Special Inspections For
High-Rise Building Smoke Control Systems
For Compliance with the Florida Building Code: Mechanical

by

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Introduction

This course describes the commissioning process necessary to meet the overall approach to smoke management for high-rise building smoke control projects in the State of Florida. It also describes the coordination of commissioning the smoke control system with commissioning of related building systems. Commissioning criteria is established by the Special Inspector in accordance with the prescriptive and performance requirements from the Smoke Control Rational Analysis as described in Section 909 of the 2007 Edition of the Florida Building Code and Section 513 of the 2007 Edition of the Florida Building Code: Mechanical. Section 403.15 of the Florida Building Code requires smoke control be provided in high-rise buildings, which is defined as buildings having floors used for human occupancy over 75 feet in height above the lowest level of fire department vehicle access. Section 909 of the Florida Building Code applies to mechanical or passive smoke control systems when they are required by other provisions of the Florida Building Code. The smoke control system is required to meet the performance requirements of Section 909 of the Florida Building Code with an exception for I-2 occupancies that otherwise comply with occupancy specific alternative criteria, which is outside the scope of this course. Further, Section 403.13 of the Florida Building Code requires high-rise exit stairways be constructed as smokeproof enclosures in accordance with Section 909.20. The pressurization option is covered herein, being the most common and pragmatic means of compliance in most high-rise applications. Note that elevator pressurization need not be considered when elevator lobbies are provided in compliance with the performance criteria based solely on the standard elevator shaft vents in accordance with Section 3004.1 of the Florida Building Code. Where provided as an alternative to such elevator lobbies, elevator shaft pressurization must be in accordance with Section 707.14.2 of the Florida Building Code.
Definitions

The following terminology is used herein, even though these terms may not be explicitly defined in the text of the Florida Building Code:

“Active Smoke Zone” – Smoke control zone that uses mechanical equipment, such as fans and dampers, to limit the movement of smoke.

“Passive Smoke Zone” – Smoke zone that uses fire resistance rated smoke barriers to limit the movement of smoke.

“Smoke Zone” – A space enclosed by passive or active smoke zone boundaries, not less than the floor of fire origin, within which occupants are provided exit access to required exits.

“Smoke Zone Boundary” – A continuous perimeter, vertically and horizontally, around a smoke zone, including: wall, floor, or ceiling assemblies.

“Smoke Control System” – The active and passive systems within the high-rise building that work either singly or collectively to establish a tenable environment for the evacuation or relocation of occupants in adjacent smoke zones by limiting smoke migration from the zone of fire origin. As such, the Florida Building Code intends that occupants within smokeproof enclosures and adjacent to the zone of fire origin must not be exposed to harmful concentrations of combustion products. Take note, this does not mean no exposure at all, but rather that any concentrations to which occupants are exposed be within allowable limits. Where multiple floors are open to each other they are considered a single zone, such as contiguous parking levels.

“Smoke Barrier” – This term is directly defined by FBC Section 702.1. Cautionary Note: the FBC does not always require corridor construction in accordance with the FBC's definition of a Smoke Barrier, depending on the Occupancy classification. For example, FBC Section 1017.1 sets forth that Use Group B corridors in a fully sprinklered building (as is the case in high-rise buildings) need no fire resistance rating. This situation is Code compliant from either the FBC,
or the Florida Fire Prevention Code for that matter. Furthermore, FBC Section 709.3 defines the minimum construction of a Smoke Barrier to include "a 1 hour fire resistance rating." Since FBC Section 1017.1 states Use Group B corridors are not required to have any FRR and Section 709.3 requires a minimum 1 hour FRR to be considered as a Smoke Barrier, it follows that the corridors in such a case cannot be set forth as Smoke Barriers within the bounds of the FBC.

The smoke control requirements applicable for a high-rise building are found in Section 909. The 'active' pressurization method is defined in language from FBC Sections 909.5 and 909.6, which are specifically limited to Smoke Barriers by reference to Section 709. Therefore, treating corridors as Smoke Barriers in a high-rise office building is simply not founded within the language of the Code.

**Special Inspector**

A qualified smoke control system Special Inspector is required to be retained independently for the purpose of verifying compliance of smoke control system installations in high-rise buildings as prescribed by Florida Building Code Section 909.18. All mandatory inspections, as required by the Florida Building Code, must be performed by the Authority Having Jurisdiction. Inspections performed by the Special Inspector are in addition to the mandatory inspections performed by the Authority Having Jurisdiction.

A complete report of smoke control system testing must be prepared by the Special Inspector. The special inspection report must include identification of all devices by manufacturer, nameplate data, design values, measured values and identification tag or mark. Test and Balance data must be collected by a flow and pressure testing professional (AABC or NEBB certified) under the supervision of the Special Inspection Agency.

Notarized Affidavits are typically filed with the Authority Having Jurisdiction by the Special Inspector and in some cases by the Owner also. Often this filing is required at the time of initial project permit application. Some jurisdictions use standard forms for this purpose.
Sample Affidavit for Smoke Control Special Inspector

Building/Mechanical Department

I (We) have been retained by ___________________________ to perform the special inspector services under the Florida Building Code 909.18.8 at the ______________________________________ project on the below listed structures as of ________________ (date). I am a registered professional fire protection engineer licensed in the State of Florida.

Permit Number(s): ________________ 

SPECIAL INSPECTOR FOR SMOKE CONTROL

909.18.8.3 Reports. A complete report of testing shall be prepared by the special inspector or special inspection agency. The report shall include identification of all devices by manufacturer, nameplate data, design values, measured values and identification tag or mark. The report shall be reviewed by the responsible registered design professional and, when satisfied that the design intent has been achieved, the responsible registered design professional shall seal, sign and date the report.

909.18.8.3.1 Report filing. A copy of the final report shall be filed with the building official and an identical copy shall be maintained in an approved location at the building.

I, (we) will notify the Building/Mechanical Department of any changes regarding authorized personnel performing inspection services.

I, (we) understand that a Special inspector inspection log for each building must be displayed in a convenient location on the site for reference by the Building/Mechanical Department Inspector. All mandatory inspections, as required by the Florida Building Code, must be performed by the Building/Mechanical Department. The Building/Mechanical Department inspections must be called for on all mandatory inspections.

Inspections performed by the Special Inspector hired by the Owner are in addition to the mandatory inspections performed by the Department.

Further, upon completion of the work under the building permit, I will submit to the Engineer of Record at the time of final inspection the completed inspection logs and a sealed statement indicating that, to the best of my knowledge, belief and professional judgment those portions of the project outlined above meet the intent of the Florida Building Code and are in substantial accordance with the approved plans.

Professional Engineer - Special Inspector

Name__________________________________________ (PRINT)

Address________________________________________

Signed and Sealed

Phone No.______________________________________

Date:
Commissioning Protocol

The Special Inspector prepares the test protocol/data collection forms based on the smoke control RATIONAL ANALYSIS along with design and trade SUBMITTALS from the smoke control system's design and installation team.

RATIONAL ANALYSIS

Florida Building Code Section 909.4 requires that systems, means and methods of construction used for smoke control be based on a Rational Analysis, which is prepared in accordance with established principles of engineering. As a minimum, the rational analysis must address the following:

- Stack effect (Florida Building Code Section 909.4.1)
- Temperature effects of fire (Florida Building Code Section 909.4.2)
- Wind effects (Florida Building Code Section 909.4.3)
- HVAC system effects (Florida Building Code Section 909.4.4)
- Climatic effects (Florida Building Code Section 909.4.5)
- Duration of Operation (Florida Building Code Section 909.4.6)

The Rational Analysis results must be confirmed as demonstrating compliance with Florida Building Code Section 909 with respect to the smoke control system's design basis. The Rational Analysis must demonstrate that the high-rise building's features in terms of altitude, elevation, weather history, and interior temperatures are taken collectively into consideration. The Rational Analysis results must establish that these features do not adversely interfere with the smoke control system’s capabilities, including the ability to maintain a minimum pressure differential across the exit stairwell doors, associated exit passageways, and elevator shafts along with other horizontal and vertical smoke control zone boundaries. Total pressure differentials modeled across smoke zone boundaries are a minimum 0.05-inches water column.
Stack Effect

The stack effect becomes more pronounced as the height of each space and the building itself increases, and as the temperature differential between the interior and exterior becomes greater. Stack effect is most pronounced in shafts with continuous columns of air.

Typically, equal but opposite pressure differentials exist above and below the neutral plane of any space, which usually occurs around the mid-height of the volume in the absence of complex exterior openings onto the building interior. Take note, pressure differentials arising from the stack effect in spaces having minimal height are usually negligible. Such spaces typically include individual floors or rooms less than thirty feet in height. Otherwise, the pressure differentials driven by the stack effect would allow smoke generated on a lower floor to move to upper levels via shafts as a result of normal winter stack effect, whereas the opposite would occur for summer temperature inversions.
The American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) in the text *Design of Smoke Management Systems*, has published the following equations, which are used to characterize the stack effect:

from 3.20 ASHRAE, Equation (1):
\[ \Delta P_{so} = (\rho_o - \rho_s)g\zeta \]

Equation (1) can be simplified if the ideal gas law, \( P_{atm} = \rho RT \) is applied. Substituting for density, we arrive at the following:

from 3.22 ASHRAE, Equation (2):
\[ \Delta P = \frac{gP_{atm}}{R} \left( \frac{1}{T_o} - \frac{1}{T_i} \right)z \]

Assuming standard atmospheric pressure, Equation (2) may be further simplified:

from 3.22a ASHRAE, Equation (3):
\[ \Delta P = K_s \left( \frac{1}{T_o} - \frac{1}{T_i} \right)z \]

where:

\( \Delta P = \) Pressure differential (in. water gage)
\( \Delta P_{so} = \) Pressure differential from shaft to outside (in. water gage)
\( g = \) Universal gravitational constant
\( K_s = \) Coefficient (7.64)
\( \rho_o = \) Density of air outside the shaft
\( \rho_s = \) Density of air inside the shaft
\( R = \) Gas constant of air
The height of a building often will determine the working range for pressurized shafts in consideration of influences like the stack effect on required minimum pressure differentials and the maximum allowable pressures, such as when excess pressure will interfere with the operation of egress doors. In these cases, full height shafts may need multi-point air injection and relief, modulating controls, and even shaft breaks to segment the overall height into smaller, more manageable columns of air.

Fig 3a: example of upper and lower zone separation within pressurized smokeproof enclosures

Sample Front Entry:
Fig 3b: example of upper and lower zone separation within pressurized smokeproof enclosures

Sample Front Entry:

Section View

- intermediate landing
- floor landing above
- floor landing
- smoke tight construction between up and down stringers between floor landing and intermediate landing
- new vestibule
Additionally, the door opening forces must be demonstrated to be below 30-lbf for the largest doors used in the project's stairwells:

\[ F = F_R + \frac{K_d W A \Delta P}{2(W - d)} \]

Where:

- \( F \) = total door-opening force (lbf)
- \( F_R \) = force to overcome the door closer (lbf)
- \( W \) = door width (ft)
- \( A \) = door area (ft\(^2\))
- \( \Delta P \) = pressure difference across the door (in. H2O)
- \( d \) = distance from the doorknob to the knob side of the door (ft)
- \( K_d \) = coefficient (5.20)

**Fire Temperature Effects**

Section 909.4.2 of the Florida Building Code intends that the buoyancy and expansion relating to gases produced by the design fire be addressed. It is the intent of the Florida Building Code that the potential impact of design fires on the particular fire protection systems and passive barrier systems present in a high-rise building be examined. Based upon the analysis, logical steps can be taken to reduce the probability of smoke migration from the zone of fire origin to surrounding smoke zones.

The production of gases and smoke is dramatically reduced as a result of the cooling effects of water. Further, the heat release rates (HRRs) of sprinkler-controlled fire scenarios are typically far less than those observed for similar uncontrolled fire scenarios, thereby limiting smoke production.

According to the principles of smoke control design, buoyancy forces of heated gases are a direct result of the density differential between the heated and unheated or relatively unheated gases within a space.
ASHRAE Equations (1), (2), and (3) presented above can be applied to arrive at the pressure differential between zones outside the zone of fire origin.

On the conservative basis that the heated gases within the zone of fire origin must be cooled by sprinklers to some temperature below 250°F, application of the above equations demonstrates that only minor pressure differentials must be achieved. Sprinkler controlled fires actually are expected to develop smoke temperatures of 165°F based upon NFPA 92B, *Standard for Smoke Management Systems in Malls, Atria, and Large Spaces*, where even this value is conservative once mixing and cooling effects are considered. The larger a given space, the greater the heat losses must be to the surroundings as the hot gas layer is diluted, which causes the progressively smaller pressure gradient. Rooms with low ceiling heights and sprinkler controlled fires generate very small pressure gradients in the zone of fire origin as a result of buoyancy effects. The minimum 0.05 inches-water gage pressure differential to the zone of fire origin is therefore sufficient to overcome expected buoyancy-based pressures in rooms other than large open spaces, e.g. atria.

Smoke movement is caused also by expansion of the heated gases produced by a fire. The degree to which the hot gases expand, causes migration to adjacent spaces, which again depends on whether sprinklers are present and the leakage paths between the zone of fire origin and the adjacent zones. The ratio of the volumetric flows (into and out of the zone of fire origin) is expressed as a ratio of absolute temperatures:

\[
\frac{Q_{\text{out}}}{Q_{\text{in}}} = \frac{T_{\text{out}}}{T_{\text{in}}}
\]

from 3.27 ASHRAE, Equation (4):

Therefore, for the sprinklered high-rise building, the hot gases would expand only about 1.25 to 1.5 times the volume of the gases at ambient room temperature, depending on the upper layer temperature, reasonably assuming negligible heat losses to the walls, etc. Reducing the temperature of the hot gas layer by sprinklering the building, creates an environment where the effects of expansion on smoke migration during a fire are pragmatically insignificant.
Wind Effects

Florida Building Code Section 909.4.3 indicates that the adverse effects of wind be considered. The effects of wind pressures, which are generated between the windward and leeward sides of the building, cause leakage from the outside to the inside as a significant influence on interior pressures and associated air movement within the building. Further, placement of intake and relief vents for smoke control must consider the impact of wind and the possibility of reintroduction of smoke into the mechanical systems of the building in question.

from 3.28 ASHRAE, Equation (5):

\[ P_w = \frac{1}{2} KC_w \rho_o V^2 \]

where:

- \( P_w \) = Pressure that wind exerts on building surface (windward side)
- \( C_w \) = Pressure coefficient (dimensionless variable – reference Table 2 below)
- \( K \) = 0.0129
- \( \rho_o \) = Outside air density
- \( V \) = Wind velocity (varies as function of height according to Equation (6))
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Equation (6):

\[ V = V_o \left( \frac{z}{z_o} \right)^n \left( \frac{H}{z_H} \right)^n \]

where:

- \( V_o \) = Reference Velocity (ft)
- \( z \) = Elevation of boundary layer at reference (ft)
- \( z_o \) = Reference elevation (ft)
- \( z_H \) = Elevation of boundary layer (ft)
- \( H \) = Height of building (ft)
- \( n \) = Wind exponent (based on surrounding terrain – reference Table 1 below)

Table 1: Terrain Categories

<table>
<thead>
<tr>
<th>Terrain Category</th>
<th>Wind exponent value (( n ))</th>
<th>Boundary layer elevation (( z ))</th>
</tr>
</thead>
<tbody>
<tr>
<td>City Center with High-Rise buildings for half of structures upwind by at least 6600 feet</td>
<td>0.33</td>
<td>1,500 ft</td>
</tr>
<tr>
<td>Fringe Urban (low-rise buildings), Suburban (single family homes), and Wooded Spaces upwind by at least 6600 feet</td>
<td>0.22</td>
<td>1,200 ft</td>
</tr>
<tr>
<td>Generally Open Terrain with obstructions mostly less than 33 ft in height</td>
<td>0.14</td>
<td>900 ft</td>
</tr>
<tr>
<td>Open Unobstructed Areas, not more than 1600 ft upwind</td>
<td>0.1</td>
<td>700 ft</td>
</tr>
</tbody>
</table>

The impact of wind on the building's smoke control system is highly dependent on the layout and nature of openings into the building. Depending on whether the fire is on the windward or leeward side of the building, the pressure caused by wind may either facilitate the spread of smoke, or largely prevent smoke from moving out of the zone of fire origin.
### Table 2: Pressure Coefficients ($C_W$) for High-Rise Buildings

<table>
<thead>
<tr>
<th>Building Height Ratio</th>
<th>Building Plan Ratio</th>
<th>Wind Direction to Building</th>
<th>Windward Surface</th>
<th>Leeward Surface</th>
<th>Side Surfaces</th>
</tr>
</thead>
<tbody>
<tr>
<td>($h/w$) is greater than 0.5 but less than or equal to 1.5</td>
<td>($l/w$) is greater than 1.0 but less than or equal to 1.5</td>
<td>Long side windward</td>
<td>0.7</td>
<td>-0.25</td>
<td>-0.6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Short side windward</td>
<td>0.7</td>
<td>-0.25</td>
<td>-0.6</td>
</tr>
<tr>
<td></td>
<td>($l/w$) is greater than 1.5 but less than 4.0</td>
<td>Long side windward</td>
<td>0.7</td>
<td>-0.3</td>
<td>-0.7</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Short side windward</td>
<td>0.7</td>
<td>-0.1</td>
<td>-0.5</td>
</tr>
<tr>
<td>($h/w$) is greater than 1.5 but less than or equal to 6.0</td>
<td>($l/w$) is greater than 1.0 but less than or equal to 1.5</td>
<td>Long side windward</td>
<td>0.8</td>
<td>-0.25</td>
<td>-0.8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Short side windward</td>
<td>0.8</td>
<td>-0.25</td>
<td>-0.8</td>
</tr>
<tr>
<td></td>
<td>($l/w$) is greater than 1.5 but less than 4.0</td>
<td>Long side windward</td>
<td>0.7</td>
<td>-0.4</td>
<td>-0.7</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Short side windward</td>
<td>0.8</td>
<td>-0.1</td>
<td>-0.5</td>
</tr>
</tbody>
</table>

where:

- $h$ = Height of building in section view
- $w$ = Width of building in plan view (short side)
- $l$ = Length of building in plan view (long side)

Local temperature data is available from the National Climatic Data Center (NCDC) of the National Oceanic and Atmospheric Administration (NOAA) for the nearest station to the jurisdiction in which the high-rise building is located. Two and a half times the mean maximum wind speed (averaged over a typical year) is reasonable as the basis of analysis, in favor of the maximum/peak gusting wind speed that would be expected to occur only intermittently during the course of a year.
When using NCDC data take care to apply the data properly by understanding these terms:

Wind - Average Speed (MPH)

The average wind speed table is based on the speed of the wind regardless of direction.

Wind - Maximum Speed (MPH)

The maximum wind speed table expresses both a maximum wind speed for the stations and, where available, the direction (relative to true North) from which it blew. If the direction is expressed as one of the 16 compass points the maximum speed is calculated from the minimum time during which one mile of wind passed the station.

HVAC System Effects

Florida Building Code Section 909.4.4, directs the effect of the Heating Ventilation and Air Conditioning (HVAC) systems on the transport of smoke and fire must be considered and the system designed to prevent the transport of fire products through the use of combination smoke/fire dampers and automatic shutdown of HVAC equipment. Pressure differentials ranging from 0.05 to 0.30 inches water gage might be expected as a result of normal HVAC operations. Because these normal HVAC pressures are high enough to interfere with the minimum smoke boundary benchmark, all HVAC operations that are not essential to the operation of the smoke control (other than isolated units within passively separated spaces) should be shut down in order to minimize unwanted pressure differentials, unless such pressures are specifically addressed in the smoke control system design.
Climatic Effects

Section 909.4.5 of the Florida Building Code indicates that the smoke control system must address the effects of low temperatures on the system, property, and occupants of the building. Data from the National Climatic Data Center of the NOAA supports the assumption that the climate in Florida does not present the kind of extreme of cold or hot temperatures for considerations beyond normal and reverse stack effect influences.

Duration of Operation

Section 909.4.6 of the Florida Building Code indicates that the entire smoke control system, including all constituent components and subsystems be capable of operating for the greater of not less than 20 minutes or 1.5 times the calculated egress time.

SUBMITTALS

Submittals to be used by the Special Inspector must include architectural, mechanical, electrical, fire alarm, fire sprinkler and HVAC as necessary to demonstrate:

- passive and active smoke control zoning,
- sequences of operation,
- system plan view layouts and riser diagrams,
- equipment wiring and interconnection diagrams,
- product data - fans, ducts, dampers, control equipment, control interfaces and devices, monitoring interfaces and devices, fire detection devices and associated control/interface equipment
- coordination between life safety systems: fire alarm, sprinkler, and smoke control
- equipment identification and labeling schemes (cross-reference trade and design documents, if device identification is not uniform throughout submittals)
- power sources for all smoke control equipment (labeled by distribution panel and circuit breaker for all smoke control equipment and field devices)
General Considerations

Smoke management is achieved by providing effective compartmentation and mechanically induced pressure differentials. The nature and locations of leakage paths in a high-rise building drive the implementation of smoke control in the high-rise building. Primary leakage paths occur at the following points:

- At doors gaps around the top and sides of jambs
- In utility spaces such as telecomm, electrical rooms and mechanical rooms where cables, duct and conduit passes through the walls and floor slabs
- At kitchens and restrooms/bathrooms where pipes penetrate the floor and walls
- At curtain walls between the exterior wall and floor slab
- At shafts and walls near damper openings
- At elevator doors

Passive Smoke Control Systems

The following items are part of a passive system:

- Door closers, jamb seals/gaskets, astragals and adjustable sweeps on required doors.
- Firestopping in combination with mechanical fixtures to provide proper sealing of floor slab penetrations and the space between the floor slab and curtain wall (where applicable).
- Sealing the required gap between ducts and fire/smoke dampers.
- Taping and sealing larger gaps or cracks in the smoke barrier construction.

Passive system construction must comply with the requirements set forth in Chapter 7 of the Florida Building Code, such that smoke zones are completely separated from each other.

Smoke boundary doors must be tight fitting and cannot have louvers. Doors must be listed/approved for their use, and should be either self-closing or automatic-closing, by actuation of smoke detectors in accordance with Florida Building Code Section 907.10. Smoke tight doors must be installed with gaskets so that a UL1784 compliant seal is provided where the door meets the stop on both the sides.
and the top in accordance with FBC Section 710.5.2. Smoke and draft control doors listed in accordance with UL 1784 are tested with an artificial bottom seal installed across the full width of the bottom of the door assembly during the test. The door assembly may leak air up to 3 cubic feet per minute per square foot of door opening at 0.10 inch water column for both the ambient temperature test and the elevated temperature exposure test.

FBC Section 712.5 limits the air leakage rate of smoke barrier penetrations. Penetrations in smoke barriers are tested in accordance with the requirements of UL1479 for acceptable air leakage. The smoke barrier penetration assembly may leak air up to 5.0 cubic feet per minute per square foot of penetration opening at 0.30 inch of water for both the ambient temperature and elevated temperature tests.

Maximum leakage areas must have to correspond with those set forth in Florida Building Code Section 909.5:

- **Walls:** $A/A_W = 0.00100$
- **Exit Enclosures:** $A/A_W = 0.00035$
- **Elevator and Shaft Walls:** $A/A_W = 0.00150$
- **Floors and Roofs:** $A/A_W = 0.00050$
- **Stairwell Doors:** Minimally 0.169 sq. ft. of leakage/door

In consideration of mixed-approach smoke control systems, smoke dampers are not required:

- where the building is equipped throughout with an approved smoke control system in accordance with Florida Building Code Section 909, and smoke dampers are not necessary for the operation and control of the system or where the smoke damper will interfere with the operation of the smoke control system.
- in corridor penetrations where the duct is constructed of steel not less than 0.019-inch (0.48 mm) in thickness and there are no openings serving the corridor.
- in Use Group B bathroom and toilet room exhaust openings with steel exhaust subducts, having a wall thickness of at least 0.019 inches (0.48 mm) that extend at least 22 inches (559 mm) vertically and the exhaust fan at the upper terminus, powered continuously in
accordance with the provisions of Florida Building Code Section 909.11, maintains airflow upward to the outside.
- where the openings in ducts are limited to a single smoke compartment and the ducts are constructed of steel.

Treatment of elevator shafts depends upon the passive protection features provided. FBC Section 707.14.2.5 describes the application of an elevator shaft pressurization system where required elevator lobbies are optionally omitted. When required elevator lobby enclosures are provided in accordance with the FBC, the elevator shaft requires no pressurization. If the elevator shaft pressurization alternative is provided, the elevator pressurization system must activate directly by the elevator lobby smoke detectors or by means of the intermediary building fire alarm system. The described activation sequence matches the elevator recall sequence, which allows the shaft pressurization to activate only when the affected elevator bank is recalled. This operational sequence limits how much pressure is injected into the building - unless all shafts are automatically or manually recalled at the same time. Unilateral activation of all pressurization fans can be pragmatically problematic for effective smoke control. Accordingly, applying limited automatic activation sequences as described by the FBC for elevator shaft pressurization systems should be examined where pressure differentials are proving difficult to achieve under field commissioning. The difficulty may well be the result of simply too much air being supplied into the building without adequate natural means of relief, when considering the tightness of exterior wall construction inherent in modern, energy efficient high-rise buildings. Sufficient relief of pressurization systems becomes a concern that must be recognized and accommodated.
Active (Mechanical) Smoke Control Systems

Controls for each zone of the active smoke control system must be provided in the Fire Command Station at the Firefighter’s Control Panel. All components must be listed/approved and installed using a methodology appropriate to ensure the prescribed survivability as follows:

- Equipment including fans, ducts and dampers in accordance with Florida Building Code Section 909.10.
- Primary and secondary power systems in accordance with Florida Building Code Section 909.11.
- Detection and control systems in accordance with Florida Building Code Section 909.12.
- Control air tubing in accordance with Florida Building Code Section 909.13.
- Marking and Identification in accordance with Florida Building Code Section 909.14.
- Control Diagrams in accordance with Florida Building Code Section 909.15.
- Fire-fighter's smoke control panel in accordance with Florida Building Code Section 909.16.
- System Response Time in accordance with Florida Building Code Section 909.17.
- Acceptance Testing in accordance with Florida Building Code Section 909.18.

Upon any sprinkler water flow or fire alarm activation, except manual pull stations, the smoke control system must activate. Subsequent changes to the smoke control system must be limited manual operation from the Fireman's Over-ride Panel, unless the system capacities are capable of maintaining design pressures associated with any subsequent automatic changes from the initial smoke control sequence. Careful consideration must be also be given to automatic changes from the initial smoke control sequence when the likely, but limited, movement of smoke beyond the zone of fire origin occurs as the result of occupant evacuation through boundary doors.
System Implementation Requirements

This section is not intended to disclose all requirements listed/approved in Florida Building Code Section 909, but is intended to highlight those areas of design where some care is required to ensure that the system implementation in a high-rise building is adequately coordinated, according to the requirements presented in Section 909.10 through Section 909.18. All requirements in Section 909 must nevertheless apply, unless specifically noted otherwise.

EQUIPMENT

All equipment including, but not limited to, fans, ducts, and any dampers, must be suitable for their intended use and must be listed/approved for the probable temperatures for which these components may be exposed. Proper listings for this equipment must be obtained from the Nationally Recognized Testing Laboratory (NRTL) prior to installation. Nationally recognized testing laboratories can be verified in the Federal Register Online.

Ducts

Any ducts should be capable of withstanding the probable temperatures and pressures to which they are exposed from their point of origin to their required point of service.

For exhaust ducts, this encompasses all ductwork (from each required inlet within each required smoke zone) to the point of outlet at the building's exterior.

For relief ducts, this encompasses all ductwork between the primary inlet (at the point of relief in each required smoke zone) to the point of outlet.

For pressurization ducts, this encompasses all ductwork from the point of outside air intake at the building's exterior to the primary outlet (terminating at the boundary of each required smoke zone).
Interior ductwork extensions from outside air intake to stair and elevator pressurization fans (or interior fan room enclosure with equivalent fire resistant rating) and from fans to the boundary of the pressurized shaft/exit passageway must be protected by 2 hour fire resistive rating (FRR). Furthermore, such ducts must be leak tested to 1.5 times the maximum design pressure in accordance with nationally accepted practices. The maximum leakage cannot exceed 5 percent of the design flow after installation.

Outside air inlets and exhaust outlets must be located so as not to expose such inlets/outlets to the reintroduction of smoke into the building.

Duct Smoke Detectors

Duct smoke detectors in supply ducts must automatically shut down the related fan. If part of a smoke control system, a manual override must be provided at the Fire Command Center. Duct smoke detectors in return air systems over 2,000 cfm and serving multiple spaces must automatically activate the mechanical smoke control sequence.

Fans

The Florida Building Code, Section 909.10.1 requires that components of exhaust fans be rated and certified by the manufacturer for the probable temperature to which the components may be exposed. Pressurization fans need only be temperature-rated for exposure to outside air temperatures.

Please note that, in addition Section 909.10.5 requires belt-driven fans to have 1.5 times the number of belts required for the design duty, where the minimum number of belts is two. Calculations and manufacturer’s fan curves must be included as part of the documentation for the design. Motors driving these fans are required to have a minimum service factor of 1.15.
Dampers

Smoke and fire dampers need to be provided at the following locations:

- Smoke barriers (zone boundaries).
- Shaft enclosures and exit passageways.
- Fire-resistive construction in rated exit access corridors.
- Enclosed elevator lobbies.

Smoke/fire dampers must be monitored to verify proper position (open and/or close).

Barometric dampers are required where necessary to prevent over-pressurization of critical building elements, even where such zones are served by Variable Frequency Drive (VFD) controlled fans, which are subject to unregulated fan speed failure modes.

POWER SYSTEMS

Primary and secondary power is required for the smoke control. Transfer to full standby power must be automatic and must occur within sixty seconds of loss of primary power. Other response times listed in Section 909.11 apply after the power transfer is complete. The system must be capable of withstanding power outages by means of a continuous power supply or uninterruptible power supply (UPS) whenever components of the system possess volatile memory. Furthermore, a power surge protector or conditioner is included for those elements of the smoke management system that are susceptible to power surges. Among other services, the emergency generator(s) must supply power to the following systems, which are considered essential to the smoke control system.

- Fire alarm systems.
- Fire detection systems.
- Sprinkler alarm and supervisory systems.
- Smoke management equipment including panels and controls.
- Stair pressurization systems.
- Elevator shaft pressurization systems.
Other loads connected to the generator must comply with the National Electrical Code Section 700, regarding: capacity, rating, selective load pick-up, load shedding and peak load shaving requirements.

UPS sources provided for microprocessor-based equipment relying on volatile memory or requiring initialization upon restoration of power must be sized for 15 minutes of primary power loss to allow continuity until the generator is running under full power. At least one primary power shutdown must be performed for Acceptance Testing under secondary power operations.

DETECTION AND CONTROL SYSTEMS

All control systems must be supervised in accordance with the Florida Building Code. Positive confirmation of actuation, testing, manual override, device mechanisms, and the presence of power downstream of all disconnects must be provided. Fans that are used for smoke management must be monitored with listed/approved pressure sensors or load sensing current sensors to verify air flow. Dampers must be monitored using end switches and should be wired individually or in series (not less than two circuits should be used – one circuit for supply dampers and one circuit for exhaust dampers) or one signaling line circuit with modules indicating actual damper position. Complex systems capable of monitoring performance status may monitor the status of the smoke zone as a whole, rather than display the status of individual components of the smoke control system associated with the smoke zone. Such configurations are subject to the review and approval of the Authority Having Jurisdiction. In these cases, field located pressure sensors/transducers, e.g. static or differential pressure sensors, may be substituted where proper fan and damper positions are validated by satisfaction of required boundary conditions.

All required equipment status and supervision must be displayed at the firefighter’s over-ride panel, which must be listed/approved for its use, along with the smoke control-applied portions of the fire alarm and energy management systems.

UL 864 control equipment must be UUKL category compliant for application on smoke control systems, again including associated portions of the fire alarm and energy management systems, along
with their respective subsystems and components. All power and control wiring, regardless of its voltage, must be fully enclosed within continuous raceways, or similarly protected. Take note that this rigorous standard of care exceeds the minimum requirements otherwise normally applicable for fire alarm system and energy management systems as prescribed by NFPA 70, The *National Electrical Code*. Accordingly, those portions of these systems that are applied to smoke control applications often include, but are not limited to low voltage circuits serving:

- Smoke detection,
- Sprinker flow monitoring,
- Equipment status and fault monitoring,
- Control relays and modules, and
- Associated signaling line (data) circuits.

**CONTROL AIR TUBING**

Tubing for pneumatic controls for smoke control equipment must be hardened by utilization of hard drawn copper tubing complying with the Florida Building Code. Control air tubing must be of sufficient size to meet the required response times. Tubing must be flushed clean and dry prior to final connections and must be adequately supported and protected from damage. Tubing passing through concrete or masonry must be sleeved and protected from abrasion and electrolytic action. Control tubing serving other than smoke control functions must be isolated by automatic isolation valves or must be an independent system. Take note that while pneumatically operated equipment may be relatively less common in newer high-rise construction, remote pressure sensors/transducers and their tubing extensions to and from smoke control equipment and associated reference points remain a consideration.

**MARKING AND IDENTIFICATION**

The detection and control systems are required to be clearly marked at all junctions, accesses, and terminations. This marking should be approved for its use by the Authority Having Jurisdiction and in accordance with generally accepted practice. Furthermore, smoke barriers and smoke partitions must be permanently identified with signs or stenciling in a manner acceptable to the Authority having
Jurisdiction. Such identification shall be above any dropped ceiling and in concealed spaces.

CONTROL DIAGRAMS

Control diagrams that depict the devices in the smoke control system identifying their locations and functions must be current and kept within the building's Fire Command Center, along with file copies for the Authority Having Jurisdiction.

Inspections

The following represents inspection requirements that must be fulfilled by either the Authority Having Jurisdiction or the Special Inspector, as determined by the Authority Having Jurisdiction. Operational tests are to be performed on each smoke control system component and subsystem prior to acceptance testing. Such operational tests are to take place before interconnection of the individual components and subsystems to the smoke control system.

Verify automatic dampers, as follows: that automatic dampers installed within smoke-control systems are listed/approved and conform to the requirements of approved recognized standards. Verify that fire dampers are labeled for use in dynamic systems. Permanent access shall be provided to all dampers, actuators, and other concealed smoke control equipment/devices. Ceiling access panels shall be provided in hard ceilings, where necessary for compliance. Wall access panels shall be provided in shafts/walls, where necessary for compliance. Access panels shall be fire resistive rated (FRR), wherever installed in FRR ceiling/shaft/wall assemblies. Smoke control damper blades shall be accessible for visual inspection, servicing and adjustments (by means of permanently installed access panels in the ductwork), wherever such dampers are not otherwise accessible by means of fixtures. Visual inspection of actuator shafts (located external to the duct) is not an acceptable alternative to the required access.
Verify control diagrams, as follows: that the location of all fire alarm initiating devices corresponds to control diagrams. Verify the location of all output devices (dampers, fans, automatic doors, controls/actuators, conductors, junction points) are installed according to the approved control diagrams. Verify that fire alarm initiating devices which activate smoke-control devices are properly zoned in accordance with the respective smoke-control zone. This includes automatic sprinkler systems. Early phase testing and inspection of duct leakage, smoke/fire damper visual, freedom of movement, and continuity test/inspection may be permitted without approved control diagrams. The smoke management control diagrams must be submitted to the Authority Having Jurisdiction prior to commencement of testing of smoke control equipment.

Fig 4: This exposed duct smoke detector sampling tube located across an air plenum opening will never work correctly.
Fig 5: This properly rated fire door is located in a passive smoke barrier, but is missing a UL 1784 compliant jamb seal.
Verify fan belts, as follows: that belt-driven fans have 1.5 times the number of belts required for the design duty, where the minimum number of belts is two.

Fig. 6a: Incorrect fan belt configuration

Fig. 6b: Correct fan belt configuration
Verify identification marking, as follows: that the equipment, detection and control systems are clearly marked at all junctions, accesses, and terminations. Note that junction boxes, cover plates, and conduit couplings may be color coded as an acceptable means of infrastructure identification.

Fig. 7: These dampers require individual, permanent field ID tags that match the control diagrams.
Fig. 8: The final cable connection to the damper actuator from this damper control module is not in EMT for proper physical protection:

Ducts must be verified as being protected by, and supported directly from, fire-resistance-rated structural elements of the building by substantial, noncombustible supports. Except where flexible connections (for the purpose of vibration isolation) comply with the Florida Building Code, Mechanical by nature of being constructed of approved fire-resistance-rated materials. The Florida Building Code includes provision for fire-resistance-rated duct materials and fan protection wherever elevator shaft and stairwell pressurization fans are located in or traverse interior spaces of the high-rise building.
Fig. 9: The duct penetration of the floor slab has a fire damper, but this stair pressurization relief duct must be extended and fire resistive rated all the way to the exterior for proper compliance.

Outside air inlets must be verified as located so as to minimize the potential for introducing smoke or flame into the building. Exhaust outlets must be verified as located so as to minimize reintroduction of smoke into the building and to limit exposure of the building or adjacent buildings to an additional fire hazard.
Testing Procedures

Environmental conditions that are present during all acceptance activities must be documented, including temperature, wind speed and direction.

Verify smoke control equipment action and priority order, as follows:

- that the firefighter's over-ride panel (FOP) has priority over other building systems such as: building management or automatic temperature control systems [ATC, BAS, BMS, EMCS, etc.] in smoke control mode.
- that the firefighter's over-ride panel functions in accordance with its design intent.
- that doors, fans, and dampers are configured properly and that the appropriate status indication light is lit upon status change on the firefighter's over-ride panel.

Verify controls, as follows:

- that each smoke zone has been put into operation by the actuation of one automatic initiation device, including sprinkler water flow. Verify that each additional device within the zone (this includes sprinkler zones) has been verified to cause the same sequence, but the operation of fan motors may be bypassed after the first few positive trials to prevent damage.
- positive confirmation of actuation, testing and manual override from the Fireman's Override Panel in the Fire Command Center.
- control sequences throughout the system, including verification of manual override from firefighter's control panel (override must be verified for both normal and automatic smoke control sequences).
- operation under stand-by power conditions and verification of smoke-control system operations from the firefighter's control panel.
- operation of the automatic weekly self-test by the smoke control system.
The FOP status indicators must be provided for all smoke control equipment by LED indicators as follows:

- Fans, dampers and other operating equipment in their normal status—WHITE.
- Fans, dampers and other operating equipment in their off or closed status—RED.
- Fans, dampers and other operating equipment in their on or open status—GREEN.
- Fans, dampers and other operating equipment in a fault status—YELLOW/AMBER.

A lamp-test push button or other self-restoring means must be included to test the firefighter’s control panel. Fault status for each component or subsystem must be identified. The graphical layout of the panel must be submitted to the Authority Having Jurisdiction prior to installation and acceptance. The firefighter’s control panel is required to provide control capability over the complete smoke control system within the building, as follows:

- “On/Auto/Off” control over each individual piece of operating smoke control equipment, or groups of equipment as approved by the Authority Having Jurisdiction, where such equipment can also be controlled from other sources within the building.
- “Open/Auto/Close” control over all individual dampers, or groups of dampers as approved by the Authority Having Jurisdiction, relating to smoke control where such equipment can also be controlled from other sources within the building.

Local personnel-safety disconnects located at the equipment do not require over-ride capability from the smoke control system or Fireman's Over-ride Panel.

Any modulating dampers or variable speed fans must display their proper performance through positive feedback of appropriate field sensors. Fault indications must be provided through the FOP from such equipment wherever any conditions exist that might interfere with the activation of equipment from the smoke control system. Instances of such conditions even include local “on/auto/off” control capability.
Verify new dampers and new smoke barrier doors, as follows: that dampers and smoke doors have been tested for functionality as installed while under pressures expected from the smoke control mode.

Verify duct smoke detectors are flowing the required air through the detector housing. Manufacturers publish in their product data the acceptable pressure differential range, for validating the air flow rate – as installed – is within the minimum and maximum operational air flow range of the device's listing or approval. The measurement is made across the inlet and outlet tubes of the detector housing with a manometer.

Verify sprinkler flow and new automatic fire detection devices, as follows: that smoke or fire detectors which are a part of the smoke control system are tested in accordance with NFPA 72, National Fire Alarm Code, by the installing contractor(s) in their final installed condition.

Verify control air tubing, as follows: that control air tubing must be tested at three times the operating pressure for not less than 30 minutes without any noticeable loss in gage pressure prior to final connection to devices.

Verify duct inlets and outlets, as follows: that inlets and outlets have been read using generally accepted practices to determine air quantities and submitted with final Special Inspection report.

Verify duct and shaft construction, as follows:

- that ducts/shafts are pressure tested to 1.5 times the maximum design pressure. Long runs of duct work whose volume exceeds the capability of available leakage testing apparatus may be tested in shorter segments, with allowable leakage based on the sum of all segments, to determine cumulative leakage for the entire duct (measured leakage must not exceed five percent of the design fan flow serving the duct).
- that ducts which are part of a smoke control system have been traversed using generally accepted practices to determine actual air quantities.
Verify fans, as follows:

- that motors driving fans do not operate beyond their name plate horsepower (kilowatts) as determined from measurement of actual current draw or kW meter.
- that fan blades have correct directional rotation.
- that measurements of voltage, amperage, revolutions per minute and belt tension have been made.
- the proper operation of air flow sensors.
- that on-board normal duty equipment safety devices for motors with VFD controllers do not shut down the fan (standard factory settings are prone to do so when not properly adjusted for the smoke control field application)

Verify pressurized stair enclosure such that at least 0.05-inch water gage minimum and 0.35 maximum (regardless, not to exceed 30 lbs pull force to open entry doors and 15 lbs pull force to complete swing). Measurements must be made relative to each smoke proof enclosure entrance door on the fire floor for each test scenario. The measurements must be made with all stairwell doors closed.

Verify pressurized elevator shaft enclosure, such that at least 0.04-inch positive water gage minimum and 0.06 maximum. Measurements must be made relative to each elevator entrance door on the fire floor for each test scenario. This pressure must be measured at the midpoint of each hoistway door, with all ground floor level hoistway doors open and all other hoistway doors closed.

Verify active smoke zone boundaries, as follows: that measurements using calibrated equipment have been made of the pressure differences across smoke zone boundaries. Such measurements must be conducted for each possible smoke control scenario. One measurement must be made across each smoke barrier door or set of doors, and the data must clearly indicate the higher and lower pressure sides of the doors. The measurements must be made with all smoke zone boundary doors closed. Minimum 0.05 inches water gage pressure differentials are to be maintained between vertically adjacent zones and between vertically adjacent floors relative to the zone of fire origin.

Verify component response times, as follows: that control and actuation response times, as measured from the time the equipment being tested is actually commanded to operate or shut down, is the same...
for automatic and manual means of initiating smoke-control, as required (note that protection of equipment through time delays or staging of start commands, as permitted by the Florida Building Code is allowed). The smoke control system activation should be initiated immediately after receipt of the appropriate automatic or manual activation command. The components should be activated in the sequence necessary to prevent physical damage of the equipment and the total response time for the individual components to achieve their desired operating mode from when the component receives the signal should not exceed standard practice:

- Smoke damper closing/opening
- Fans starting/stopping or energizing/deenergizing
- Fan volume modulation
- Temperature control override
- Positive indication of system status
- Smoke door closing/opening
- Pressure control modulation
- Normal duty equipment safety override

Verify standby power, as follows: that full stand-by power is automatically serving smoke control equipment within 60 seconds of primary power failure and is capable of supporting all smoke control loads for not less than 20 minutes in duration.

Verify passive zones using door fan testing or equivalent pressure/leakage testing where possible. It may not be possible to conduct such testing in large volume spaces, in which case leakage may be tested with artificial smoke or a tracer gas. Significant smoke leakage between passive zones should be considered a failure, using the criteria for UL 1784 as prescribed by Section 715.3.3 of the Florida Building Code.

The number/percentage of passive zones to be pressure tested will be documented by the Architect/Engineer of Record. Calculations for all passive zones prepared by the Architect/Engineer of Record will be supplied to the Special Inspector. Testing will be conducted under the direction and control of the Special Inspector.
Smoke Testing

Commissioning smoke control systems with chemical smoke is not mentioned in Section 909 of the Florida Building Code, or the identical provisions of the Florida Mechanical Code. And, in the context of the means and methods laid out by FBC Section 909, the use of chemical smoke testing really has no relationship to the physics being calculated. To that end, FBC Section 909 and its referenced resources are all geared towards validating the fire physics with proper pressure differential testing across the zone boundaries for pressurization method smoke control systems.

The pressurization method testing process is essential to actually verifying the functional capabilities of the smoke control installation, as opposed to documenting unrelated movement of cold smoke. I say 'unrelated', because based on the functional criteria that must be properly configured to meet the physics behind the calculations, cold smoke testing doesn't accomplish anything compared to the testing laid out in nationally recognized NFPA 92A, *Standard for Smoke-Control Systems Utilizing Barriers and Pressure Differences*. And, since there is no foundation for smoke testing in FBC Section 909 for that same reason, the concept of creating a smoke bomb layouts for the purposes – and what end measurement criteria on which to set **pass** or **fail** – is not supported by FBC Section 909 for pressurization method commissioning.

The Special Inspector's scope of responsibilities as laid out by FBC Section 909 are specifically limited to establishing compliance with FBC Section 909. Accordingly, any inspections or tests not supported by FBC Section 909 are outside the purview of the Special Inspector, and as such, these kinds of activities must be performed directly by the Authority Having Jurisdiction making any such request. It is important to note that the Special Inspector must ensure such activities and their **pass** criteria do not interfere with the compliance criteria laid out in FBC Section 909 without formal approval of the Building Official as a sanctioned “alternative means of compliance.” Reference Section 104.11 of the FBC for a detailed explanation of the documentation process for “alternative means of compliance.” Such language resides only there, inasmuch as it is entire absent from Section 909 of the FBC and Section 513 of the FMC. Therefore, "alternative means of compliance" documentation is not part of the Rational Analysis or Special Inspector's scope, and in fact cannot be, since it is not the purview of those Code Sections.
There have been considerable advances in fire science, which have been developed since the "air changes per hour" and "exit sign obscuration" concepts were first conceived in the '70's. The “air changes per hour” and “exit sign obscuration” concepts have been found to fall short of addressing the adverse influences of hot gas bouyancy and expansion, wind, flow path geometry, fire dynamics, associated smoke production, and other building systems' interference with the smoke control system.

The FBC sets forth the use of passive and/or pressurization methods as solutions for this kind of high-rise structure. The pressurization method can be accomplished via negative pressure in the zone of fire origin (by means of relief/exhaust air), pressurization of the adjacent zones (by means of supply air) or a combination of the two. Pressurization of adjacent floors is not mandatory, and would only be necessary where calculations bear out the need to assist the exhaust from the zone of fire origin to some extent necessary to meet the minimum pressure differentials across the smoke zone boundaries.

This design concept accomplishes the Code intended encapsulation of the fire zone, just as passive construction alone could accomplish the same protection, both of which perform better than the old "air changes per hour," which only flushes the floor of cold chemical smoke without any real context for demonstrating performance under a real fire scenario -- all of these are considerations for which the most recent computer-based fire models and computations are able to account.

Furthermore, there is no currently available data from any nationally recognized research laboratory upon which to derive any relationship whatsoever between the obscuration of exit signage in the field from cold chemical smoke as opposed to actual products of combustion from a structure fire.

None of this discussion is intended to say cold smoke does not have its place, but I present this information only to help explain the limits to which chemical smoke is appropriately applied within the overall commissioning process.

FBC Section 909.6 stipulates that a tenable environment is not expected in the smoke control zone of fire origin. And, FBC Section 909.1 specifically limits the scope of the required smoke control systems.

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FBC Section 909 required smoke control systems are not intended to:

- Protect building contents
- Assist in restoring building operation
- Assist emergency response personnel with fire suppression or overhaul activities.

The usual result from chemical cold smoke testing is the unfortunate misleading of building occupants and first responders into a false sense of security.

Under careful consideration of these issues, the substitution of chemical smoke commissioning criteria for proper pressure testing methodology should be undertaken with extreme caution.

**Recording Tests and Failed Inspections or Tests**

The Special Inspector must document specific tests and inspections in the final Special Inspection report. The Special Inspector must provide the Special Inspection report documentation to the Chief Building and Mechanical Officials in the event that a failing test or inspection has not been corrected by the Contractor. Should the Contractor not correct the areas failing the test or inspections, a correction notice is given to the appropriate Contractor, with a copy of this notice provided to the Building's Owner. Re-testing or inspection must be rescheduled as soon as possible.
Final Reports

Reports must be in compliance with Section 909.18 of the Florida Building Code. Recording the inspection results and acceptance testing information as set forth in NFPA 92A, *Standard for Smoke-Control Systems Utilizing Barriers and Pressure Differences*, makes use of industry standard procedures for demonstrating the final smoke control system is installed and functioning in accordance with Section 909 of the Florida Building Code.

Completed inspection logs are to be included in the final report along with a sealed statement indicating that, to the best of the Special Inspector's knowledge, belief, and professional judgment, those portions of the project outlined by Section 909 of the Florida Building Code meet the intent of the Florida Building Code and are in substantial accordance with the approved plans. The flow and pressure testing professional must also sign and affix their Associated Air Balance Council (AABC) or National Environmental Balancing Bureau (NEBB) agency stamp to their Test and Balance results for the Smoke Control System, which also must be included with the final report. The final Special Inspection report must be reviewed by the responsible registered design professional (Engineer/Architect of Record) and, when satisfied that the design intent has been achieved, the responsible registered design professional must review and, as evidence of their approval, seal, sign and date the Special Inspection report before its final submission to the Building Official.

A copy of the final report must be filed with the Authority Having Jurisdiction with an identical copy maintained in the Fire Command Center.