

ENGINEERING REPORT

TOPIC: Smoke Detectors

Report No. 498-2

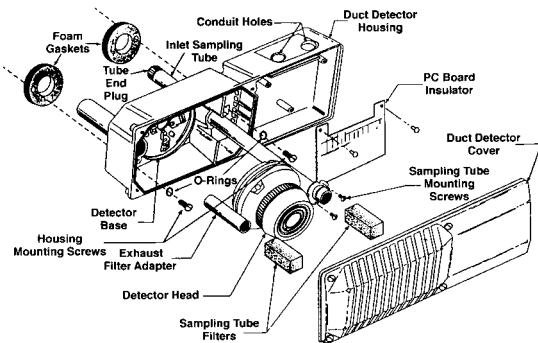
JULY 2001

By Richard L. Cravy

Smoke control is a proven technology that saves lives. Smoke and combination fire/smoke dampers and the devices used to control them, like smoke detectors, are important components of smoke control systems. Smoke and combination fire/smoke damper manufacturers have made the application of smoke detectors easier by factory installing detectors on dampers but questions regarding their proper utilization remain. This report outlines the basic principles behind the application of duct smoke detectors and answers the following questions:

1. What are Smoke Detectors?
2. Why are Smoke Detectors used?
3. Which is the right Smoke Detector to use?
4. How are Smoke Detectors used?
5. How does Ruskin factory install Duct Smoke Detectors on fire/smoke dampers?

WHAT ARE SMOKE DETECTORS?



TYPICAL DUCT SMOKE DETECTOR

Smoke detectors are devices used to detect visible or invisible particles of combustion (smoke).

There are two types of smoke detectors in use today. They are the area smoke detector and the duct smoke detector. The area smoke detector, also known as a spot-type detector is a device whose detecting element is concentrated at a particular location or spot. Area detectors are normally mounted to a ceiling and detect smoke in a specific area.

The duct smoke detector is a device mounted within an air duct or located outside the duct with tubes protruding into the duct to detect smoke **flowing** within the duct. Most duct

smoke detectors installed by Ruskin are the type located outside the duct with air stream sampling tubes penetrating and traversing the duct. The sampling tubes are positioned so air may be drawn through the detector, sampled, and then returned to the air stream in the duct. **The air must be moving through the duct at a velocity between 300 to 4,000 fpm. for the detector to function properly. There are, however, duct detectors that do not require air movement to properly function.**

What are Addressable Smoke Detectors?

Addressable smoke detectors are smoke detectors, that are part of a fire alarm system. They provide alarm and trouble indications to a control unit (fire alarm panel) and are capable of communicating an address for purposes of identification. Duct smoke detectors, factory installed by damper manufacturers, are not normally addressable devices.

WHY ARE SMOKE DETECTORS USED?

NFPA (National Fire Protection Association) studies show smoke is the major cause of property damage and loss of life in fire situations. National and local safety standards and codes recognize the ability of air duct systems to transfer smoke and toxic gases from area to area. These standards and codes **require** the installation of smoke detectors to prevent injury and limit panic or property damage by reducing the spread of smoke.

The 1997 Uniform Building Code and the 2000 International Building Code require smoke detectors be used as follows:

1. Where a damper is installed within a duct, a smoke detector shall be installed in the duct within 5 feet (1524mm) of the damper with no air outlets or inlets between the detector and the damper. The detector shall be listed for the air velocity, temperature and humidity anticipated at the point where it is installed.

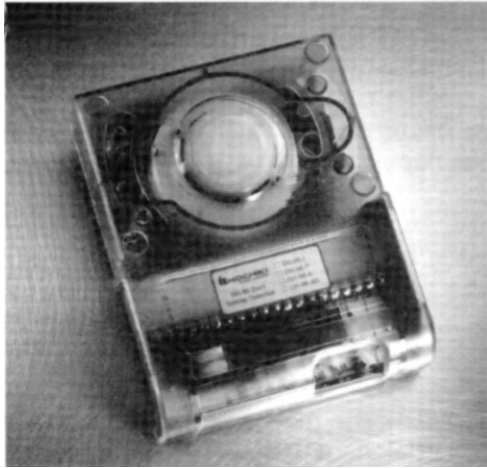
2. Where a damper is installed within an unducted opening in a wall, a spot-type detector listed for releasing service shall be

installed within 5 feet (1524mm) horizontally of the damper.

3. Where a damper is installed in a ceiling, a spot-type detector listed for releasing service shall be installed on the ceiling within 5 feet (1524mm) of the damper.

4. Where a damper is installed in a corridor wall or ceiling, the damper may be controlled by a smoke-detection system installed in the corridor.

5. When total-coverage smoke-detection system is provided within all areas served by an HVAC system, dampers may be controlled by the smoke-detection system.



WHICH SMOKE DETECTOR IS THE RIGHT ONE TO USE?

Selecting the correct type of detector (area or duct) with the correct principle of operation is very important. Area and duct smoke detectors are categorized according to the principle of operation utilized to sense the smoke. The two most widely used duct detectors are the photoelectronic type and the ionization type.

Ionization smoke detection is based on the principle of ion flow within a chamber. An alarm condition occurs when the ion flow is affected by smoke particles. This type of detector is most effective near the fire source.

Photoelectronic smoke detection is based on the principle of optical detection. It is also known as the "scattered" light principle. An alarm condition occurs when smoke particles enter a light path and some of the light is "scattered" by reflection and refraction onto a sensor. This type of detector is best for areas where dense smoke may occur, such as in ductwork

Ruskin factory installs photoelectronic duct detectors when the duct smoke detection option is ordered.

HOW ARE SMOKE DETECTORS USED?

Building codes and other publications like NFPA101 (the Life Safety Code), and NFPA72 (the National Fire Alarm Code) assist the designer with the application of smoke detectors. In addition, smoke detector manufacturers publish guides for the proper application of their smoke detectors. Ruskin literature also details the different ways in which duct smoke detectors are factory installed and wired.

Area smoke detectors are the preferred means of controlling smoke per NFPA 72.

HOW DOES RUSKIN FACTORY INSTALL DUCT SMOKE DETECTORS?

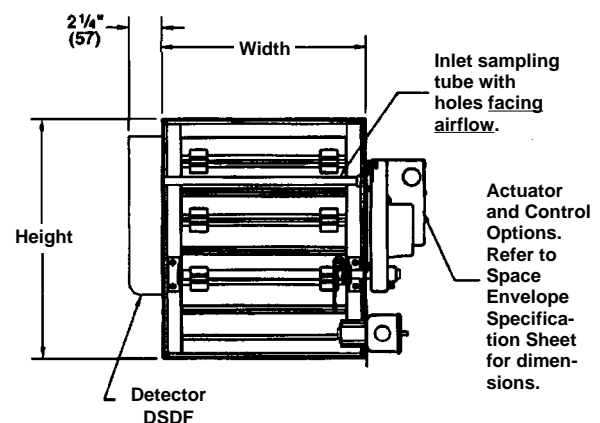
Ruskin factory installs duct smoke detectors on smoke and fire/smoke dampers in accordance with the detector manufacturer's recommendations and with UL approval.

UL does not have a separate product category for factory mounted smoke detectors. The smoke detector and the damper have been individually evaluated by their applicable UL standards.

Ruskin considers the following when factory installing duct smoke detectors:

Location - Ruskin factory installs the detector on the sleeve within 5 feet of the damper with the sampling tube traversing the sleeve at its widest point. The detector is typically installed on the **top or side** of the sleeve opposite from the actuator and other control options (see illustration below).

Space - The space "envelope" or overall size of the damper assembly is increased. The



SPACE ENVELOPE FOR RUSKIN FACTORY MOUNTED SMOKE DETECTORS

Ruskin DSD literature shows the additional "space" needed for a factory installed duct detector.

Air Flow - Ruskin factory installs duct smoke detectors for use in systems with air velocities of 0 to 4,000 fpm. If air flow is present it must be uniform. A detector requiring airflow is mounted on the damper sleeve so the holes in the sensing tube face away from the damper (downstream of the damper and upstream of the fan). The holes in the sensing tube must face in the direction of airflow. The air flows into the sensor through the tube, is sampled, and is exhausted through the exhaust tube. If airflow is opposite of that indicated above, the damper installer must rotate the sensing tube so the holes face in the direction of airflow.

Summary

The application of smoke detectors can be confusing. In order to make the process simpler, remember the following items:

1. More codes and standards are requiring the

use of smoke detectors. **The authority having jurisdiction should be consulted prior to applying any type of detector.**

2. Area detectors are the preferred means of controlling smoke spread per NFPA72.
3. Photoelectronic type detectors are recommended for sensing smoke in ductwork.
4. Factory installed smoke detectors require additional "envelope space." Refer to the damper manufacturer's literature for application information.
5. Ruskin factory installs photoelectronic duct smoke detectors per code requirements, in accordance with the manufacturer's recommendations and with UL approval.
6. Field installed duct smoke detectors must follow the detector manufacturer's installation instructions.
7. The damper/detector package is not UL listed as an assembly.

RUSKIN®

3900 Dr. Greaves Rd.
Kansas City, MO 64030
(816) 761-7476
FAX (816) 765-8955
www.ruskin.com