

Shut Down The Fan: A Reprise

by Dean K. Wilson, P.E.

***Question:* My grandfather passed away last summer. He had spent many years as a fire fighter. Among his possessions, I found back issues of various national and regional fire magazines. In the December 1971 edition of *Fire Chief* magazine, published by H. Marvin Ginn Corporation, I found an article that you wrote entitled: “Shut down the fan.” Will you give me the background on what led you to write that article and also give me an update on that subject? As a fire alarm installation contractor, I constantly have to interface our systems with building air handling systems. Thanks.**

First of all, please accept my most sincere sympathy on the death of your grandfather. I wrote the article you discovered following a fire in a strip shopping center in West Seneca, a suburb of Buffalo, New York. The shopping center consisted of thirty one-story shops of various kinds anchored by a two-story department store. The fire occurred in a pizza shop, three stores away from the department store. Only the department store had the protection afforded by an automatic sprinkler system.

The responding fire departments held the fire to the pizza shop, with slight fire damage to the shops on either side. However, the department store suffered a total loss of the contents in the store due to smoke damage.

The architect who designed the building had placed the fresh air intake for the air handling system on the second floor exterior wall overlooking the roofs of the other stores in the strip

shopping center. As the fire consumed the pizza shop, the department store air handling system sucked the smoke rising from the fire into the air handling system and distributed it throughout the building. Heavy soot and smoke residue covered every surface and every item in the store.

You must remember that in the early 1960's, when the department store owner built this store, smoke detectors had not yet become widely used. In fact, only a couple of manufacturers even made smoke detectors. The point of my original article intended to encourage property owners to prevent the spread of fire by more carefully locating fresh air intakes, and to install smoke detectors to shut down the air handling system's fan when smoke entered the air ducts.

Today, thirty nine years later, the interface between a building's fire alarm system and a building's air handling system has become a normally accepted practice. Building owners, Authorities Having Jurisdiction (AHJs), architects, engineers, designers, installers, and maintainers of building systems, along with the manufacturers of the related equipment, have two main documents to which they may turn for information and requirements: NFPA 90A and NFPA 72.

NFPA 90A-2009, *Standard for the Installation of Air-Conditioning and Ventilating Systems*, requires the installation of smoke detectors as follows in this partial list of the requirements:

6.4.2.1 Smoke detectors listed for use in air distribution systems shall be located as follows:

- (1) Downstream of the air filters and ahead of any branch connections in air supply systems having a capacity greater than 944 L/sec (2000 ft³/min)
- (2) At each story prior to the connection to a common return and prior to any recirculation or fresh air inlet connection in air return systems having a capacity greater than 7080 L/sec (15,000 ft³/min) and serving more than one story

6.4.2.2 Return system smoke detectors shall not be required where the entire space served by the air distribution system is protected by a system of area smoke detectors.

6.4.2.3 Smoke detectors shall not be required for fan units whose sole function is to remove air from the inside of the building to the outside of the building.

6.4.3.1 Smoke detectors provided as required by 6.4.2 shall automatically stop their respective fan(s) on detecting the presence of smoke.

6.4.4.1 Smoke detectors shall be installed, tested, and maintained in accordance with NFPA 72, *National Fire Alarm Code*.

6.4.4.2 In addition to the requirements of 6.4.3, where an approved fire alarm system is installed in a building, the smoke detectors required by the provisions of Section 6.4 shall be connected to the fire alarm system in accordance with the requirements of NFPA 72, *National Fire Alarm Code*.

6.4.4.2.1 Smoke detectors used solely for closing dampers or for heating, ventilating, and air-conditioning system shutdown shall not be required to activate the building evacuation alarm.

The first requirement, 6.4.2.1 (1), intends to prevent a fire in the air handling system filters from spreading smoke throughout the building. If the air handling system draws smoke into the system from outside the building, the detectors specified in the first requirement should detect that smoke. The second requirement, 6.4.2.1 (2), intends to prevent the recirculation of smoke throughout a building by the air handling system should a fire occur in some part of the building.

NFPA 72-2010, *National Fire Alarm and Signaling Code*, presents requirements in two Chapters, 17 and 21. Some selected requirements include the following:

17.7.4.2.2* Detectors placed in environmental air ducts or plenums shall not be used as a substitute for open area detectors. Where detectors are used for the control of smoke spread, the requirements of 17.7.5 shall apply. Where open area protection is required, 17.7.3 shall apply.

A.17.7.4.2.2 Smoke might not be drawn into the duct or plenums when the ventilating system is shut down. Furthermore, when the ventilating system is operating, the detector(s) can be less responsive to a fire condition in the room of fire origin due to dilution by clean air.

17.7.5* Smoke Detectors for Control of Smoke Spread.

A.17.7.5 Refer to NFPA 101, *Life Safety Code*, for the definition of smoke compartment; NFPA 90A, *Standard for the Installation of Air-Conditioning and Ventilating Systems*, for the definition of duct systems; and NFPA 92A, *Standard for Smoke-Control Systems Utilizing Barriers and Pressure Differences*, for the definition of smoke zone.

17.7.5.1* Classifications. Smoke detectors installed and used to prevent smoke spread by initiating control of fans, dampers, doors, and other equipment shall be classified in the following manner:

- (1) Area detectors that are installed in the related smoke compartments
- (2) Detectors that are installed in the air duct systems
- (3) Video image smoke detection that is installed in related smoke compartments

17.7.5.2.1 Detectors that are installed in the air duct system in accordance with 17.7.5.1 (2) shall not be used as a substitute for open area protection.

17.7.5.3.1 To prevent the recirculation of dangerous quantities of smoke, a detector approved for air duct use shall be installed on the supply side of air-handling systems as required by NFPA 90A, *Standard for the Installation of Air-Conditioning and Ventilating Systems*, and 17.7.5.4.2.1.

17.7.5.4.1 Area Smoke Detectors Within Smoke Compartments. Area smoke detectors within smoke compartments shall be permitted to be used to control the spread of smoke by initiating operation of doors, dampers, and other equipment.

17.7.5.4.2.1 Supply Air System. Where the detection of smoke in the supply air system is required by other NFPA standards, a detector(s) listed for the air velocity present and that is located in the supply air duct downstream of both the fan and the filters shall be installed.

Exception: Additional smoke detectors shall not be required to be installed in ducts where the air duct system passes through other smoke compartments not served by the duct.

17.7.5.4.2.2* Return Air System. Unless otherwise modified by 17.7.5.4.2.2 (A) or 17.7.5.4.2.2(B), if the detection of smoke in the return air system is required by other NFPA standards, a detector(s) listed for the air velocity present shall be located where the air leaves each smoke compartment, or in the duct system before the air enters the return air system common to more than one smoke compartment.

- (A) Additional smoke detectors shall not be required to be installed in ducts where the air duct system passes through other smoke compartments not served by the duct.
- (B) Where total coverage smoke detection is installed in all areas of the smoke compartment served by the return air system, installation of air duct detectors in the return air system shall not be required, provided that their function is accomplished by the design of the area detection system.

A.17.7.5.4.2.2 Detectors listed for the air velocity present can be permitted to be installed at the opening where the return air enters the common return air system. The detectors should be installed up to 12 in. (300 mm) in front of or behind the opening and spaced according to the following opening dimensions [see Figure A.17.7.5.4.2.2(a) through Figure A.17.7.5.4.2.2(c)]:

- (1) Width.
 - (a) Up to 36 in. (910 mm) - One detector centered in opening
 - (b) Up to 72 in. (1.83 m) - Two detectors located at the one-quarter points of the opening
 - (c) Over 72 in. (1.83 m) - One additional detector for each full 24 in. (610 mm) of opening
- (2) Depth. The number and spacing of the detector(s) in the depth (vertical) of the opening should be the same as those given for the width (horizontal) in A.17.7.5.4.2.2(1).

(Note: Due to space considerations, I have omitted the Figures referenced above.)

17.7.5.5 Location and Installation of Detectors in Air Duct Systems.

17.7.5.5.1 Detectors shall be listed for the purpose for which they are being used.

17.7.5.5.2* Air duct detectors shall be installed in such a way as to obtain a representative sample of the airstream. This installation shall be permitted to be achieved by any of the following methods:

- (1) Rigid mounting within the duct
- (2) Rigid mounting to the wall of the duct with the sensing element protruding into the duct
- (3) Installation outside the duct with rigidly mounted sampling tubes protruding into the duct
- (4) Installation through the duct with projected light beam

17.7.5.5.3 Detectors shall be mounted in accordance with the manufacturer's published instructions and shall be accessible for cleaning by providing access doors or control units in accordance with NFPA 90A, *Standard for the Installation of Air Conditioning and Ventilating Systems*.

17.7.5.5.4 The location of all detectors in air duct systems shall be permanently and clearly identified and recorded.

17.7.5.5.5 Detectors mounted outside of a duct that employs sampling tubes for transporting smoke from inside the duct to the detector shall be designed and installed to allow verification of airflow from the duct to the detector.

17.7.5.5.6 Detectors shall be listed for operation over the complete range of air velocities, temperature, and humidity expected at the detector when the air-handling system is operating.

17.7.5.5.7 All penetrations of a return air duct in the vicinity of detectors installed on or in an air duct shall be sealed to prevent entrance of outside air and possible dilution or redirection of smoke within the duct.

21.7.5 If the fire alarm control unit actuates the HVAC system for the purpose of smoke control, the automatic alarm initiating zones shall be coordinated with the smoke-control zones they actuate.

21.7.6 Where interconnected as a combination system, a firefighter's smoke control station (FSCS) shall be provided to perform manual control over the automatic operation of the system's smoke control strategy.

As you can read in these requirements, the ability to control the spread of smoke inside a building has come a long way since 1971. The interface between a building's fire alarm system and

a building's air handling system has become a very important tool in reducing the loss when a fire occurs.

Building owners, Authorities Having Jurisdiction (AHJs), architects, engineers, designers, installers, and maintainers of building systems, along with the manufacturers of the related equipment, should become very familiar with the requirements that cover this subject in both NFPA 90A and in NFPA 72.

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