

# **SMOKE DAMPERS**

## **A DECADE OF LESSONS LEARNED AND ISSUES WITH IMPLEMENTATION OF NBCC 2015/2020 CHANGES**

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# AGENDA

## 1. A short history

How did we get here and why?

## 2. The Codes and what changed

Brief overview of the related codes

## 3. How do we implement these changes?

A technical overview of how these code changes have been met.

## 4. Challenges and issues with implementations

What is working and what isn't in the current installation solutions to meet the code.

## 5. Issues with annual inspections of smoke dampers

## 6. Questions and discussion

How do we see this going in our area?

# **1. A BRIEF HISTORY - SMOKE DAMPERS AND NBC 2015**

# **A BRIEF HISTORY OF SMOKE DAMPERS**

*The NFPA documented the importance of damper smoke controls many times:*

*- 1939 National Board of Fire Underwriters recommended that dampers be installed in HVAC systems to interrupt the passage of smoke, flame, and heat during a fire.*

*- According to the NFPA, fire deaths due to smoke inhalation outnumber deaths due to burns by a 2-1 margin from 2002, it was even worse (3-1 margin) prior to 1999. It is estimated that smoke inhalation is the primary cause of death in 60-80% of burn victims each year. Thousands of fire fighters are injured due to smoke inhalation each year.*

*- Even under a successful sprinkler suppression, smoke is still generated and can travel through duct openings if not properly isolated.*

# **WHY THE CHANGE?**

***The NRC comments on the introduction of the 2015 NBC smoke dampers:***

## ***Installation Of Smoke Dampers***

***To reduce the likelihood of smoke spreading into egress paths, smoke dampers or combination fire/smoke dampers are now required in ducts or air transfer openings when, in specific locations, they penetrate an assembly required to be a fire separation.***

## **2. THE CODES, AND WHAT HAS CHANGED?**

# REQUIREMENT FOR DUCT SMOKE DETECTORS

The basic requirement for duct smoke detectors in a building as per NBC (previous versions included)

## 3.2.4.12. Prevention of Smoke Circulation

- 1) If a fire alarm system is installed, an air-handling system shall be designed to prevent the circulation of smoke upon a signal from a duct-type smoke detector if the air-handling system
  - a) serves more than one storey.
  - b) serves more than one suite in a storey, or
  - c) serves more than one fire compartment required by Sentence 3.3.3.5.(2). *(This is for care, treatment or detention occupancies where more than 10 occupants are sleeping and must be split into multiple fire compartments).*

# SMOKE DAMPERS AND THE NBC

## Smoke dampers do not appear in the body of the 2010 NBC at all

- Smoke dampers are mentioned in the appendix – article 9.32.1.2 sentence (2)
  - The phrase “smoke dampers” is only in the appendix for secondary suites in residential private dwellings and it is there to discourage their use in limiting smoke movement in those instances.
    - A-9.32.1.2.(2) Application of Subsection 9.32.3. and Ventilation of Houses Containing a Secondary Suite.

*Ventilation for Smoke Control -The control of smoke transfer between dwelling units in a house with a secondary suite, or between the dwelling units and other spaces in the house, is a critical safety issue. Although providing a second ventilation system to serve the two dwelling units is expensive—and potentially difficult in an existing building—it is necessary to achieving a minimum acceptable level of fire safety. Alternative solutions to providing separate ventilation systems for the dwelling units must address smoke control. **Although smoke dampers restrict the spread of smoke by automatically closing in the event of a fire, their installation in a ventilation system that serves both dwelling units in a house with a secondary suite is not considered to be a workable solution because they are very expensive, require regular inspection and maintenance, and must be reset after every activation.***

# SMOKE DAMPERS AND THE NBC

Smoke Dampers first appear in the body of the 2015 NBC (same in 2020)

## • 3.1.8.7 Location of Fire and Smoke Dampers

- (1) Except as permitted by Article 3.1.8.8., a *fire damper* having a *fire-protection rating* conforming to Sentence 3.1.8.4.(2) shall be installed in conformance with Article 3.1.8.10. in ducts or air-transfer openings that penetrate an assembly required to be a *fire separation*.
  - **Fire dampers are now clarified for when and how to install compared to 2010 NBC**
- (2) Except as provided in Article 3.1.8.9., a smoke damper or a combination smoke/fire damper shall be installed in conformance with Article 3.1.8.11. in ducts or air-transfer openings that penetrate an assembly required to be a *fire separation*, where the *fire separation*,
  - (a) separates a *public corridor*,
  - (b) contains an egress door referred to in Sentence 3.4.2.4.(2),
  - (c) serves an *assembly, care, care and treatment, detention or residential occupancy*, or
  - (d) is installed to meet the requirements of Clause 3.3.1.7.(1)(b) or Sentence 3.3.3.5.(4).
- **Smoke dampers are now added for 'when' to install compared to 2010 NBC and continue on to the 'where'...**

# SMOKE DAMPERS AND THE NBC

## Smoke Damper installation in the body of the 2015 / 2020 NBC

### 3.1.8.11 Installation of Smoke Dampers

- (1) Where smoke dampers are used as a *closure* in an air-transfer opening, they shall be installed in the plane of the *fire separation*.
- (2) Where combination smoke and *fire dampers* are used as a *closure* in a duct, they shall be installed within 610 mm of the plane of the *fire separation*, provided there is no inlet or outlet opening between the *fire separation* and the damper.
- (3) Except as required by a smoke control system, smoke dampers and combination smoke and fire dampers shall be configured so as to close automatically upon a **signal from an adjacent *smoke detector* located as described in CAN/ULC-S524, “Installation of Fire Alarm Systems”**, within 1.5 m horizontally of the duct or air-transfer opening in the fire separation,
  - (a) on both sides of the air-transfer opening, or
  - (b) in the duct downstream of the smoke damper or combination smoke/fire damper.

# SMOKE DAMPERS AND THE NBC

## Smoke Damper installation in the body of the 2015 / 2020 NBC

### 3.1.8.11 Installation of Smoke Dampers

- (3) Except as required by a smoke control system, smoke dampers and combination smoke and fire dampers shall be configured so as to close automatically upon a **signal from an adjacent smoke detector located as described in CAN/ULC-S524. "Installation of Fire**

#### **\*WHAT IS A SMOKE DETECTOR?**

*Smoke detector* means a **fire detector** designed to operate when the concentration of airborne combustion products exceeds a predetermined level.

*Fire detector* means a device that detects a fire condition and automatically **initiates an electrical signal to actuate an alert signal or alarm signal** and includes *heat detectors* and *smoke detectors*. **Fire detectors required by this Code SHALL be connected to the fire alarm system (NBCC 2020 – 3.2.4.10 (1))**

*Alarm signal* means an audible signal transmitted throughout a *zone or zones* or throughout a *building* to advise occupants that a fire emergency exists.

*Alert signal* means an audible signal to advise designated persons of a fire emergency.

# SMOKE DAMPERS AND THE NBC

## Smoke Damper installation in the body of the 2015 / 2020 NBC

### 3.1.8.11 Installation of Smoke Dampers

- (3) Except as required by a smoke control system, smoke dampers and combination smoke and fire dampers shall be configured so as to close automatically upon a **signal from an adjacent smoke detector** located as described in CAN/ULC-S524, "Installation of Fire

#### ***\*Another Opinion...***

***Some jurisdictions and authorities believe that this statement is purely stating that the detectors need to be located as described in CAN/ULC-S524 and that this statement isn't requiring detectors to be under any other requirement in relation to S524.***

# **SMOKE DAMPERS AND THE NBC**

## **Smoke Damper installation in the body of the 2015 / 2020 NBC**

### **3.1.8.11 Installation of Smoke Dampers**

- 4) Smoke dampers or combination smoke/fire dampers shall be installed in the vertical or horizontal position in which they were tested.
- 5) A tightly fitted access door shall be installed for each smoke damper and combination smoke/fire damper to provide access for their inspection and the resetting of the release device. (See Note A-3.1.8.10.(5).).

# SMOKE DAMPERS AND THE NBC

## 3.1.8.9. Smoke Dampers Waived

- 1) Except as provided in Sentence (2), the requirement for smoke dampers or combination smoke/fire dampers stated in Sentence 3.1.8.7.(2) is permitted to be waived for ducts
  - a) that serve commercial cooking equipment (see also Article 6.3.1.7.),
  - b) in which all inlet and outlet openings serve not more than one fire compartment, or
  - c) that penetrate a vertical fire separation referred to in Clause 3.3.1.7.(1)(b) or in Sentence 3.3.3.5.(4), provided
    - i) the movement of air is continuous, and
    - ii) the configuration of the air-handling system prevents the recirculation of exhaust or return air under fire emergency conditions.

*Clause c) refers to floor areas that are separated for barrier-free access to egress (3.3.3.5 is for care and treatment occupancy). These fire compartments are for getting people out quickly and thus they have allowed some of these conditions to not require smoke dampers, based on other fire separation design already being enforced.*

# SMOKE DAMPERS AND THE NBC

## 3.1.8.9. Smoke Dampers Waived

2) The requirement for smoke dampers or combination smoke/fire dampers stated in Sentence 3.1.8.7.(2) is permitted to be waived for noncombustible branch ducts having a melting point above 760°C that penetrate a fire separation,

a) provided the ducts

i) have a cross-sectional area not more than 0.013 m<sup>2</sup> and serve only air-conditioning units or combined air-conditioning and heating units discharging air not more than 1.2 m above the floor,

ii) extend not less than 500 mm inside exhaust duct risers that are under negative pressure and in which the airflow is upward as required by Article 3.6.3.4., or

iii) are required to function as part of a smoke control system, or

b) where the fire separation separates a vertical service space from the remainder of the building, provided each individual duct exhausts directly to the outdoors at the top of the *vertical service space*

# **3. HOW DO WE IMPLEMENT THESE CHANGES?**

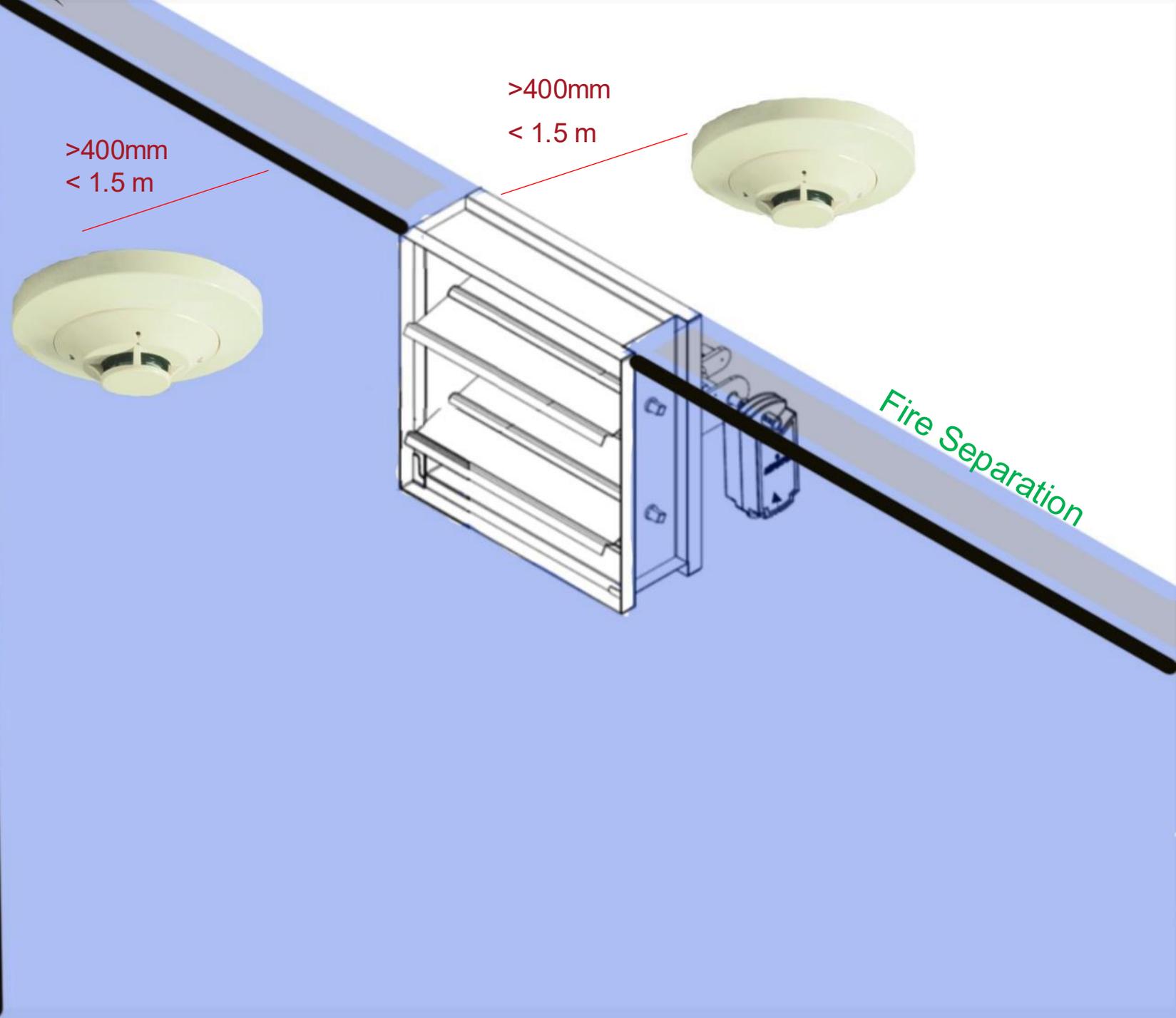
**A technical overview of how these changes are being met**

### 3.1.8.11 Installation of smoke dampers:

close automatically upon a signal from an adjacent *smoke detector* located as described in CAN/ULC-S524, "Installation of Fire Alarm Systems", within 1.5 m horizontally of the duct or air-transfer opening in the fire separation,

(a) on both sides of the air-transfer opening, or...

- What does the ceiling space look like on either side of the air transfer opening? Make sure that SD is in same ceiling space as damper (not above ceiling tiles)
- Is there clearance for the detectors as per S524 for spacing of smoke detectors?
- Can we use the smoke detectors in the hallway?

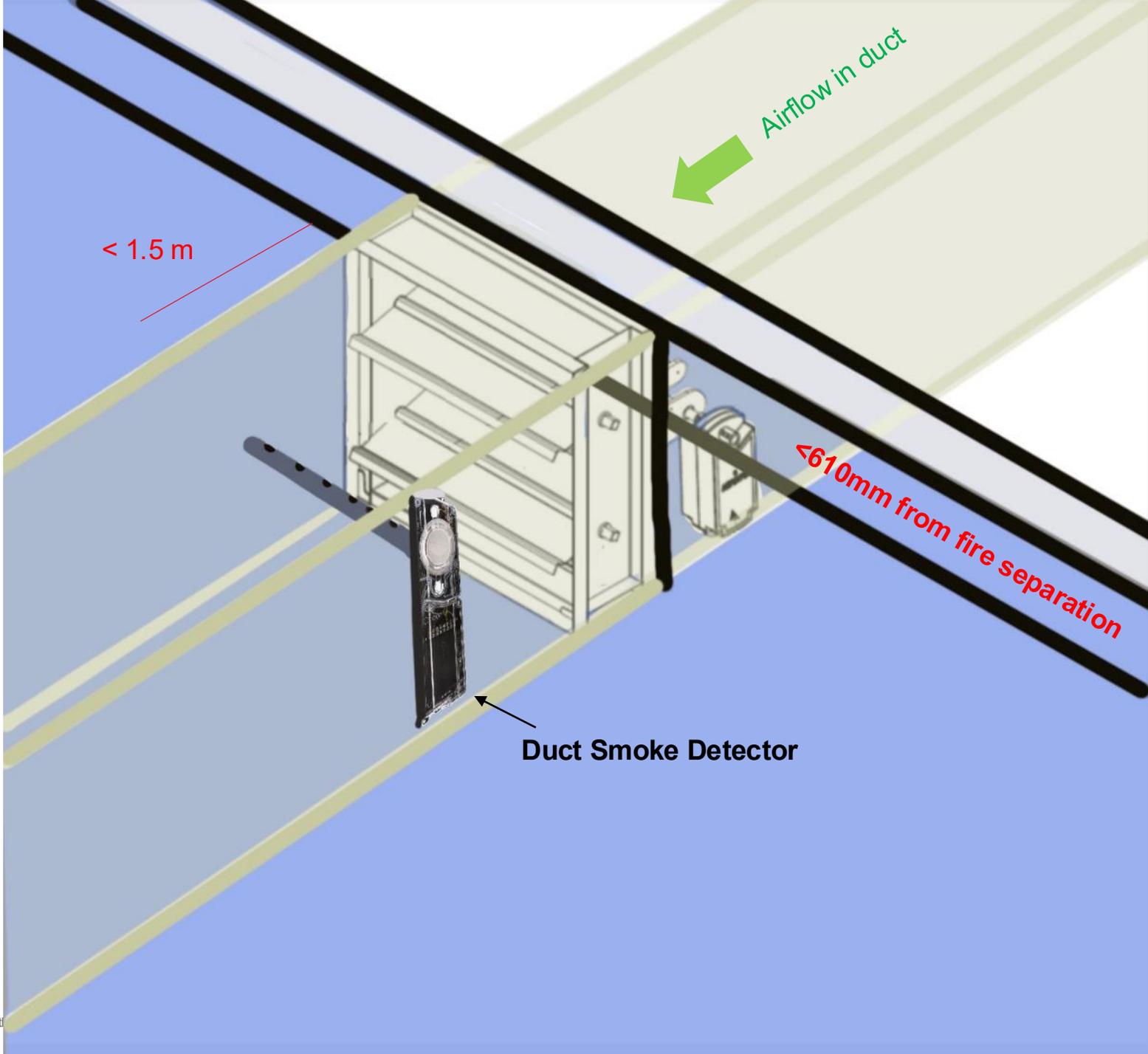


3.1.8.11 Installation of smoke dampers:

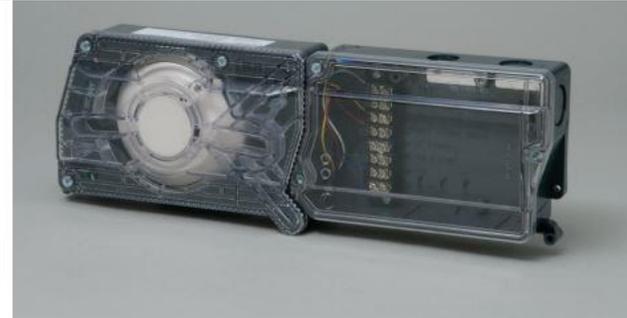
(2) Where combination smoke and *fire dampers* are used as a *closure* in a duct, they shall be installed within 610 mm of the plane of the *fire separation*, provided there is no inlet or outlet opening between the *fire separation* and the damper.

(3) close automatically upon a **signal from an adjacent *smoke detector*** located as described in CAN/ULC-S524, “Installation of Fire Alarm Systems”, within 1.5 m horizontally of the duct or air-transfer opening in the fire separation,

(b) In the duct downstream of the smoke damper or combination smoke and fire damper



# BE CAREFUL OF MINIMUM AIRFLOW FOR DUCT DETECTORS



## Specifications

**Size: (Rectangle)** 14.38 in (37 cm) Length; 5 in (12.7 cm) Width, 2.5 in (6.6 cm) Depth.

**Size: (Square)** 7.75 in (19.7 cm) Length; 9 in (22.9 cm) Width; 2.5 in (6.35 cm) Depth.

**Weight:** 1.6 lb (0.73 kg).

**Operating Temperature Range:** -4°F to 158°F (-20°C to 70°C).

**Storage Temperature Range:** -22°F to 158°F (-30°C to 70°C).

**Operating Humidity Range:** 0% to 95% relative humidity (non-condensing).

**Air Duct Velocity:** 100 to 4,000 ft/min (0.5 to 20.32 m/s).

# CHECK THAT SPOT DETECTORS HAVE RATING FOR DUCTS

For a complete list of detector bases see [DN-60981](#)

**Shipping weight:** 3.4 oz. (95 g)

**Operating temperature range:**

- FSP-951: 32°F to 122°F (0°C to 50°C)
- FSP-951T Series: 32°F to 100°F (0°C to 38°C)
- FSP-951R Series installed in a DNR/DNRW, -4°F to 58°F (-20°C to 70°C)

**UL/ULC Listed Velocity Range:** 0-4000 ft/min. (1219.2 m/min.), suitable for installation in ducts

**Relative humidity:** 10% – 93% non-condensing

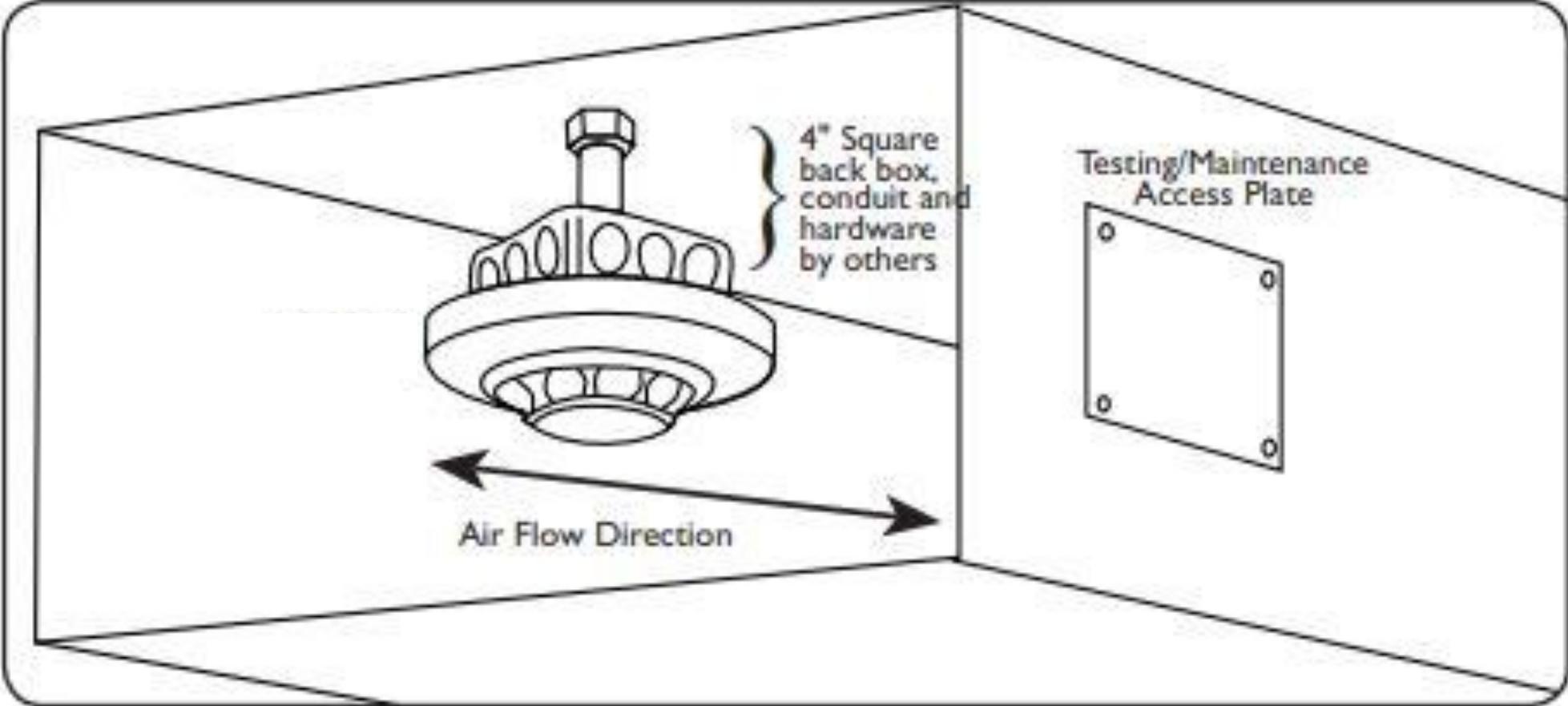
**Thermal ratings:** fixed-temperature set point 135°F (57°C), rate-of-rise detection 15°F (8.3°C) per minute, high temperature heat 190°F (88°C)

## ***ELECTRICAL SPECIFICATIONS***

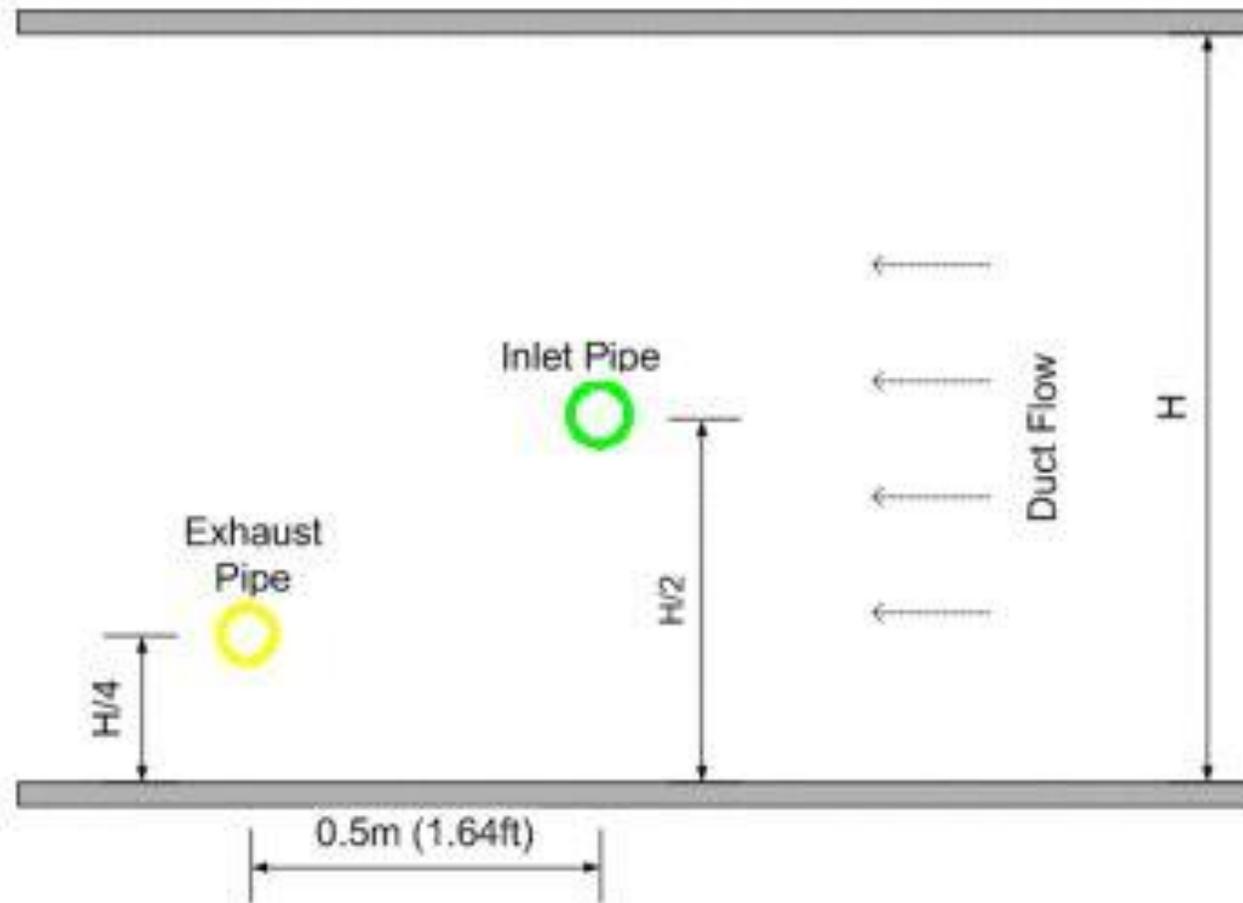
Photoelectric Smoke Detectors



# EXAMPLE OF MOUNTING A SPOT SMOKE DETECTOR IN A DUCT

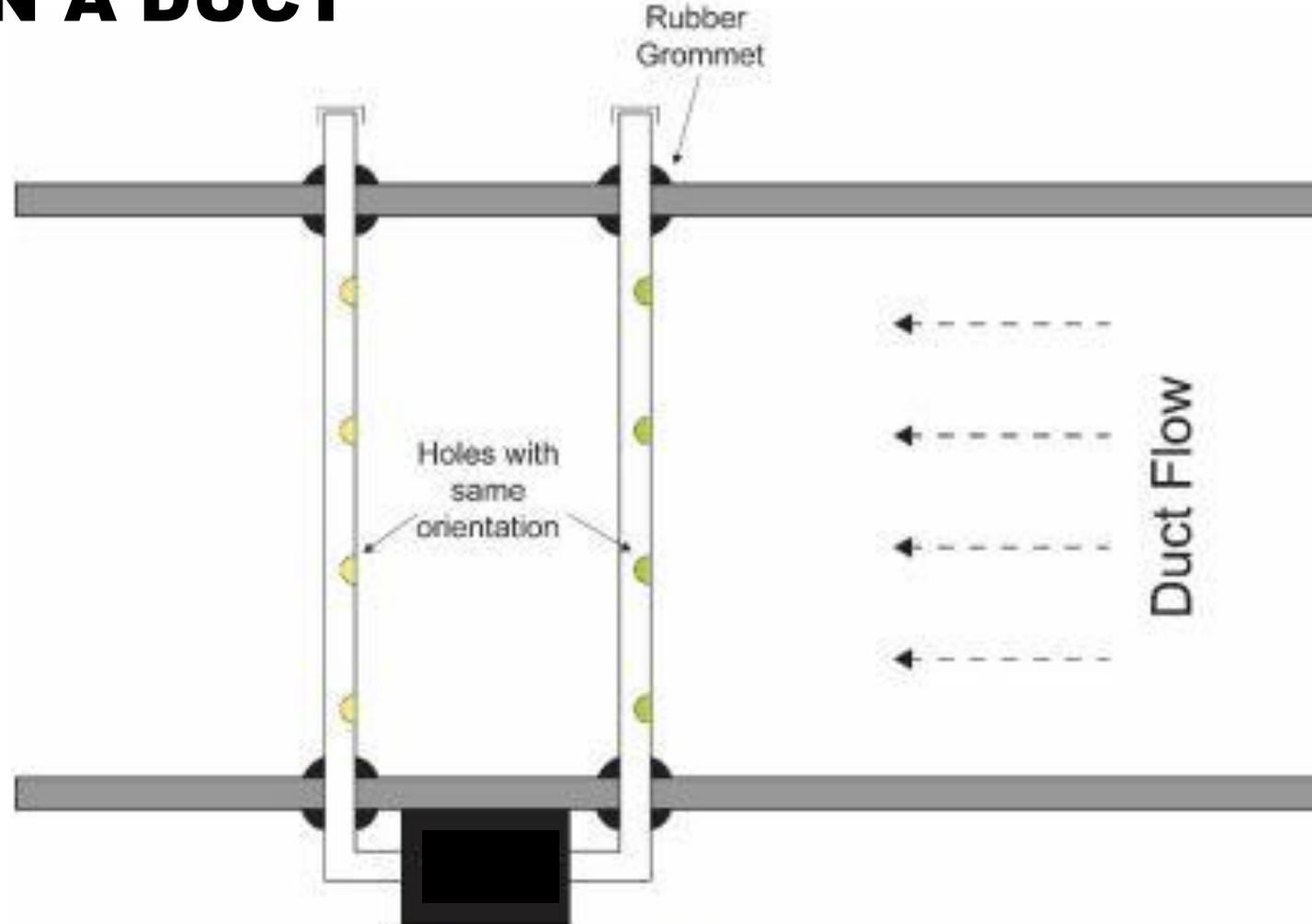


# EXAMPLE OF MOUNTING AN ASPIRATING SMOKE DETECTOR IN A DUCT



*Figure 1: Side view of the inlet and exhaust pipe positions for a small ventilation duct.*

# EXAMPLE OF MOUNTING AN ASPIRATING SMOKE DETECTOR IN A DUCT

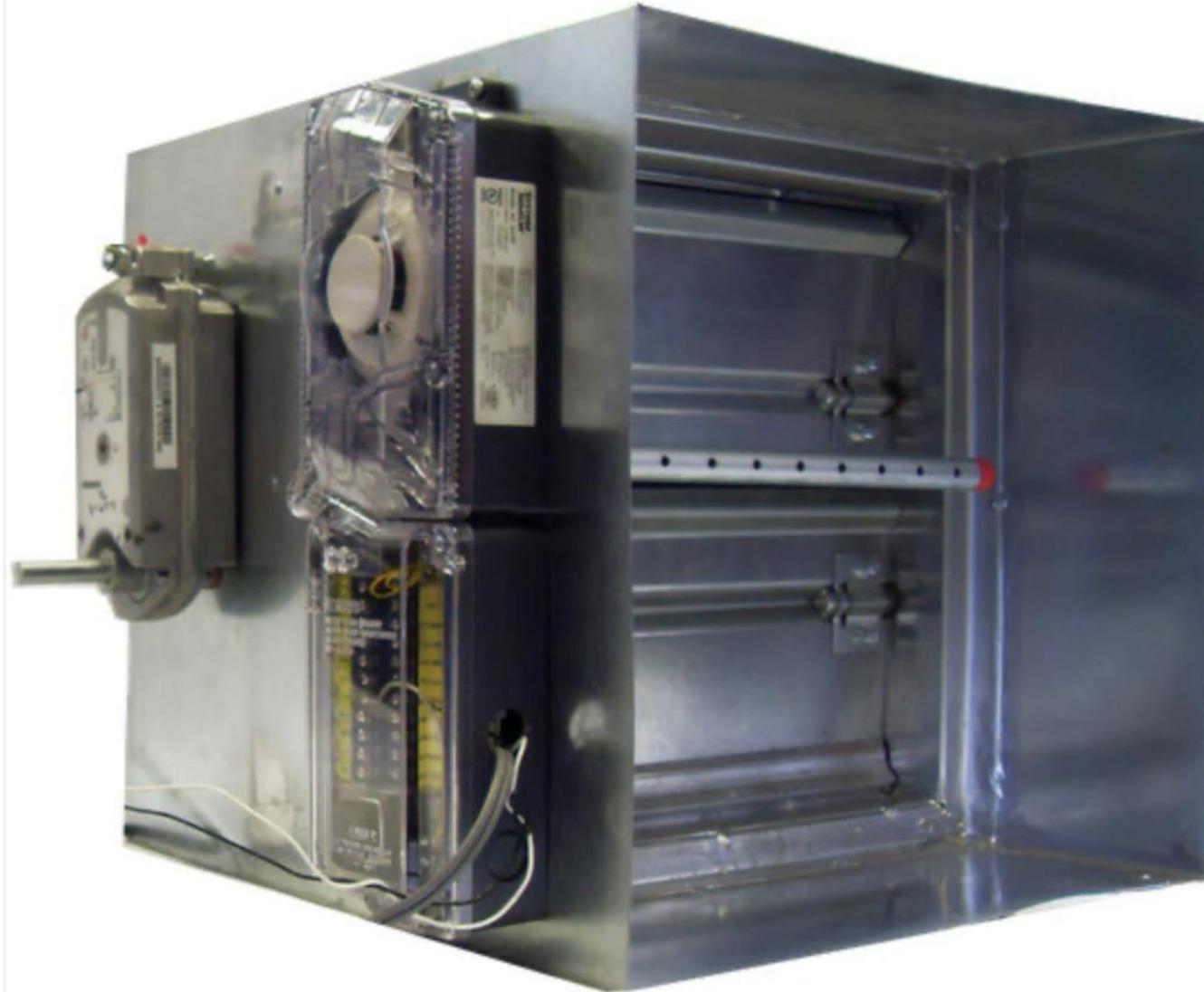


*Figure 2: Top view of the inlet and exhaust pipe positions, including sampling hole location, for a small duct.*

# EXAMPLE OF AN INTEGRATED DUCT AND DETECTOR

*Must have a minimum airflow of 100 FPM.*

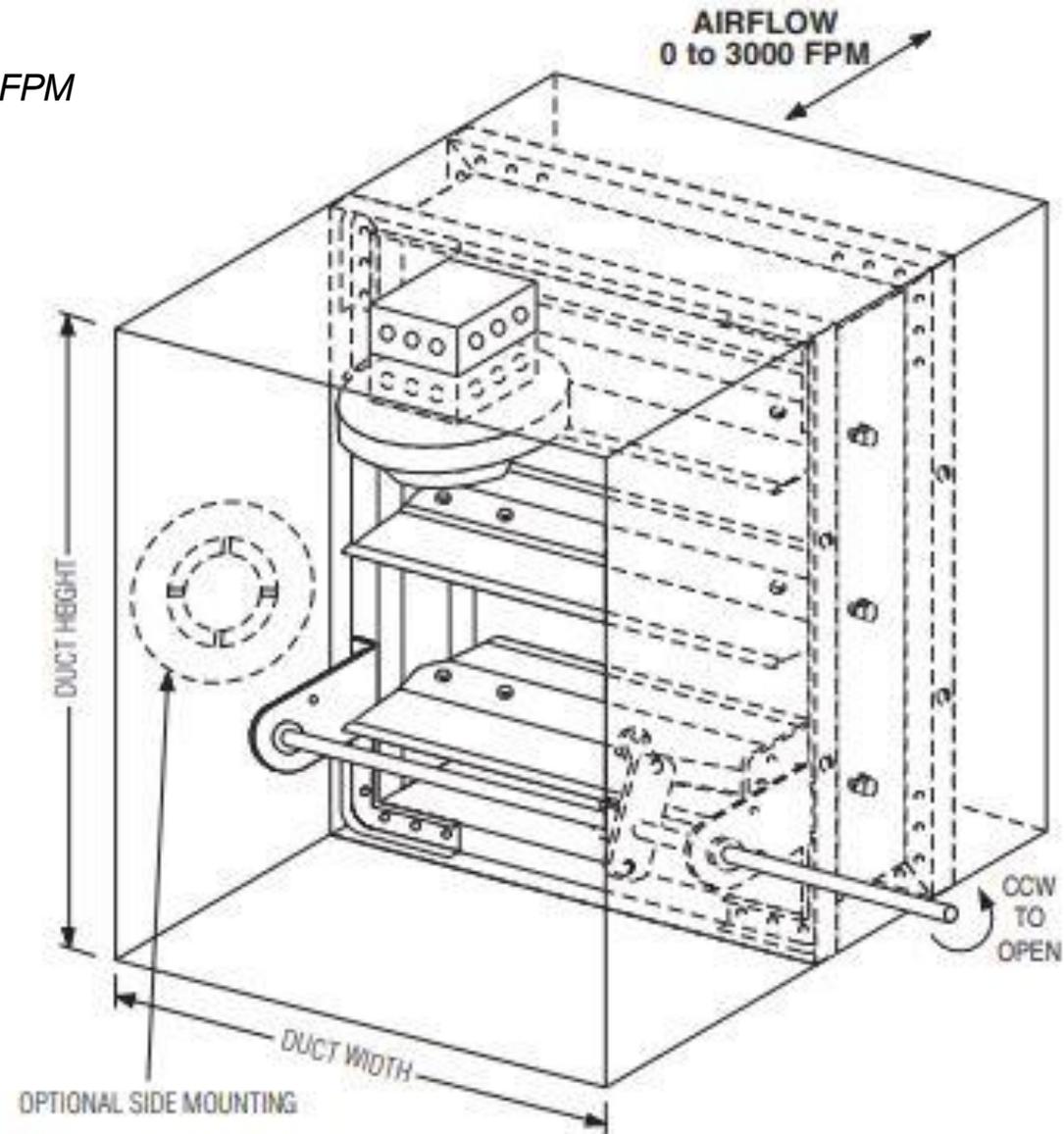
*If Air Handler shuts down, this damper should close automatically to ensure smoke containment.*



Note direction of sampling tube!

# EXAMPLE OF AN INTEGRATED DUCT AND DETECTOR

*No-Flow detectors can operate at 0FPM*



# 3 LEVELS OF CONNECTION OF DUCT DETECTION FOR SMOKE DAMPERS

## 120VAC, not connected to FACP

- No risk of false alarms calling FD
- No backup power in power loss situation.
  - But does damper just spring shut on power loss?
  - AHU on generator but dampers are not?
- No monitoring of an alarm condition, only provides control to damper
- Could be wired to a local alarm

## 120VAC, connected to FACP

- Monitored and time stamped (at FACP) for any off normal conditions
- Could potentially cause false alarms
  - (*configuring as SUPERVISORY could help*)
  - Would a supervisory condition be valid to alert staff as an *ALERT*
- Tie into fire alarm panel ensures testing to 536?

## 24VDC smoke detector connected to fire alarm

- Meets S524 standards for supervision of wiring and backup power
- Monitored and time stamped (at FACP) for any off normal conditions
- Tie into fire alarm panel ensures testing to 536
- No requirement for AHU to shutdown on activation of alarm. Except as per 3.2.4.12
- Should these detectors be alarm points? Maybe SUPERVISORY?

# **4. CHALLENGES AND ISSUES WITH IMPLEMENTATION OF THESE NEW CODES**

# REVISIONS AND COMMENTARIES

## Proposed revision to 2020 NBC 3.1.8.11.(3)

This proposed change introduces Note A-3.1.8.11.(3) to clarify that the activation of a smoke damper or combination smoke/fire damper by a smoke detector **does not necessarily require** that device to be part of a fire alarm system **where such system is not otherwise required** by the NBC.

*This proposed change would not affect buildings with fire alarm systems already installed, it seems to be more of a clarification so that owners aren't obliged to add a fire alarm system due to a need for smoke dampers.*

# **ISSUES THAT HAVE COME UP AROUND CANADA...**

- Many duct smoke detectors when there are common supply ducts... Some engineers are designing systems with individual HVAC per suite with no common airflow other than possibly corridors.**
- Spot Smoke detectors for low air flow and no airflow ducts. These need to be rated for these locations.**
- Perhaps dampers should all shut when their related air handling unit shuts down to protect zero-airflow conditions where smoke may not be detected. Note that all related AHU's (on the floor area) must shut down to not cause negative or positive pressure in ducts.**
- Expansion ducts may be required for smaller ducts that require smoke dampers and detection. If the duct detector is too large for the duct, the duct may need a wider portion installed to accommodate a detector. Can the ceiling space accommodate this? Airflow calculations – must include these expansions.**
- Small areas that require multiple ducts... how do we install them properly - away from bends?**

# **ISSUES THAT HAVE COME UP AROUND CANADA...**

- **Some AHJ's have allowed buildings to have HVAC with integral 120VAC duct detector / dampers not wired to Fire Alarm system. It was deemed acceptable to have Sprinkler and Fire Alarm Initiating devices provide any annunciation / notification.**
- One AHJ report stated – No need of connection of 120VAC smoke dampers and duct detector to FA system as it is for CONTROL only and not for DETECTION.
- **Seeing Ancillary relays and detectors (that are not UL/ULC rated) being used to connect smoke damper detection to fire alarm panel.**
- **Some sites are reporting that Mechanical Contractors are being held responsible to ensure that these integrated duct detectors work. No CFAA tech present for these commissioning phases. Do we need to?**
- **How does resetting work for 120VAC duct detectors? Is it a full power cycle?**
- **How about the safety of having 120VAC circuits for duct detectors. Are they labeled?**

# **ISSUES THAT HAVE COME UP AROUND CANADA...**

- **Vertical shafts supplying many floor hallways (or stacked suites) with air... how do we protect these areas?**
- **End switches on dampers connected to fire alarm? If we test and they annunciate damper function, does this meet “visual inspection” as per S-536?**
- **What about repairs to 120VAC duct detectors? Can a Fire Alarm technician who is not a journeyman electrician repair/replace these devices? What other qualifications are acceptable?**
- **What about more zoning needed due to separate zones for each AHU? Needed?**
- **The Codes and Standards are a ‘minimum’ requirement.**

# POSSIBLE SOLUTIONS...

- **S-1001 IST could be the safety in this system to ensure that all of these integrated units are being tested? What if 120VAC dampers are not connected to the Fire Alarm? Are they now an ‘integrated system’?**
- **Work with Mechanical Engineers and Code Consultants to make a safe system that is above and beyond the *sometimes-confusing* directions in the NBC.**
- **Connections to the fire alarm could be a good idea, but this could also be the start of another issue - false alarms from duct detectors.**
  - One suggestion is to look at the NFPA as they use duct smokes as a TRACKING SUPERVISORY signal.
  - Perhaps even have a SUPERVISORY for the initial alarm of a duct smoke and then have it advance to ALARM after a set time if the TRACKING SUPERVISORY has not cleared.
  - Many jurisdictions have NBC 2015 duct detectors in place for a few years... *are they having constant nuisance alarms?*

# 5. ISSUES WITH ANNUAL INSPECTIONS OF SMOKE DAMPERS

How some jurisdictions are meeting the code changes for annual inspections

# **FIRE CODE AND DAMPER INSPECTIONS**

**2015 fire code 2.2.2.4 (5) Fire and smoke dampers etc shall be a) inspected no greater than every 12 months to ensure they are in place and not obviously damaged or obstructed and b) be tested to NFPA80 “Fire doors and other opening protectives”.**

**-This changed from NFC 2010 which only asked for fire dampers to be inspected for obvious damage or obstruction.**

**NFPA105 is mentioned in NFPA 80 in relation to smoke dampers.**

**NFPA80 says in 19.3.2.1 The test shall determine that the system has been installed and functions as intended. Perhaps this is where testing can be mandated? Testing frequency in NFPA80 is first year and then every 4 years (6 if a hospital) or after any repair.**

**Must be tested under the conditions in which it is intended to operate (a dynamic damper must be tested with the HVAC running).**

**What about S1001? Will the smoke dampers and integrated duct detectors with HVAC have to be tested if not connected to fire alarm system?**

# Things to consider after this seminar...

- **Consider ways to work with the project teams and building officials if you are considering an alternative design to the prescriptive requirements of the codes and standards.**
- **You should pay attention to the conflicts and differences of opinion throughout the country on how these lines of code are being interpreted. Think of where you agree or disagree with the local interpretations, BUT...**
- **Always stick to your local AHJ's *most recent* interpretation of the codes.**
- ***Technicians* - Consider writing in recommendations in their report if they see something that concerns them. 'Should' statements may be a better idea and not 'Shall'.**
- **Consider the S536 obligations for annual inspections in relation to smoke detectors in ducts...**

# S536 AND SMOKE DAMPERS

## CAN/ULC-S536:2019

### 14.4.5 Additional Requirements for Air Duct Type Smoke Detectors

14.4.5.1 Each air duct type smoke detector shall be inspected and tested including the following as applicable:

a) Rated for the air duct size and installed correctly in the air duct system to ensure device operation;

b) The **positive airflow and/or differential pressure** at the sampling tubes is within the manufacturer's specified limits for the detector; and

c) Confirm operability by introducing smoke or simulated smoke to the detector in accordance with the manufacturer's instructions.

14.4.5.2 **Remote test switches**, magnetic test points, etc. **shall not be used** to confirm operability.

# 6. QUESTIONS AND DISCUSSION

What do you think? What has been your experience so far?

The CFAA  
**TECHNICIANS**  
PODCAST



Canada's Podcast For Technicians In  
The Fire Alarm Industry



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# THANK YOU

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