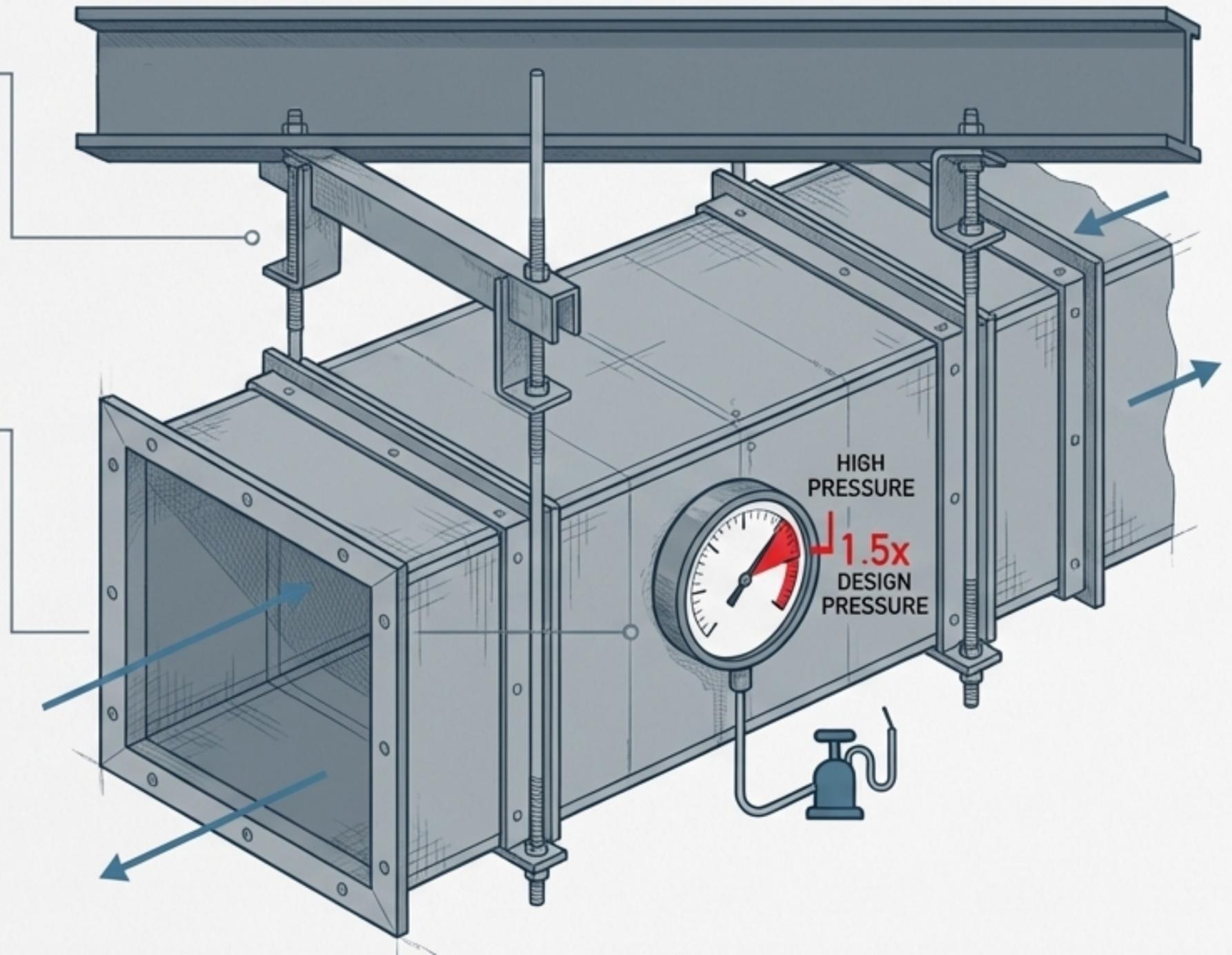
Ducts must be supported directly from fire-resistance-rated structural elements using substantial, noncombustible supports (513.10.2). Vibration exception permitted only if constructed of approved fire-resistance-rated materials.

## Mandatory Leak Testing

- Test Pressure: 1.5 times the maximum design pressure.
- Pass Criteria: Measured leakage shall not exceed 5 percent of design flow (513.10.2).

## Placement Strategy

Outdoor air inlets and exhaust outlets must be located to minimize the potential for reintroducing smoke/flame into uninvolved portions of the building (513.10.3).



# Exhaust Fan Specifications and Thermal Ratings

## Thermal Ratings

$$T_s = T_a + \frac{Q_c}{(c \times m)}$$

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$c$  = Specific heat of smoke

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$m$  = Exhaust rate

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$Q_c$  = Convective heat output

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$T_a$  = Ambient temp

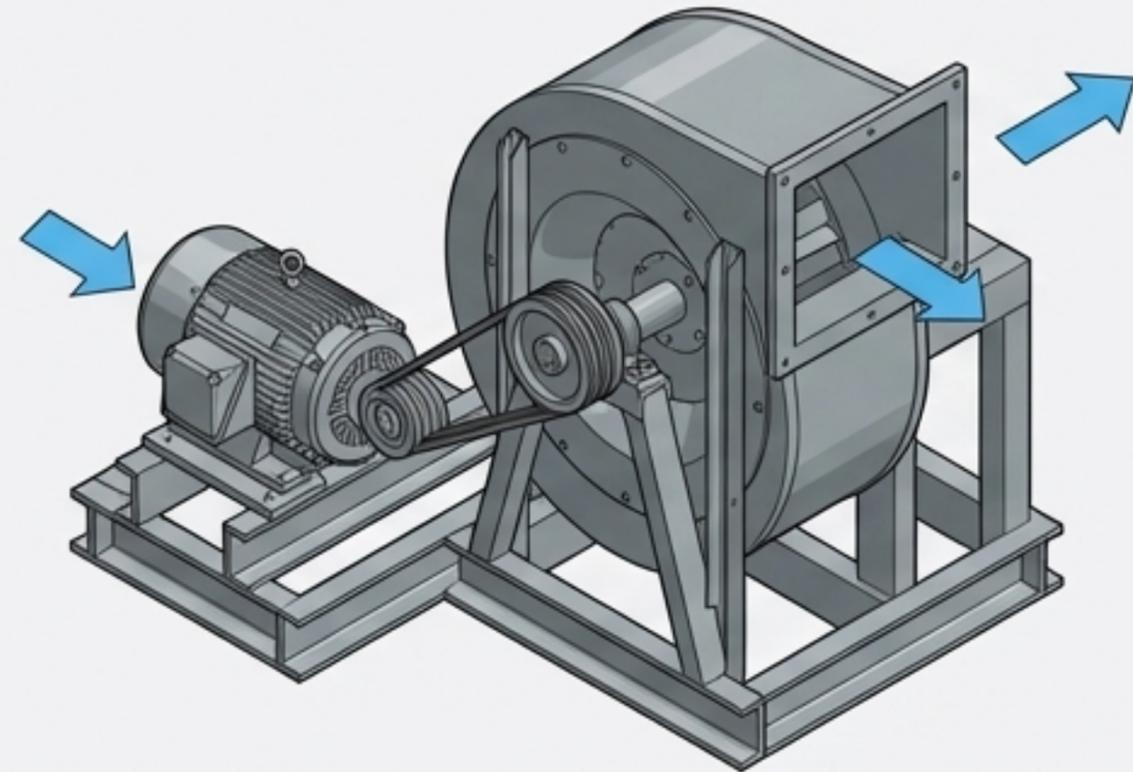
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$T_s$  = Smoke temp

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Fans must be certified for the probable temperature rise computed by Equation 5-2 (513.10.1).

## Mechanical Specifications



**Mechanical Redundancy:** Belt-driven fans must have 1.5 times the number of belts required for design duty (minimum of two belts) (513.10.5).

**Motor Standards:** Motors cannot operate beyond nameplate horsepower under actual current draw and require a minimum service factor of 1.15. Fans must be supported by noncombustible devices (513.10.5).

# Standby Power and System Reliability

## Isolated Equipment Room

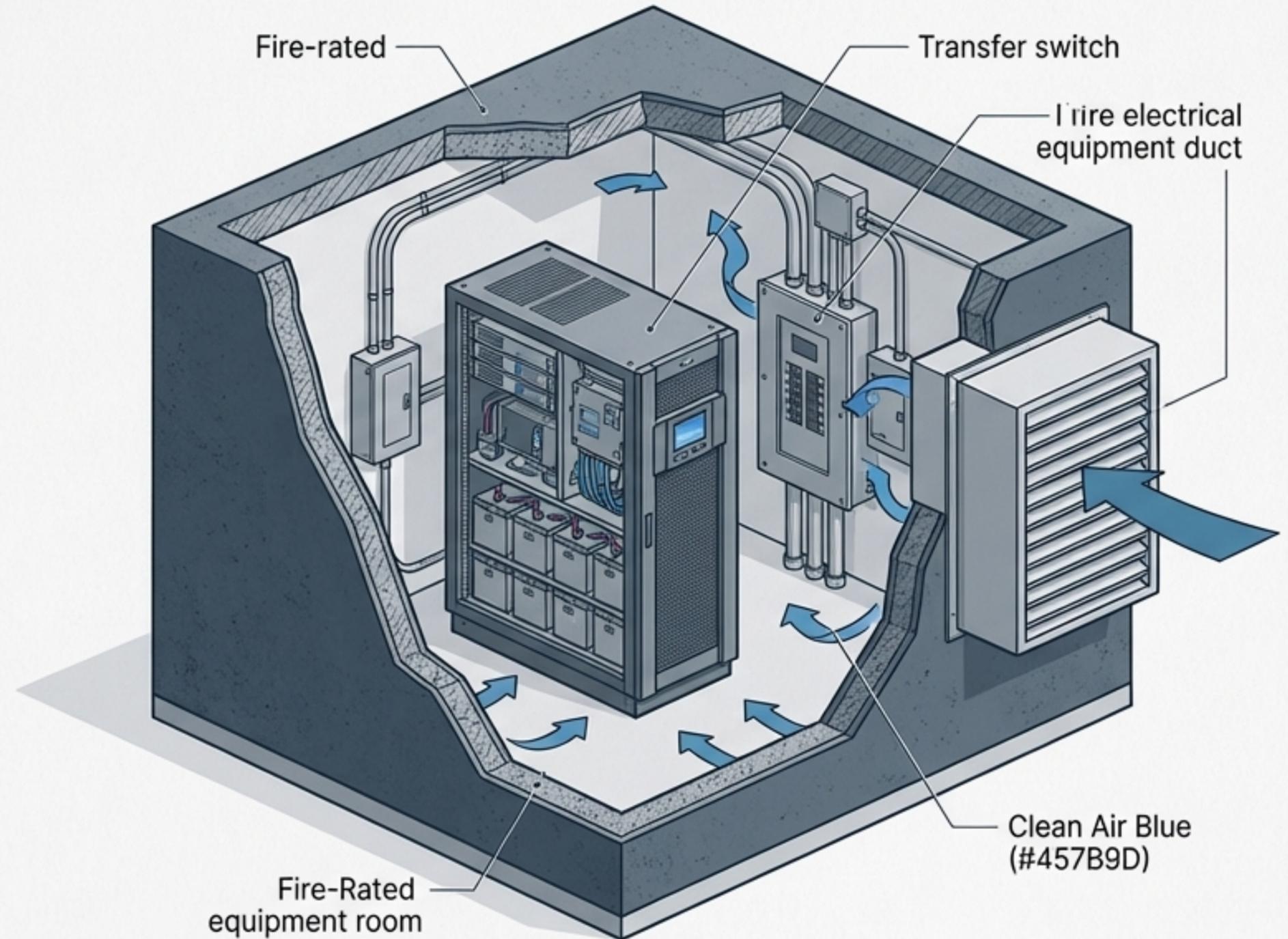
The standby power source and transfer switches must be housed separately from normal power transformers/switchgear. The room requires direct exterior ventilation and a minimum 1-hour fire-resistance-rated enclosure (513.11.1).

## Uninterruptible Power (UPS)

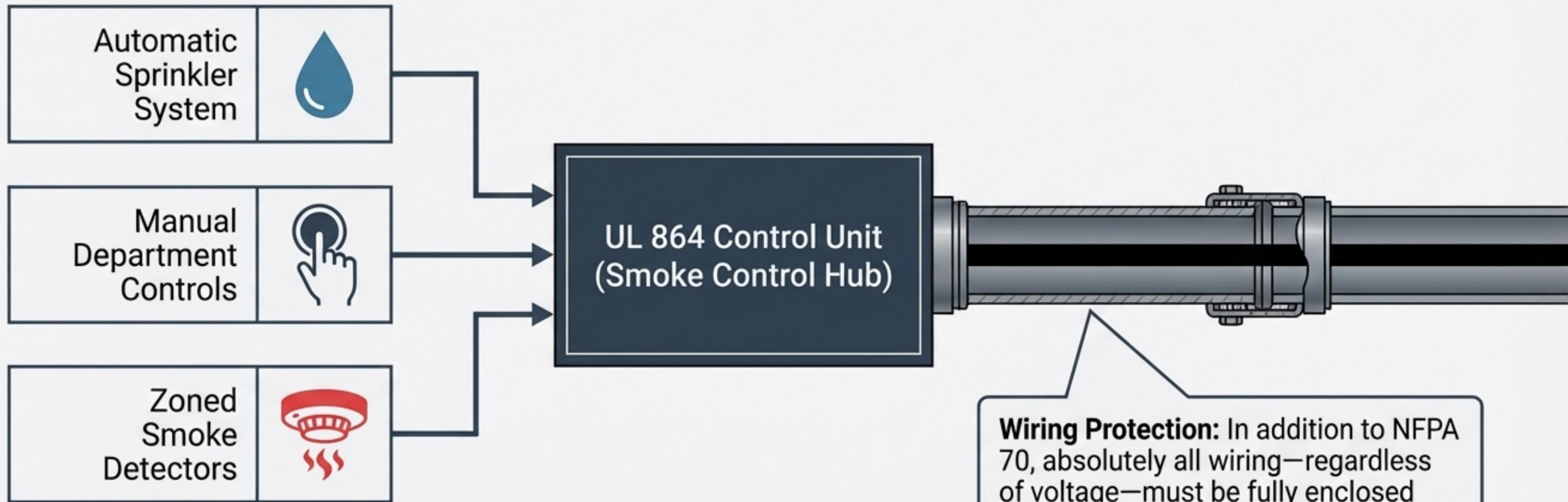
Any system element relying on volatile memory must be supplied with a UPS capable of spanning a 15-minute primary power interruption (513.11.2).

## Surge Protection

Elements susceptible to power surges must be protected by dedicated conditioners or suppressors (513.11.2).

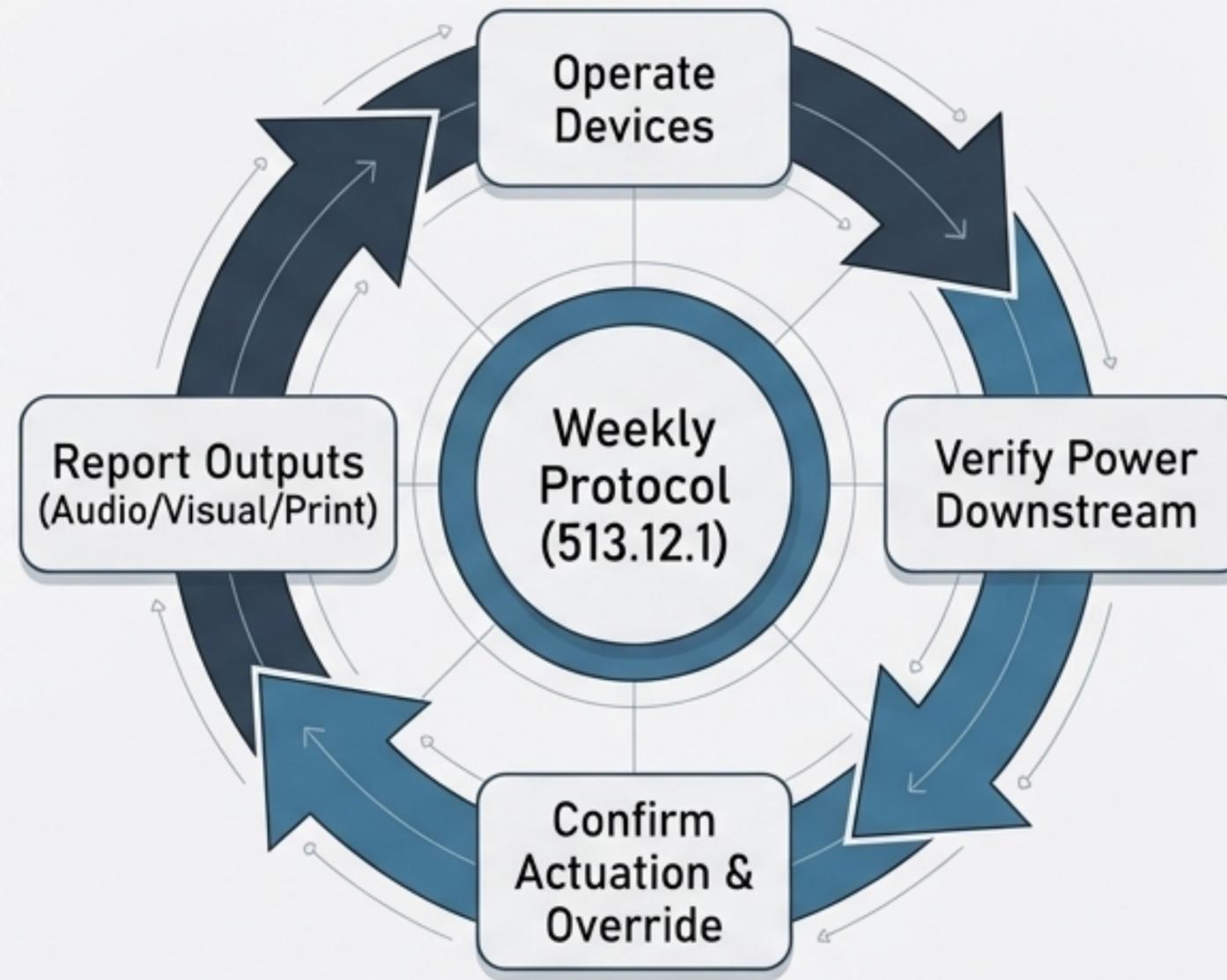


# Detection Integration and Control Wiring



**Automatic Activation:** Sequences must initiate from an appropriately zoned automatic sprinkler system, readily accessible manual controls, or required smoke detectors (513.12.4).

# Continuous Verification and Testing Sequences



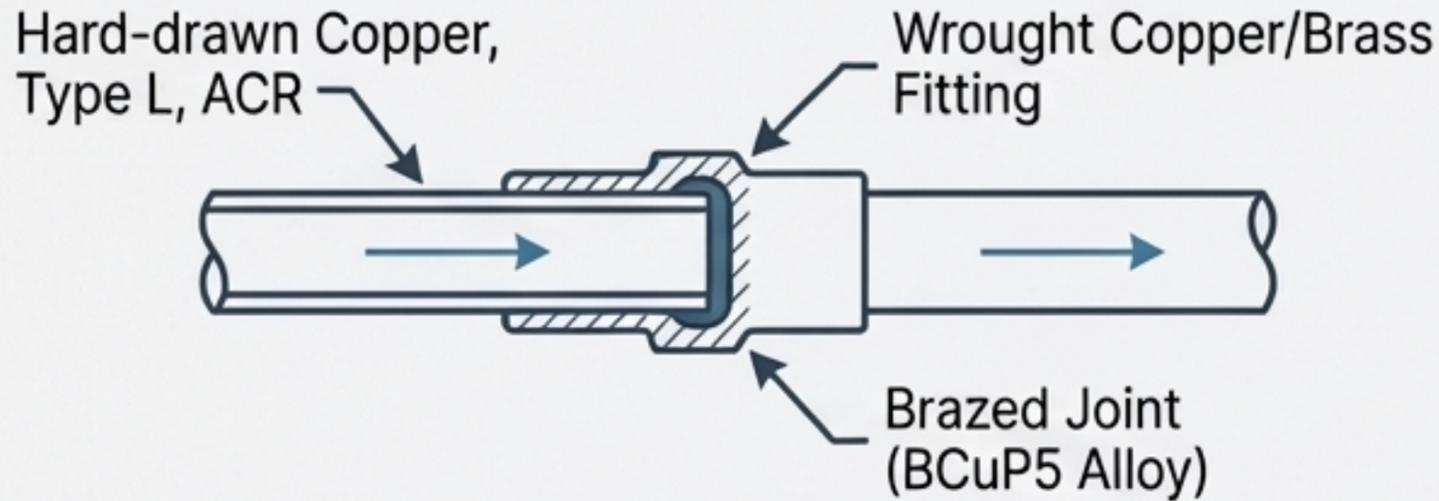
## Bypass Exceptions

Components can be bypassed from weekly testing if testing interferes with normal building operations, provided:

1. Presence of power downstream of all disconnects is still verified weekly by a listed control unit.
2. Bypassed components are tested according to the wider Florida Fire Prevention Code schedules.

# Control-Air Tubing Specifications

## Standard Material

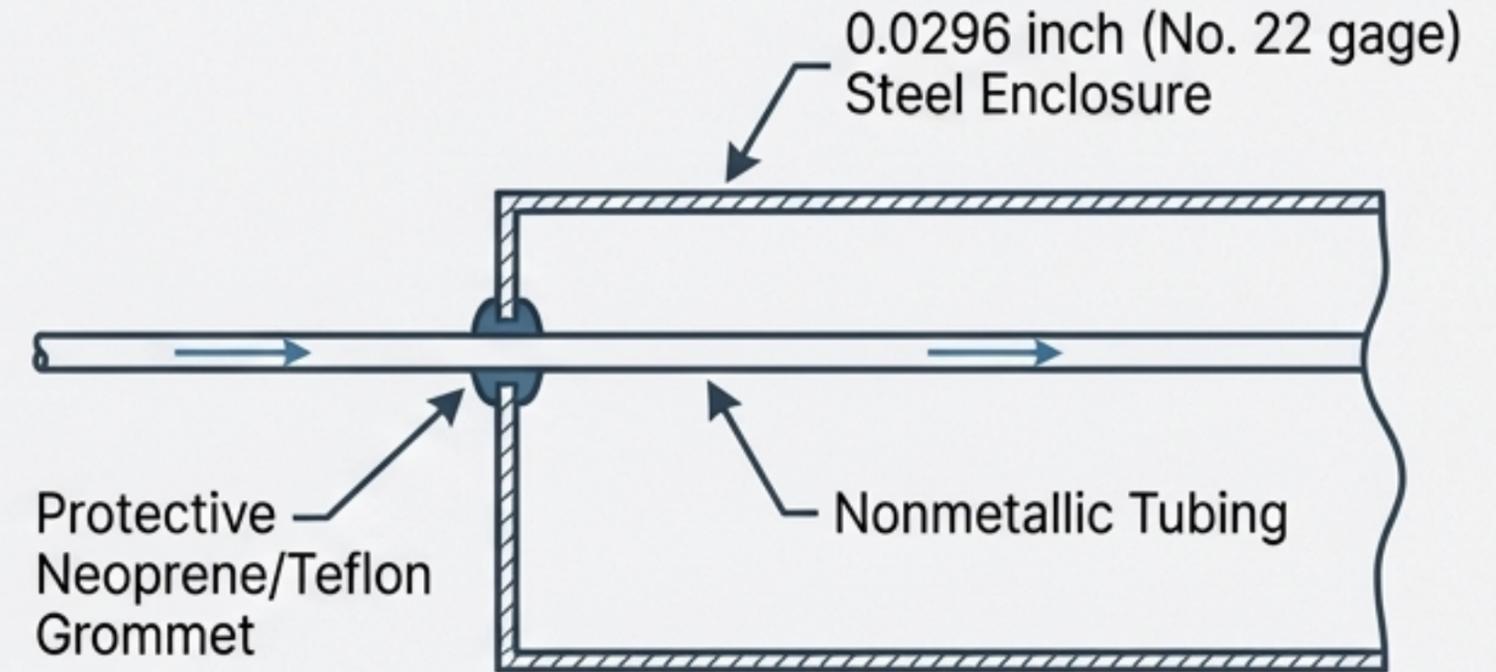


Hard-drawn copper, Type L, ACR. Fittings must be wrought copper or brass. Joints brazed using BCuP5 alloy (solidus > 1,100°F, liquids < 1,500°F) (513.13.1).

## System Testing

Tubing must be tested at 3 times the operating pressure for at least 30 minutes with zero noticeable loss in gauge pressure prior to final device connections (513.13.3).

## Nonmetallic Exceptions



Allowed only within control panels/final connections if completely enclosed in a minimum 0.0296 inch (No. 22 gage) steel enclosure with protective neoprene/Teflon grommets, documented coding, and adequate support (513.13.1).

# Final Compliance, Interface, and Acceptance

## ✓ Clear Identification

Detection and control systems must be clearly marked at all junctions, accesses, and terminations (513.14).

## ✓ First Responder Interface

A dedicated fire fighter's smoke control panel must be provided exclusively for emergency response, accompanied by identical control diagrams maintained on-site (513.15, 513.16).

## ✓ Final Handoff

System response times, acceptance testing of all components/sequences, and ultimate system acceptance fall under the strict jurisdiction of the Florida Fire Prevention Code (513.17 - 513.19).

