Smoke, Heat, and Duct Detectors
Application Bulletin

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Content

Related documentation

	National Fire Protection Association (NFPA) 1 Batterymarch Park P.O. Box 9101 Quincy, MA 02269-9101
NFPA 70	National Electric Code
NFPA 72	National Fire Alarm Code
N FPA 90A	Installation of Air conditioning and Ventilating Systems
	Underwriters Laboratories, Inc. (ULI) 333 Pfingsten Road Northbrook, IL 60062-2096
UL 38	Manually Actuated Signaling Boxes
UL217	Smoke Detectors, Single & Multiple Station
UL 228	Door Closers/Holders for Fire Protective Signaling Systems
UL 268	Smoke Detectors for Fire Protective Signaling Systems
UL 268A	Smoke Detectors for Duct Applications
UL 346	Waterflow Indicators for Fire Protective Signaling Systems
UL 464	Audible Signaling Appliances
UL 521	Heat Detectors for Fire Protective Signaling Systems
UL 864	Standard for Control Units for Fire Protective Signaling Systems
UL 1481	Power Supplies for Fire Protective Signaling Systems
UL 1638	Visual Signaling Appliances
UL 1971	Visual Signaling Appliances
	Underwriters Laboratories of Canada (ULC) 7 Crouse Road Scarborough, Ontario M1R 3A9
ULC S527	Standard for Control Units for Fire Alarm Systems
ULC S524	Standard for the Installation of Fire Alarm Systems
ULC S529	Smoke Detectors for Fire Alarm Systems
ULC S536	Standard for the Inspection and Testing of Fire Alarm Systems
ULC S537	Standard for the Verification of Fire Alarm Systems
NEMA	Guide for Proper Use of Smoke Detectors in Duct Applications
PLUS...	Requirements of state and local building codes
	Requirements of the Authority Having Jurisdiction

Overview of smoke, heat, and duct detectors

This group of detectors comprises of a variety of detection technologies available in various combinations to meet the needs of the fire protection community.

The smoke and heat detectors are constructed of a white, high-impact polymer and plug into one of a variety of mounting bases that feature base locking tabs.

The duct smoke detectors are constructed of a black, high-impact polymer with a clear plastic cover and attach directly to the HVAC system duct.

The table below lists the available detector models.

Smoke, heat, and duct detectors

Model	Description
E-PD	Photoelectric smoke detector
E-PHD	Combination photoelectric smoke and 135°F (57°C) fixed-temperature heat detector
E-HD	Combination 135°F (57°C) fixed-temperature and 15°F (8°C) per minute rate-of-rise heat detector
E-PDD	Duct smoke detector

The smoke and heat detectors are analog addressable devices that contain their own microprocessors, which allow them to make alarm decisions based on the information collected by their sensors. Depending on the detector, decisions may be based on the information gathered by up to two independent sensing elements.

The address of each detector is assigned using the two rotary switches located on the detector.

These detectors provide LEDs that indicate the detector’s condition. In normal condition, the network control panel performs background supervision indicated by the flashing green LED. An alarm condition is indicated by the flashing red LED.

Multiple sensing technologies are incorporated into E-PHD and E-HD detectors, which makes them suitable for a wide range of applications.

The tables in the Heat detector applications section of this document list the applications suitable for the E-PHD and E-HD. Tables in the Smoke detector applications section list the applications suitable for the E-PD and E-PHD. The

Duct smoke detector applications section of this document lists the applications suitable for the E-PDD.

E-PD, E-PHD, and E-PDD detectors offer a variety of sensitivity settings. The alarm sensitivity is the minimum obscuration level at which the detector will initiate an alarm condition. The alarm sensitivity level may be changed to any of five sensitivity settings using front panel programming or the configuration utility.

All smoke detectors offer alarm verification, which is used to validate an alarm condition before it is processed by the control panel. When enabled, the alarm verification function tries to reset a detector that has initiated an alarm condition. If the detector cannot be reset or if it returns to its alarm condition within the required time window, the alarm is considered valid and is processed by the control panel.

Heat detector applications

Introduction

WARNING: This detector is intended for use with ionization and/or photoelectric smoke detectors. The heat detector by itself does not provide life safety protection.

Heat detectors sense a change in air temperature and initiate alarms based on a fixed-temperature point, rate of temperature rise, or amount of temperature rise above ambient condition. Spot type heat detectors should be selected so that the rating is at least 20°F (11°C) above maximum expected ceiling temperature. Ceiling height, construction, and ventilation play significant roles in detector performance and must be considered when determining detector placement.

E-HD Fixed-Temperature/Rate of Rise Heat Detector

The table below lists six standard types of fire and the suitability of the E-HD for each. The E-HD contains a 135°F (57°C) fixed-temperature heat sensor and a 15°F (8°C) per minute rate-of-rise heat sensor, which are best suited to detect fast, flaming fires such as open wood and liquid fires without smoke.

E-HD applications

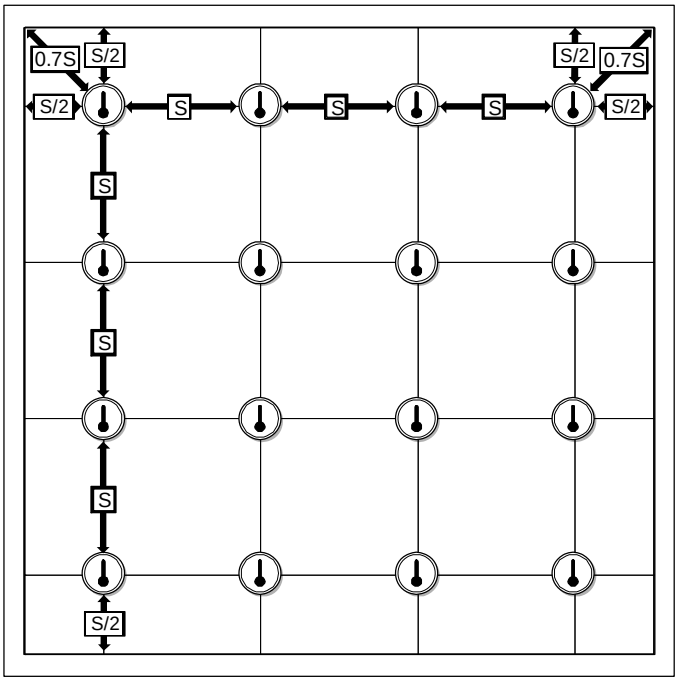
Type of fire	Suitability of E-HD
Open wood	Optimal
Wood pyrolysis	Unsuitable
Smoldering cotton	Unsuitable
PU foam	Suitable
n-Heptane	Very suitable
Liquid fire without smoke	Optimal

Spacing of heat detectors

Spot type heat detector spacing ratings are based on detector installation on a flat, smooth ceiling that is 10 feet (3 m) high. The listed spacing equates detector operation with the opening of a standard sprinkler head within 2 minutes (+/- 10 seconds) located 10 feet (3 m) from the same fire. Spot type detector spacing is

shown in the figure below. Detector coverage is typically represented as a square because most structures have flat sidewalls. Actual detector coverage is a circle whose radius is 0.7 times the listed spacing. Since all of the area within the detector's circle of coverage is suitable for detecting a fire, the shape and dimensions of the detector coverage "square" in the figure below may be modified. Note that, although the coverage "square" is now a "rectangle," the coverage area remains within the overall detector circle of coverage.

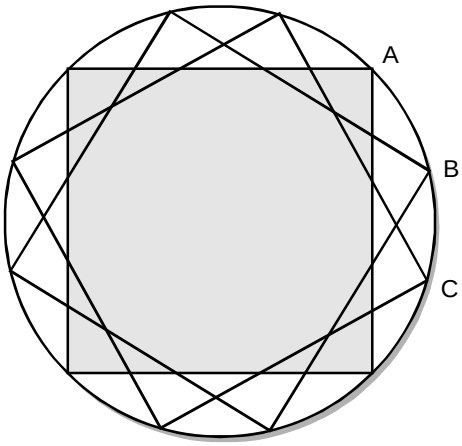
Listed Heat Detector Spacing



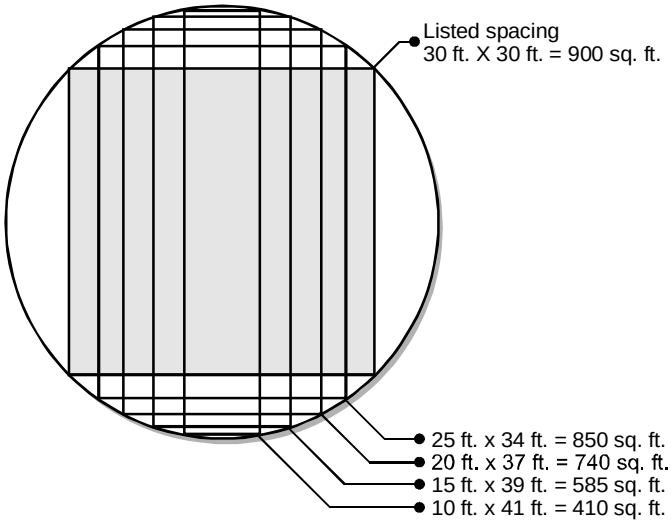
Item	Description
	Heat detector
S	Listed spacing between detectors

A spot type heat detector will cover all points located within 0.7 times the listed spacing. The listed spacing for heat detectors is S = 50 ft. (15.3 m).

Detector’s Circle of Coverage

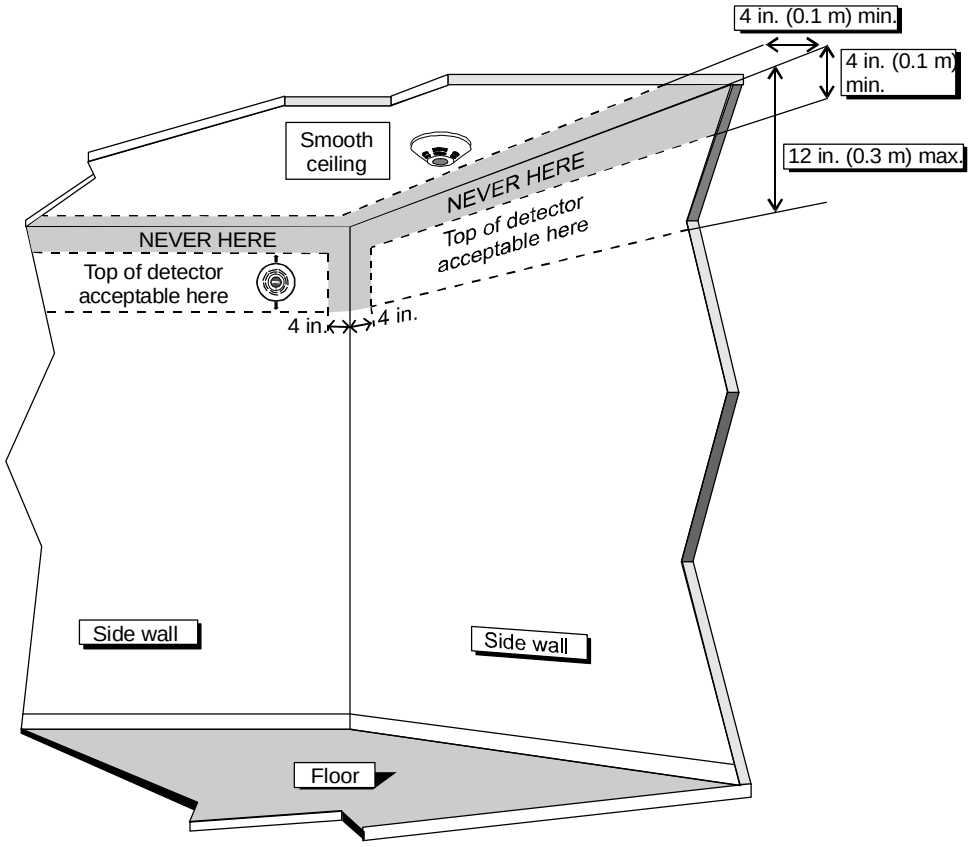


Alternate Heat Detector Coverage Configurations



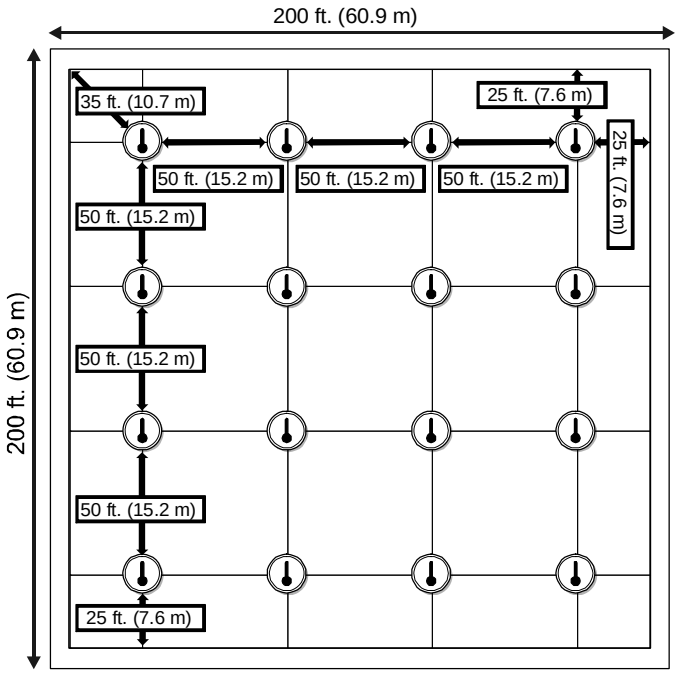
When installed on the ceiling, spot type heat detectors must be located a minimum of 4 in. (10 cm) from side walls. When installed on side walls, the detector must be between 4 in. (10 cm) and 12 in. (30 cm) from the ceiling, as shown below.

Detector Placement Near Ceiling/Wall Joints



The following figure shows the required heat detector spacing for a 200 ft. (60.9 m) by 200 ft. (60.9 m) room with a 10 ft. (3m) ceiling. The figure shows 16 heat detectors with a required listed spacing of S = 50 ft. (15.3 m).

Spacing Heat Detectors



Item	Description
	Heat detector
S	Listed spacing between detectors

Ceiling height and construction

When heat detectors are installed on other than flat, smooth ceilings or at ceiling heights greater than 10 ft. (3 m), spacing adjustments must be made. The table below lists the reduction in listed spacing that must be applied when detectors are mounted on ceilings higher than 10 ft. (3 m). This reduced spacing yields the equivalent response of detectors located on a 10 ft. (3 m) ceiling.

Spot type detector ceiling height reduction percentages

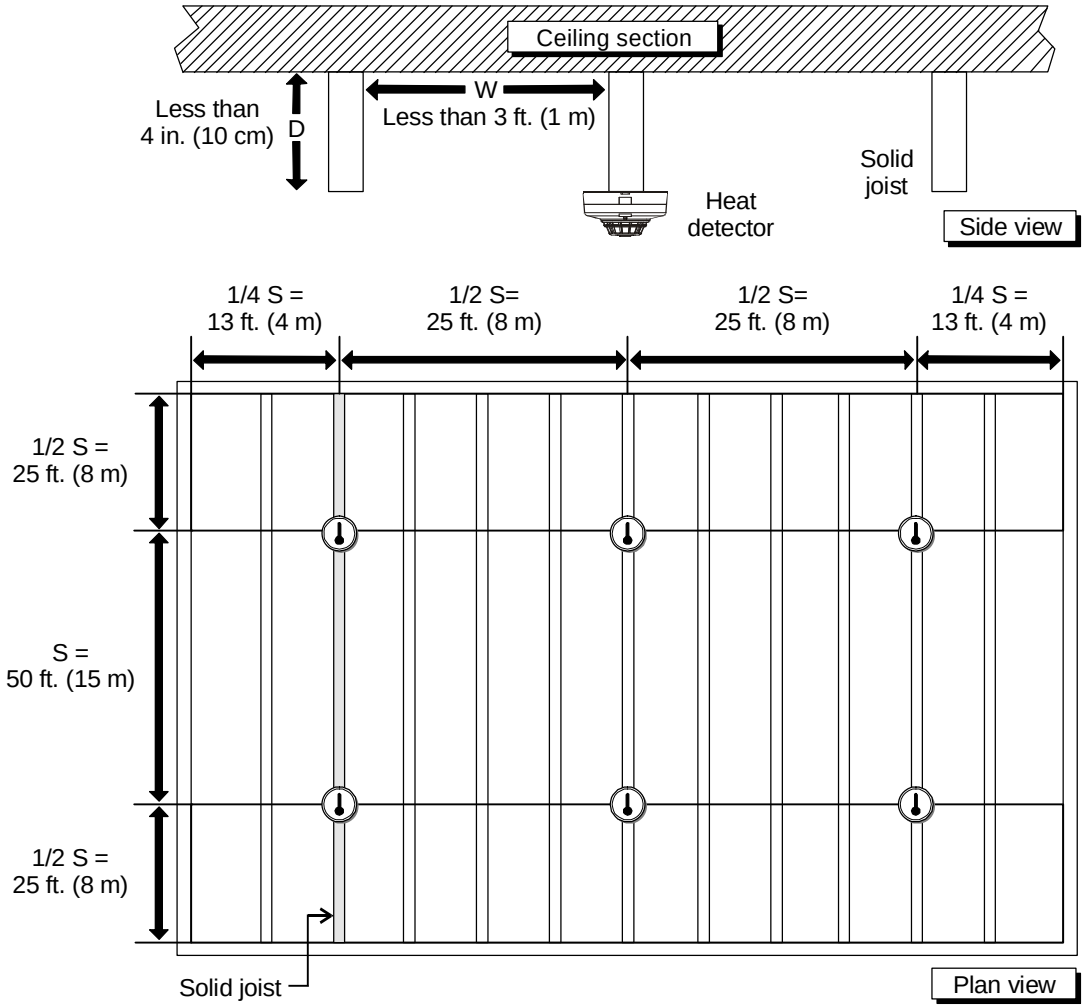
Ceiling height	Percent of listed spacing	Heat detector listed spacing
0 to 10 ft. (0 to 3 m)	100	50 ft. (15 m)
10 to 12 ft. (3 to 3.7 m)	91	46 ft. (14 m)
12 to 14 ft. (3.7 to 4.3 m)	84	42 ft. (13 m)

Ceiling height	Percent of listed spacing	Heat detector listed spacing
14 to 16 ft. (4.3 to 4.9 m)	77	39 ft. (12 m)
16 to 18 ft. (4.9 to 5.5 m)	71	36 ft. (11 m)
18 to 20 ft. (5.5 to 6.0 m)	64	32 ft. (10 m)
20 to 22 ft. (6.0 to 6.7 m)	58	29 ft. (9 m)
22 to 24 ft. (6.7 to 7.3 m)	52	26 ft. (8 m)
24 to 26 ft. (7.3 to 7.9 m)	46	23 ft. (7 m)
26 to 28 ft. (7.9 to 8.5 m)	40	20 ft. (6 m)
28 to 30 ft. (8.5 to 9.1 m)	34	17 ft. (5 m)

Exposed solid joists

Exposed solid ceiling joists may impede the flow of heat to the detectors. When spacing spot type heat detectors, a joist is defined as any solid member extending 4 in. (10 cm) or more down from the ceiling and spaced less than 3 ft. (1 m) apart. The spacing of heat detectors must be reduced by 50% in the direction perpendicular to the joist. The detectors must be mounted on the bottom of the joists.

Heat detector spacing — solid joist construction



Item	Description
	Heat detector
S	Listed spacing between detectors
W	Joist spacing

Notes

- Joists less than 4 in. (10 cm) deep are considered flat ceilings. Heat detectors must be mounted on the bottom of joists.
- Spacing perpendicular to joists deeper than 4 in. (10 cm) must be reduced by 50% of the listed spacing.

Exposed beams

Exposed beams may impede the flow of heat to the detectors. Beams are defined as members extending 4 in. (10 cm) or more down from the ceiling and spaced more than 3 ft. (1 m) apart. The spacing of heat detectors must be reduced by 33% in the direction perpendicular to the beam. Detectors can be mounted on the bottom of the beams which are less than 12 in. (30.4 cm) in depth and less than 8 ft. (2.4 m) on center. If beams are greater than 12 in. (30.4 cm) in depth and beam spacing exceeds 8 ft. (2.4 m) on center, then each bay created by the beams must have at least one detector mounted on the ceiling.

Heat detectors should be mounted on the ceiling in each bay if the ratio of beam depth (D) to ceiling height (H), D/H, is greater than 0.1 and the ratio of beam spacing (W) to ceiling height (H), W/H, is greater than 0.4.

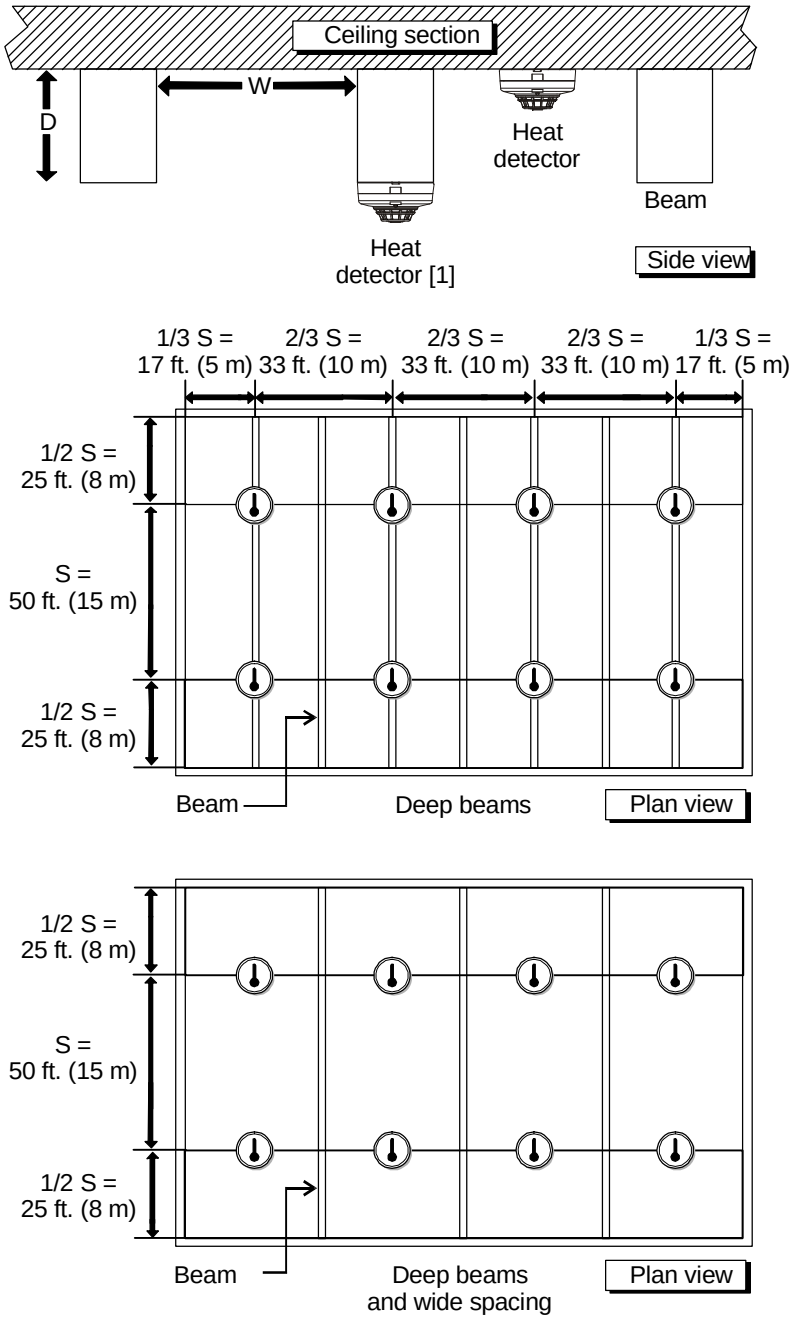
Heat detectors should be mounted on the bottom of each beam if either the ratio of beam depth (D) to ceiling height (H), D/H, is less than 0.1 or the ratio of beam spacing (W) to ceiling height (H), W/H, is less than 0.4.

Calculation

D/H > 0.1 AND W/H > 0.4 then mount the detector on the ceiling

D/H < 0.1 OR W/H < 0.4 then mount the detector on the bottom of the joist

Heat detector spacing — beam construction



Item	Description
	Heat detector
D	Depth of beam
W	Beam spacing

Notes

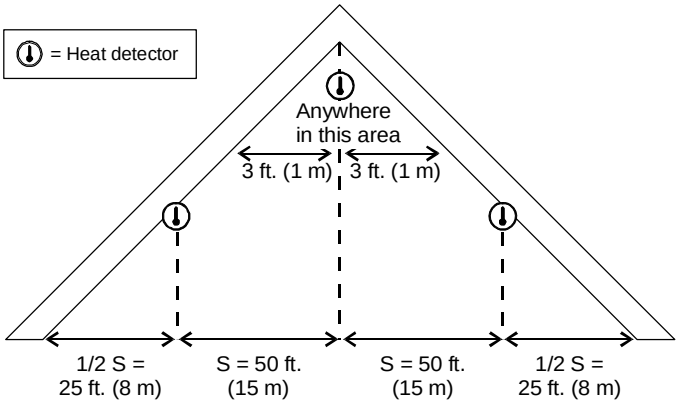
- Detectors can be located on the bottom of beams if the beams are less than 12 in. (30 cm) deep and beam spacing is less than 8 ft. (2.4 m).
- Beams less than 8 in. (20 cm) deep are considered flat ceilings. Heat detectors must be mounted on the bottom of the beams.
- Spacing perpendicular to beams deeper than 8 in. (20 cm) must be reduced by 1/3 of the listed spacing.
- If beam depth exceeds 18 in. (46 cm) and beam spacing exceeds 8.0 ft. (2.4 m) detectors must be installed on the ceiling in each bay.

Sloped ceilings

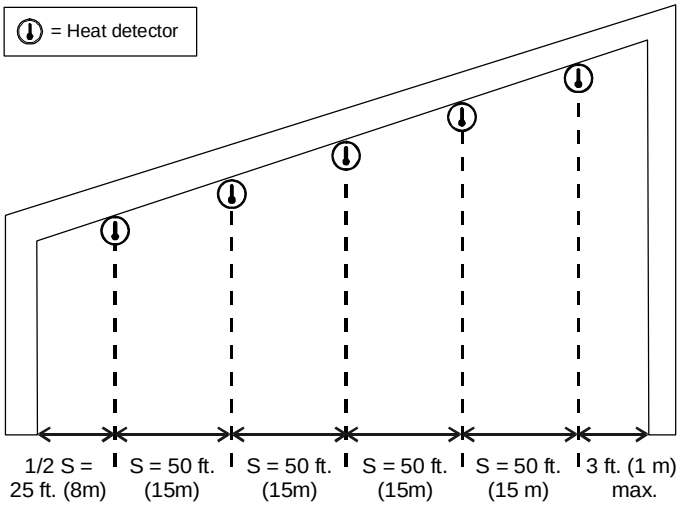
Rooms with peaked ceilings must have the first row of detectors placed within 3 ft. (1 m) (measured horizontally) of the ceiling peak. Additional detectors must be spaced based upon the horizontal projection of the ceiling and ceiling construction.

Rooms with shed ceilings having a slope greater than 1 ft. in 8 ft. (1 m in 8 m) must have the first row of detectors within 3-ft. (1 m) of the high end of the ceiling. Additional detectors, if required, shall be spaced based upon the horizontal projection of the ceiling and ceiling construction. For roofs having a slope less than 30 degrees, horizontal spacing must be adjusted according to the height of the peak. For roofs having a slope greater than 30 degrees, horizontal spacing shall be adjusted according to the average sloped ceiling height.

Heat detector spacing — peaked ceiling



Heat detector spacing — sloped ceiling



Smoke detector applications

Introduction

Smoke detectors sense the presence of smoke particles. In order for a smoke detector to sense these particles, smoke must travel from the point of origin to the detector. When evaluating a particular building or location for detector layout, likely fire locations should first be determined, and paths of smoke travel from each of these fire locations should be determined. Wherever practical, actual field tests should be conducted. The most desired location for smoke detectors would be the common points of intersection of smoke travel from fire locations throughout the building. Ceiling height, construction, and ventilation play significant roles in smoke detector performance.

E-PD Photoelectric Smoke Detector

The table below lists six standard types of fire and the suitability of the E-PD for each. Photoelectric smoke detectors have a wide range of fire sensing capabilities and are best suited to detect slow, smoldering fires such as wood pyrolysis and smoldering cotton.

E-PD applications

Type of fire	Suitability of E-PD
Open wood	Unsuitable
Wood pyrolysis	Optimal
Smoldering cotton	Optimal
PU foam	Very suitable
n-Heptane	Very suitable
Liquid fire without smoke	Unsuitable

E-PHD multi-sensor smoke detector

The table below lists six standard types of fire and the suitability of the E-PHD for each. The E-PHD is a multi-sensor device with a wider range of fire sensing capabilities than single-sensor detectors. The E-PHD contains a photoelectric smoke sensor as well as a 135°F (57°C) fixed-temperature heat sensor. The E-PHD is best suited for detecting slow, smoldering fires such as wood pyrolysis,

smoldering cotton, and n-Heptane. The supplemental information provided by the integral fixed-temperature heat sensor also makes the E-PHD very suitable for detecting the other types of fire.

E-PHD applications

Type of Fire	Suitability of E-PHD
Open wood	Very suitable
Wood pyrolysis	Optimal
Smoldering cotton	Optimal
PU foam	Very suitable
n-Heptane	Optimal
Liquid fire without smoke	Very suitable

Avoidance of false alarms

Smoke detectors are sensitive to a number of environmental factors (other than smoke) which may inadvertently activate the detectors. Careful consideration of the environment in which a detector is installed will minimize unwanted detector activation (nuisance alarms). Listed below are some common sources of false alarms to be considered when locating smoke detectors.

- Cooking equipment
- Welding, cutting, and industrial processes
- Chemical fumes
- Dust
- Engine exhaust
- Vibration
- Excessive airflow
- Lightning and power outages
- Radio frequency transmissions
- Steam and moisture

These smoke detectors provide automatic environmental compensation, which reduces the occurrence of false alarms by allowing sensing elements to adapt to long-term environmental changes, caused by dirt, smoke, temperature, and humidity.

These smoke detectors issue a dirty sensor warning when they reach the preset limit. The dirty sensor warning indicates a sensor is operating within its specified limits, but is in need of servicing. When the detector's ability to compensate for environmental changes has reached its limit, the smoke detector signals a trouble condition to the control panel.

Spacing of smoke detectors

The spot type smoke detector spacing recommendation of 30 ft. (9.1 m) is based upon the detector installation on a smooth ceiling that is 10 ft. (3 m) high. Detector coverage is typically represented as a square, because most structures have flat sidewalls. Like spot type heat detectors, smoke detector coverage is a circle whose radius is 0.7 times the listed spacing. Since all of the area within the detector's circle of coverage is suitable for detecting smoke from fire, the shape and dimensions of the detector coverage "square" may be modified. Note that, although the coverage "square" is a "rectangle," the coverage area is within the overall detector circle coverage.

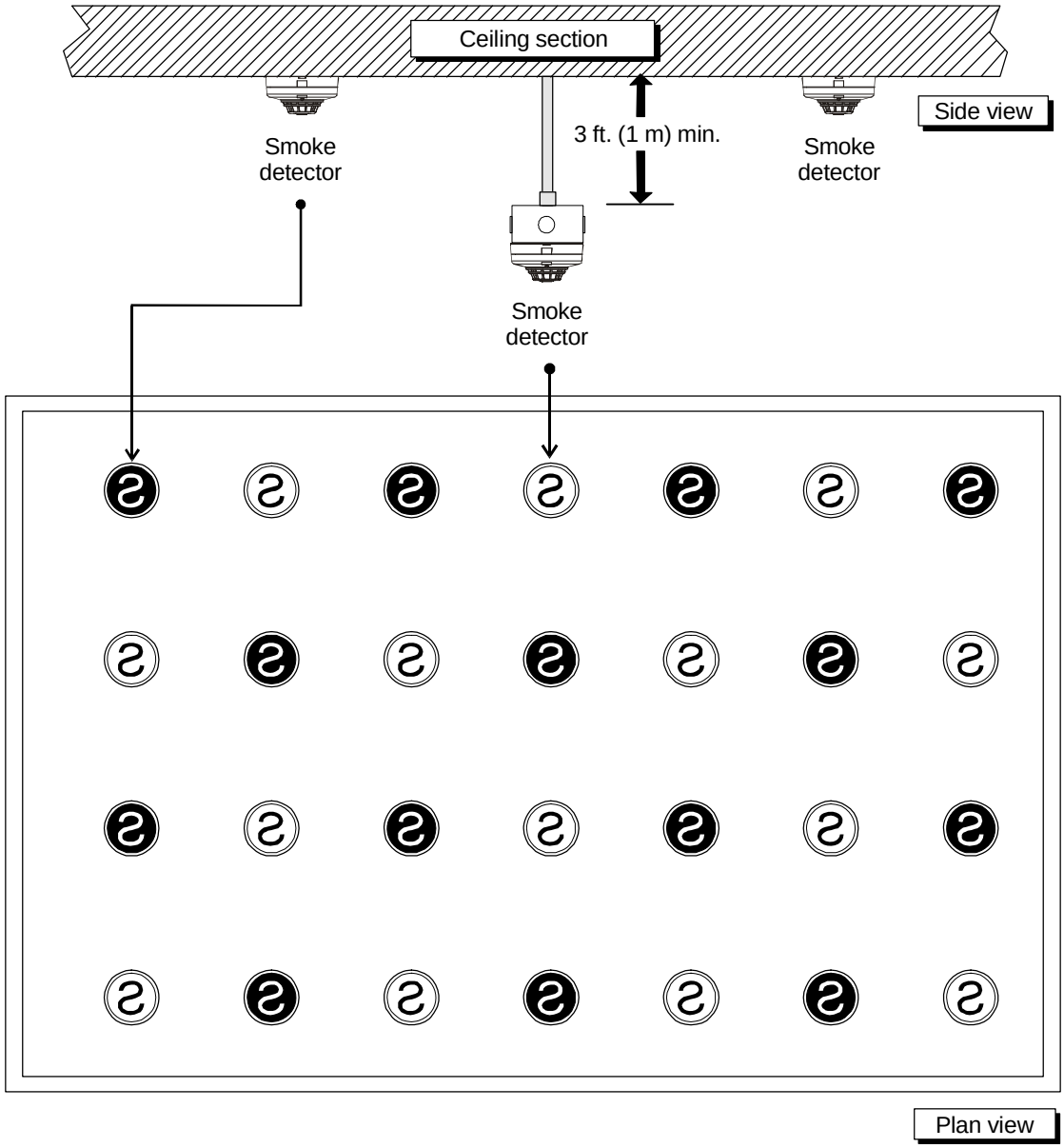
Note: Unlike heat detectors, smoke detectors are not given a listed spacing. It is recommended that smoke detectors be installed on S = 30 ft. (9.1 m) centers, on smooth ceilings. NFPA 72 *National Fire Alarm Code* contains additional information regarding spacing adjustments.

When installed on the ceiling, spot type detectors must be located a minimum of 4 in. (10cm) from sidewalls. When installed on sidewalls, the detector must be located between 4 in. (10cm) and 12 in. (30cm) from the ceiling, unless detectors are specifically positioned to counter the effects of ceiling construction or stratification.

Stratification

Stratified air within a room may impede smoke from reaching the detector. To improve detection system response in situations where stratification exists, additional detectors may be installed on sidewalls at elevations below the ceiling level as shown in the illustration.

Smoke detector compensation for stratification



Item	Description
	Smoke detector, below ceiling
	Smoke detector, at ceiling

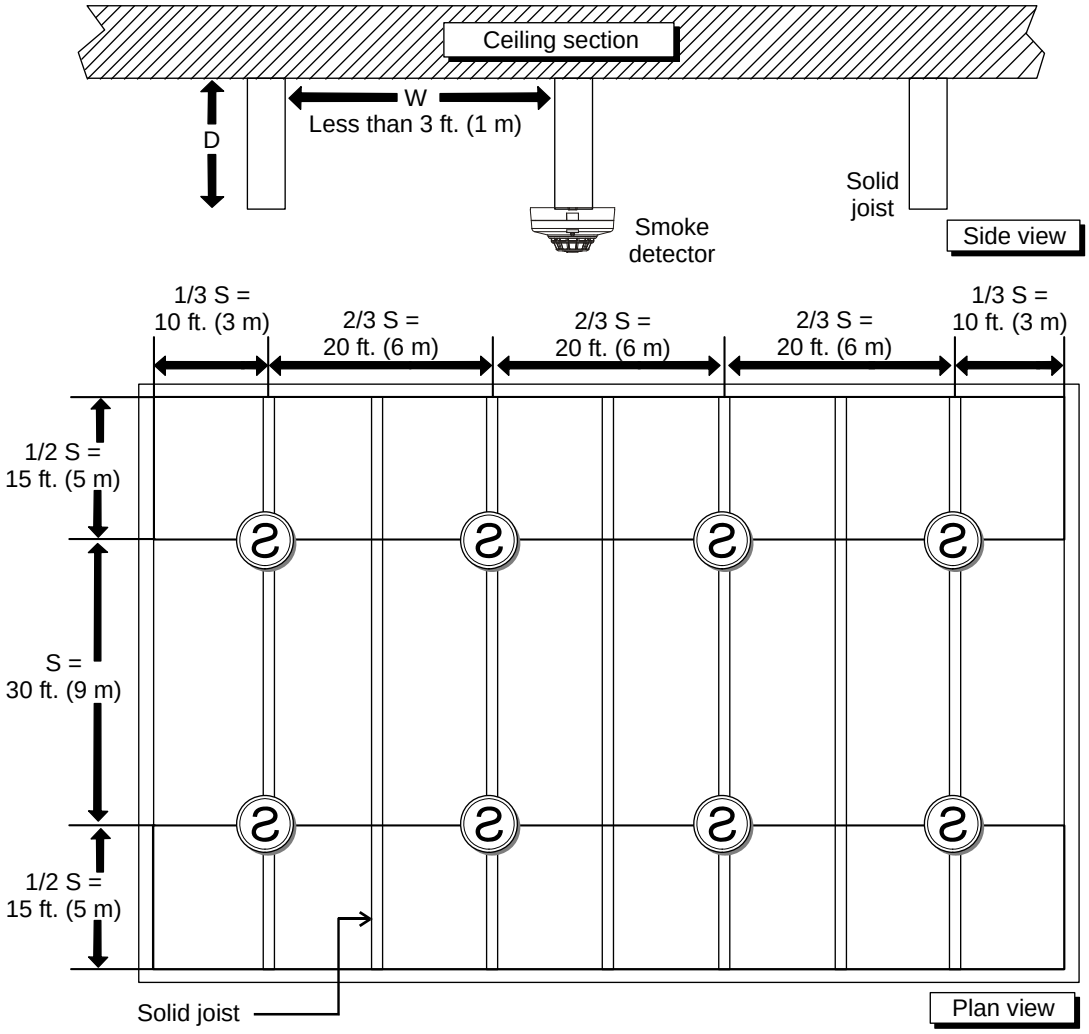
Partitions

Partitions extending from the floor to within 18 in. (46 cm) of the ceiling do not influence smoke detector spacing. Partitions closer than 18 in. (46 cm) to the ceiling may require modification of smoke detector spacing.

Exposed solid joists

Exposed solid ceiling joists may impede the flow of smoke to detectors. When spacing spot type smoke detectors, a joist is defined as any solid member extending 8 in. (20 cm) or more down from the ceiling and spaced less than 3 ft. (1 m) apart. Note that this definition differs from the one used in locating spot type heat detectors. The spacing of smoke detectors must be reduced by 33% in the direction perpendicular to the joist. The detectors must be mounted on the bottom of the joists.

Smoke detector spacing — solid joist construction



Item	Description
S	Smoke detector
D	Depth of joist
S	Recommended detector spacing
W	Joist spacing

Note

- Joists less than 8 in. (20 cm) deep are considered flat ceilings. Smoke detectors must be mounted on the bottom of joists.
- Spacing perpendicular to joists deeper than 8 in. (20 cm) must be reduced by 1/3 of the listed spacing.

Exposed beams

Beams are defined as any members extending 8 in. (20 cm) or more down from the ceiling and spaced more than 3 ft. (1 m) apart. Note that this definition differs from the one used in locating spot type heat detectors. The spacing of smoke detectors must be reduced in the direction perpendicular to the beam. Detectors may be mounted on the bottom of the beams that are less than 12 in. (30 cm). If the beams are greater than 18 in. (46 cm) deep, each bay created by the beams must have at least one detector mounted on the ceiling.

Smoke detectors should be mounted on the ceiling within each bay if the ratio of beam depth (D) to ceiling height (H), D/H, is greater than 0.1, and the ratio of beam spacing (W) to ceiling height (H), W/H, is greater than 0.4.

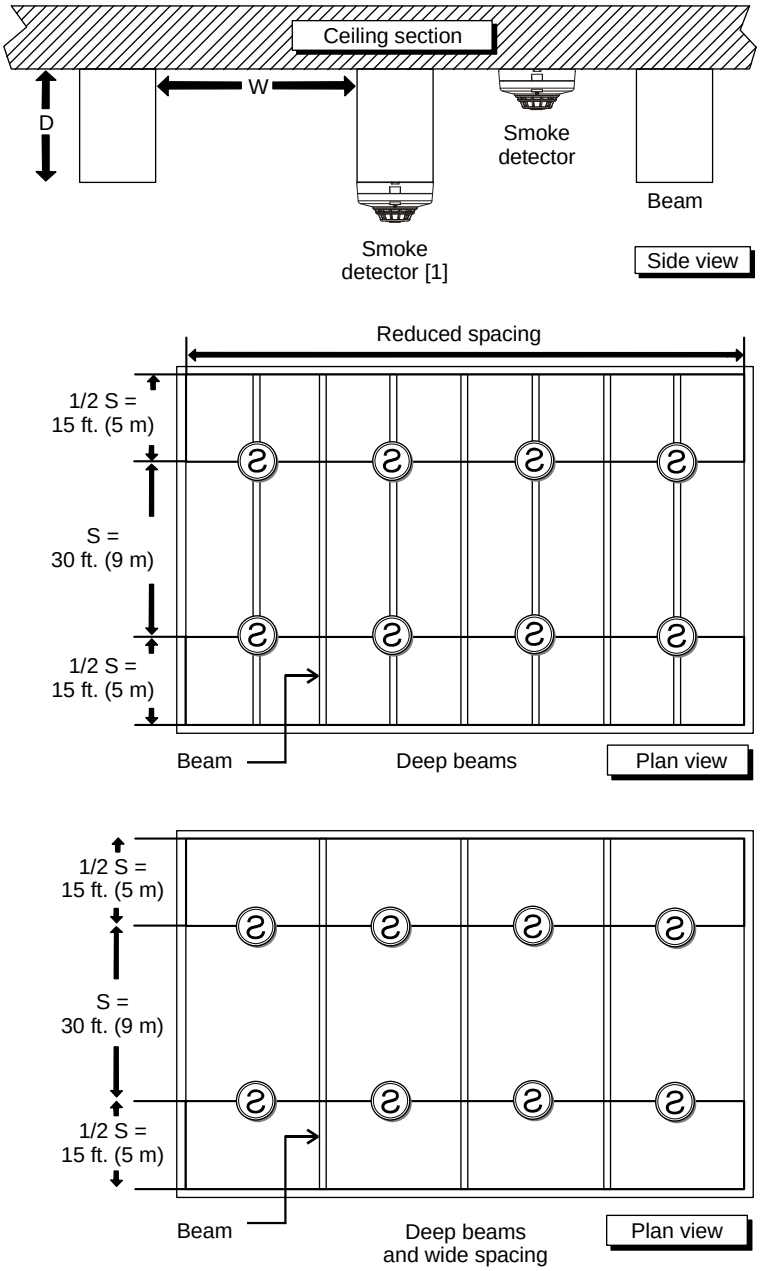
Smoke detectors should be mounted on the bottom of each beam if either the ratio of beam depth (D) to ceiling height (H), D/H, is less than 0.1, or the ratio of beam spacing (W) to ceiling height (H), W/H, is less than 0.4.

Calculation

D/H > 0.1 and W/H > 0.4 then mount the detector on the ceiling

D/H < 0.1 or W/H < 0.4 then mount the detector on the bottom of the beam

Smoke detector spacing — beam construction



Item	Description
S	Smoke detector
D	Depth of joist
S	Recommended detector spacing
W	Joist spacing

Notes

- Detector can be located on the bottom beams if the beams are less than 12 in. (30 cm) deep and beam spacing is less than 8 ft. (2.4 m)
- Beams less than 8 in. (20 cm) deep are considered flat ceilings. Smoke detectors must be mounted on the bottom of the beams.
- No definite spacing reduction is specified by code for beams deeper than 8 in. (20 cm).
- If beam depth exceeds 18 in. (46 cm) and beam spacing exceeds 8.0 ft. (2.4 m) detectors must be installed on the ceiling in each bay.

Sloped ceilings

Rooms with peaked ceilings must have the first row of detectors placed within 3 ft. (1 m) (measured horizontally) of the ceiling peak. Additional detectors, if required, must be spaced based upon the horizontal projection of the ceiling and ceiling construction. This modification of spacing for smoke detectors on sloped ceilings is identical to that used for spot type heat detectors.

Rooms with shed ceilings having a slope greater than 1 ft. in 8 ft. (1 m in 8 m) must have the first row of detectors within 3 ft. (0.9 m) of the high end of the ceiling. Additional detectors, if required, must be spaced based upon the horizontal projection of the ceiling and ceiling construction. For roofs having a slope less than 30 degrees, horizontal spacing must be adjusted according to the height of the peak. For roofs having a slope greater than 30 degrees, horizontal spacing must be adjusted according to the average sloped ceiling height. These modifications of spacing for smoke detectors on shed ceilings is identical to that used for spot type heat detectors.

High air movement

The use of spot type smoke detectors in areas of high air movement (greater than 300 ft./min. [1.5 m/sec.]) requires a suitable reduction in detector spacing to maintain detector performance. The table below should be used to reduce detector spacing in these areas. The table is not valid for use under floor or ceiling plenum areas, however, the principle of reduced spacing in these high velocity areas applies.

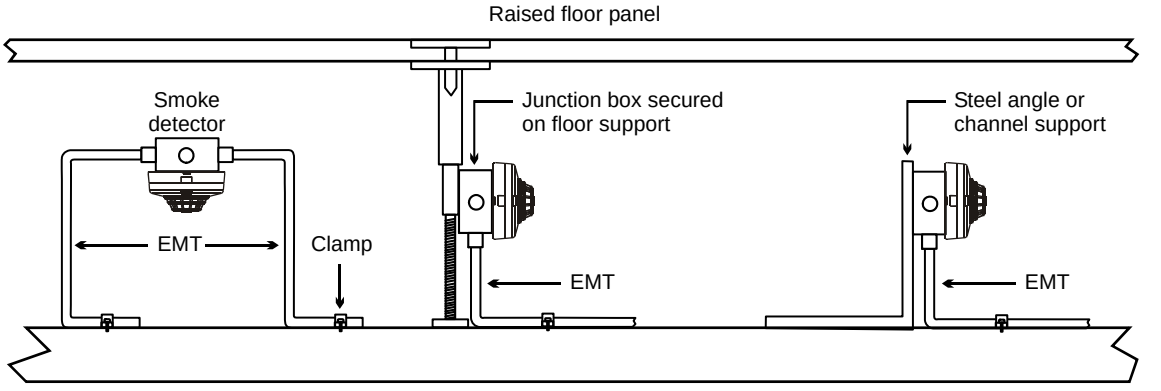
High air movement area detector spacing reduction

Minutes per air change	Number of air changes per hour	Coverage per detector
1	60	125 sq. ft. (11.25 sq. m)
2	30	250 sq. ft. (22.50 sq. m)
3	20	375 sq. ft. (33.75 sq. m)
4	15	500 sq. ft. (45.00 sq. m)
5	12	625 sq. ft. (56.25 sq. m)
6	10	750 sq. ft. (67.50 sq. m)
7	8.6	875 sq. ft. (78.75 sq. m)
8	7.5	900 sq. ft. (81.00 sq. m)
9	6.7	900 sq. ft. (81.00 sq. m)
10	6	900 sq. ft. (81.00 sq. m)

Under floor installations

When spot type smoke detectors are installed under raised floors, they are subjected to high air velocities and dust levels. Detectors should be installed base up or base vertical (never down) as shown in the figure below. This minimizes the effects of dirt, dust, and mechanical interference from cabling.

Permissible smoke detector under floor mounting



Effects of heating, ventilating, and air conditioning (HVAC) systems

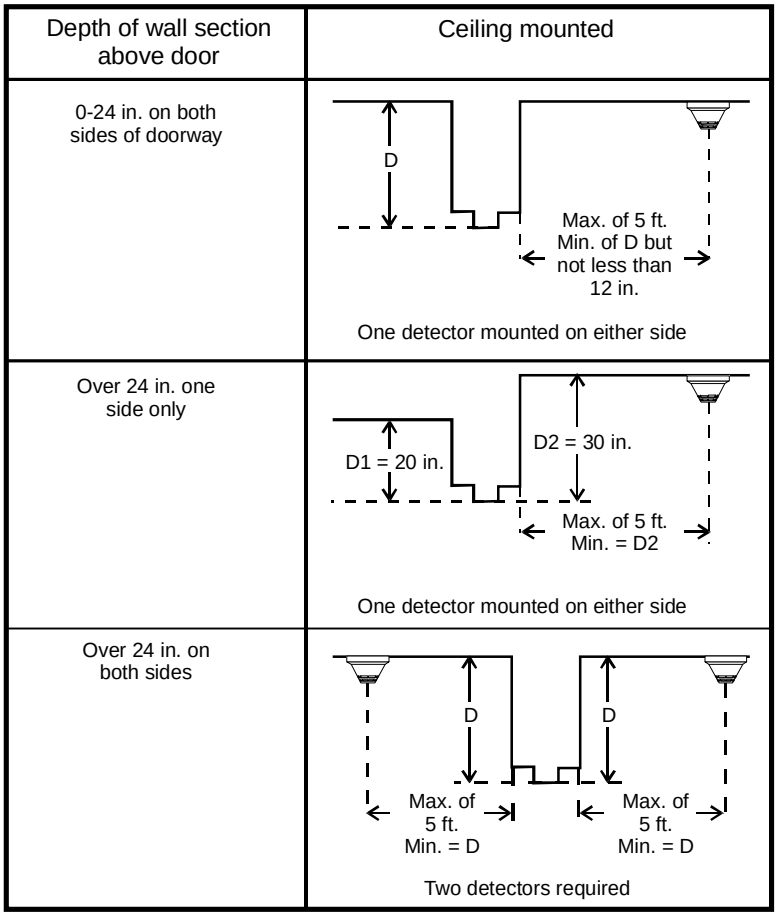
Because airflow is critical to the transportation of smoke to the detector location, smoke detectors should never be located closer than 3 ft. (1 m) to an HVAC supply diffuser. Where feasible, detectors should be located to favor the airflow heading for HVAC return grills. Do not rely on the operation of the HVAC system when spacing smoke detectors.

Door release service

Smoke detector locations

When spot type smoke detectors are installed to detect smoke coming from either side of a doorway in order to release the door, smoke detectors must be installed according to the figure below.

Smoke detector locations for door release service



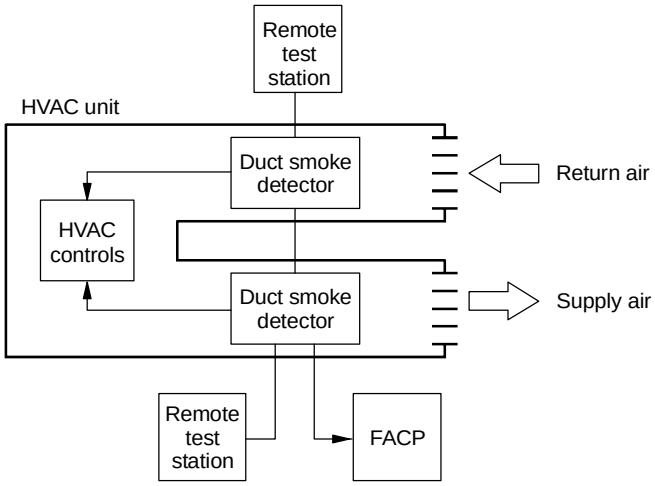
Duct smoke detector applications

Introduction

WARNING: Duct smoke detectors are not intended as substitutes for open area protection.

The duct smoke detector uses the photoelectric method of smoke detection. The duct smoke detector's primary purpose is to provide early warning of an impending fire and shut down the HVAC unit in order to prevent smoke from circulating throughout the building. It is typically used to detect smoke in the supply side of the HVAC system but can provide supervision of the return side as well.

Duct smoke detector application diagram



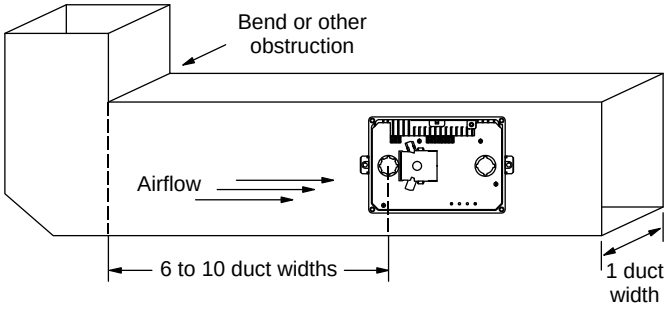
E-PDD Duct Smoke Detector installation guidelines

In order to obtain a representative sample of the air in an air handling system, locate the detector so its sampling tube is positioned in a straight length of square duct between six and ten duct widths from any bends or obstructions.

For detection of smoke in the supply air system, install the duct smoke detector in the supply air duct at a point downstream from the supply fan and air filters.

For detection of smoke in the return air system, install the duct smoke detector in the return air duct at a point before the return air stream is diluted by outside air

Duct smoke detector placement

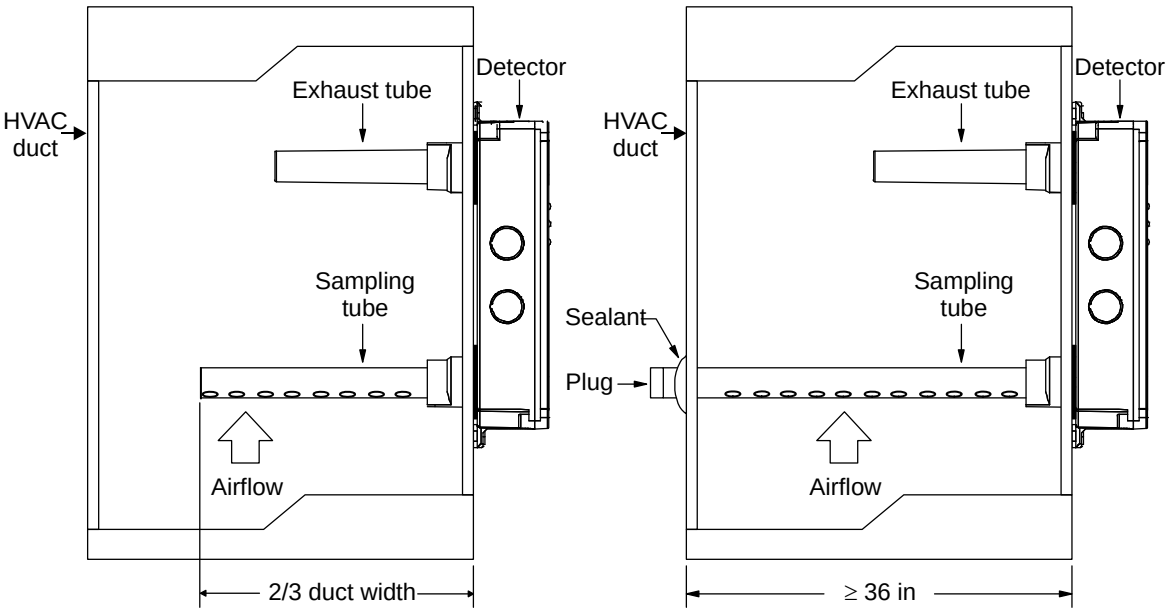


Air sampling tube

Air is introduced to the duct smoke detector's sensing chamber through a sampling tube that extends into the HVAC duct and is directed back into the ventilation system through an exhaust tube. The difference in air pressure between the two tubes pulls the sampled air through the sensing chamber. When a sufficient amount of smoke is detected in the sensing chamber, the duct smoke detector notifies the fire alarm control panel.

NFPA requirements state that sampling tubes must extend at least two-thirds of the way into the duct and those that are greater than 36 inches long must be supported at both ends.

Air sampling tube requirements



Air velocity

The duct smoke detector is designed for use in air handling systems having an air velocity rating of 100 to 4,000 ft./min.

Avoidance of false alarms

Caution: Excess temperature differentials between the ambient air and the sampled air can produce unwanted condensation inside the detector, which may cause the detector to function improperly. Precautions should be taken to limit the temperature range and the amount of condensation to which the detector is exposed.

The duct smoke detector uses differential sensing to prevent gradual environmental changes from triggering false alarms. A rapid change in environmental conditions, such as smoke from a fire, causes the detector to signal an alarm state but the accumulation of dust and debris over time does not.

The duct smoke detector issues a dirty sensor warning when it reaches a preset limit. The dirty sensor warning indicates the sensor is operating within its specified limits but is in need of servicing. When the detector’s ability to compensate for environmental changes has reached its limit, the duct smoke detector signals a trouble condition.

Initial installation testing

Smoke and heat detector initial installation test

To do an initial installation test:

1. Before testing the smoke and heat detectors, notify the proper authorities that the system is undergoing maintenance and, unless part of the test, disconnect all auxiliary equipment.
2. Visually inspect each detector and verify it is installed in the correct location. Make sure it will not be adversely affected by factors not apparent on the plans.
3. Remove the detector from its base and verify that the proper detector address, trouble signals, and messages are reported.
4. Activate smoke detectors using a chemical smoke aerosol spray (Smoke!-In-A-Can model SM-200, is recommended) or a smoke generator.
5. Activate rate-of-rise heat detectors using a heating device (a 1200- to 1500-watt commercial hair blow-dryer is recommended) approximately 3-inches from the detector.
6. If wired for Class A operation, verify this operation with each data circuit disconnected.
7. Place a ground on the data circuit and verify operation of ground fault detection circuitry.
8. Run a device maintenance report on all detectors and verify that readings fall within acceptable limits.
9. After you have finished testing the smoke and heat detectors, reset the control panel in order to restore the detectors to their normal state.
10. Notify the proper authorities that the system maintenance is complete.

Duct smoke detector initial installation test

Controls and indicators

The following table provides a description of the duct smoke detector controls and indicators.

Duct smoke detector controls and indicators

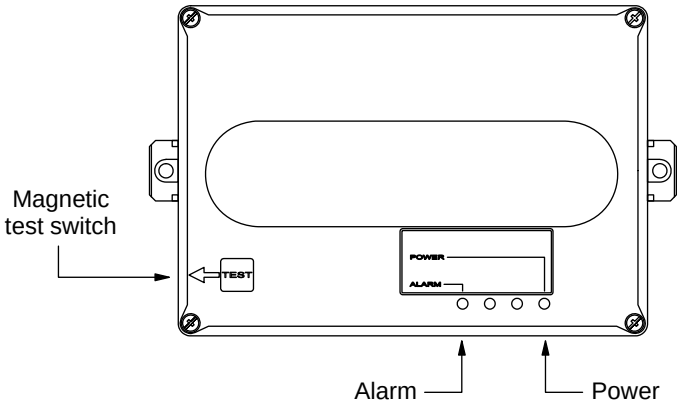
Control or indicator	Description
Magnetic test switch	Activates (alarm state) the detector when it is in the normal state. The switch is inoperative when the detector is in the trouble state. The switch cannot be used to reset the device, this must be done at the control panel.
Alarm LED	Indicates the detector is in the alarm state as follows: Flashes at a continuous rate if the first detector in alarm Flashes intermittently if not the first detector in alarm
Power LED	Off when the detector is in the alarm state Flashes intermittently when the detector is in the normal state

Notes

The intermittent flash indicates each time the control panel polls the detector.

Both LEDs are on continuously when the detector is in alarm.

Duct smoke detector controls and indicators



Normal state

The duct smoke detector operates in the normal state in the absence of any trouble conditions and when its sensing chamber is free of smoke.

Alarm state

The duct smoke detector enters the alarm state (is activated) when the amount of smoke in its sensing chamber exceeds its alarm threshold setting or when an alarm test is initiated. Upon entering the alarm state, the duct smoke detector's:

- Alarm LED turns on
- Common alarm relay contacts switch positions (unless programmed differently by the control panel)
- Remote alarm LED output turns on (is activated)

In addition, the duct smoke detector generates an alarm or supervisory event message depending on the device type with which it is configured.

Trouble state

The duct smoke detector enters the trouble state under the following conditions:

- Its cover is removed and 20 minutes pass before it is properly secured
- Its environmental compensation limit is reached
- The detector is 100% dirty
- An internal detector fault is present

Upon entering the trouble state, the duct smoke detector generates an event message based on the type of trouble encountered.

Note: All troubles are latched by the duct smoke detector. You must clear the trouble condition then reset the control panel in order to restore the detector to its normal state.

To do an initial installation test:

1. Before testing the duct smoke detectors, notify the proper authorities that the system is undergoing maintenance and, unless part of the test, disconnect all auxiliary equipment.
2. Visually inspect each detector and verify it is installed in the correct location. Make sure it will not be adversely affected by factors not apparent on the plans.
3. Verify that adequate airflow is available for the duct smoke detectors per the installation instructions.
4. Verify that the detector address is correct.

   Note: You cannot initiate an alarm test if the duct smoke detector is in the trouble state.
5. If an SD-TRK remote test-reset station is installed, turn the key switch to the TEST position for more than 5 seconds.

6. If an SD-TRM remote test-reset station is installed, hold the SD-MAG test magnet to the target area for more than 5 seconds.
7. Hold the SD-MAG where indicated on the side of the duct smoke detector for more than 5 seconds.
8. Verify the detector's Alarm LED is flashing and the appropriate event message or visual indication is reported on the fire alarm control panel.
9. Reset the control panel in order to restore the detector to its normal state.
10. Verify the remote test station's Alarm LED is flashing and the appropriate event message or visual indication is reported on the fire alarm control panel.
11. Place a ground on the data circuit and verify operation of ground fault detection circuitry.
12. Run a device maintenance report on all detectors and verify that readings fall within acceptable limits.
13. After you have finished testing the duct smoke detector, reset the control panel in order to restore the detector to its normal state.
14. Notify the proper authorities that the system maintenance is complete.

Sensitivity readings

Acceptable sensitivity range

The control system to which these detectors are connected is capable of interrogating each detector to determine its sensitivity. The system can provide a hard copy of the results of sensitivity testing if a printer is installed. The table below lists the acceptable range of sensitivity for smoke and heat detectors.

Acceptable sensitivity ranges as reported by the control panel

Model	Detection element(s)	Factory assigned sensitivity	Pre-alarm point (%obsc./ft.)	Adjustable alarm point setting (%obsc./ft.)
E-PD	Photoelectric	UL: 0.67 to 3.66%/ft. obscuration ULC: 0.74 to 3.70%/ft. obscuration	50 - 90% of alarm setting, in 5% increments (no 85% pre-alarm point)	1.0, 2.0, 2.5, 3.0, 3.5
E-PHD	Photoelectric, fixed-temperature	UL: 0.67 to 3.66%/ft. obscuration ULC: 0.87 to 3.70%/ft. obscuration	50 - 90% of alarm setting, in 5% increments (no 85% pre-alarm point)	1.0, 2.0, 2.5, 3.0, 3.5
E-HD	Fixed-temperature, rate-of-rise	135°F (57°C), 15° F/minute	N/A	N/A
E-PDD	Photoelectric (duct)	0.79 to 2.46% obsc./ft.	N/A	N/A

Routine maintenance

Scheduled testing

To conduct a scheduled test:

Detectors shall be tested on a routine basis satisfactory to the authority having jurisdiction, typically once every 6 months.

1. Before testing the smoke and heat detectors, notify the proper authorities that the system is undergoing maintenance and, unless part of the test, disconnect all auxiliary equipment.
2. Verify detector operation, wiring integrity, and control panel operation sequences specific to that detector, if any.
3. Activate smoke detectors using a chemical smoke aerosol spray tester (Smoke! In-A-Can recommended) or a smoke generator.
4. Activate rate-of-rise heat detectors using a heating device (a 1200- to 1500-watt commercial hair blow-dryer is recommended) approximately 3 inches from the detector.
5. Activate duct smoke detector using the SD-MAG magnetic test kit or a ST-TRK/TRM remote test station.
6. Run a device maintenance report on all detectors and verify that readings fall within acceptable limits. Detectors too close to the alarm threshold should be cleaned according to the manufacturer’s instructions.
7. Reset the control panel in order to restore the detectors to their normal state.
8. Notify the proper authorities that the system maintenance is complete.

Recommended Testing Schedule

Component	Testing Interval	Testing Procedure
E-HD,E-PHD	Semiannually	1. Visually inspect the heat detector. Verify that the green LED is flashing. 2. Put the detector/zone in TEST mode. **CAUTION**: Do not use excessive heat for too long or permanent detector damage may result. 3. Hold the heating device (a 1200- to 1500-watt commercial hair blow-dryer is recommended) approximately 3-inches from the detector, directed towards the heat entry slots. 4. Turn the blower on at its highest setting. The detector should alarm within 10 to 15 seconds and the red LED should illuminate. 5. Verify that a detector activation indication is listed on the printer.
E-PDD	Semi-Annually	1. Visually inspect the duct smoke detector. 2. Verify that the green LED is flashing.
E-PD,E-PHD	Annually	1. Visually inspect the smoke detector. Verify that the green LED is flashing. 2. Put the detector/zone in TEST mode. 3. If a detector functional test is required, use Smoke!-In-A-Can tester per instructions on the can. 4. Verify that a detector activation indication is listed on the printer. 5. Run a device maintenance report.
E-PDD	Annually	1. Visually inspect the duct smoke detector. Verify that the green LED is flashing. 2. Put the detector/zone in TEST mode. 3. If a detector functional test is required, use the SD-MAG magnetic test kit or the SD-TRM/TRK remote test station per kit/test station instructions. 4. Verify that a detector activation indication is listed on the printer. 5. Run a device maintenance report.

Detector cleaning procedure

To clean the heat detector (E-HD, E-PHD):

No cleaning is required.

To clean the smoke detector (E-PD, E-PHD):

Caution: Before cleaning the smoke detector, notify the proper authorities that the fire alarm system is undergoing maintenance and take steps to prevent the control panel from responding to a false alarm.

Note: Clean the smoke detector when it becomes 80% to 99% dirty or sooner if conditions warrant.

1. Disable the detector/zone to prevent false alarms.
2. Remove the detector from the base.
3. Insert a screwdriver in the small slot where the detector cap connects to the detector body.
4. Pry the detector cap off of the detector body.
5. Squeeze the optical block chamber at the two arrows labeled, “squeeze here.” Pull off the optical block chamber.
6. Blow off the optical block base in the detector body using clean compressed air.
7. Snap a new optical block chamber in place. Make sure you line up the two arrows on the block chamber with the snaps on the optical block base.
8. Connect the detector cap to the detector body by rotating the cap clockwise until is snaps into a locked position.
9. Install the detector onto the base.

   Note: To verify the effectiveness of the cleaning, recalibrate the device and run a device maintenance report. Refer to “recalibrate a device and record detector sensitivity and available compensation.”
10. Test the detector and verify sensitivity.
11. Notify the proper authorities that the system maintenance is complete.

To clean the duct smoke detector (E-PDD):

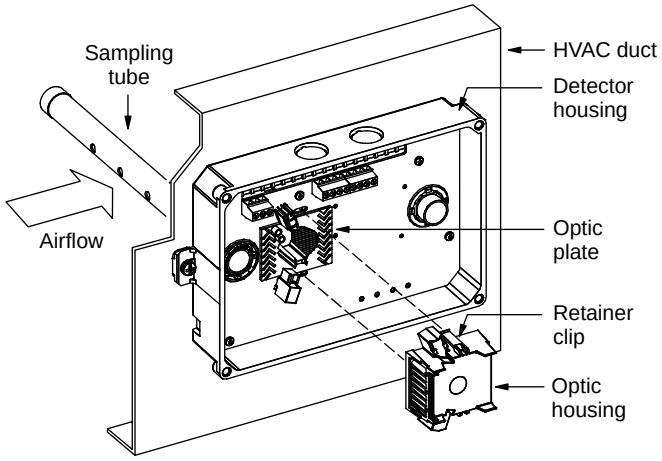
Caution: Before cleaning the smoke detector, notify the proper authorities that the fire alarm system is undergoing maintenance and take steps to prevent the control panel from responding to a false alarm.

Note: Clean the smoke detector when it becomes 80% to 99% dirty or sooner if conditions warrant.

1. Disable the detector/zone to prevent false alarms.
2. Remove the detector's cover then power down the detector by disconnecting the SLC loop wiring.
3. Using a vacuum cleaner, clean compressed air, or a soft bristle brush, remove loose dirt and debris from inside the detector housing and cover.
4. Use isopropyl alcohol and a lint-free cloth to remove dirt and other contaminants from the gasket on the detector's cover.
5. Squeeze the retainer clips on both sides of the optic housing then lift the housing away from the printed circuit board.
6. Gently remove dirt and debris from around the optic plate and inside the optic housing.
7. Install the optic housing and detector cover, then connect the SLC loop wiring.

   Note: To verify the effectiveness of the cleaning, recalibrate the device and run a device maintenance report. Refer to "recalibrate a device and record detector sensitivity and available compensation."
8. Test the detector and verify sensitivity.
9. Notify the proper authorities that the system maintenance is complete.

Duct smoke detector cleaning



Recalibrate a device and record detector sensitivity and available compensation

Environmental compensation circuits and the alarm algorithm used in these detectors guarantee that a detector's sensitivity setting is maintained as long as a detector has compensation headroom. When the detector reaches 80% dirty, the system generates a maintenance alert indicating the detector should be cleaned in the near future. When the detector reaches 100% dirty, a detector trouble condition is annunciated.

To properly judge the effectiveness of the detector cleaning process, you must observe the effect cleaning had on the detector's dirtiness level. This can be accomplished using the control panel recalibrate device feature.

Recalibrate device is used to reset a detector after it has been cleaned. The recalibrate command resets the environmental compensation and dirtiness level faster than the normal amount of time it takes the panel to recognize that the detector has been cleaned and reset it. Once a detector has been cleaned, you can quickly reset the detector by using this command to either clear the trouble or determine that more cleaning is necessary because the trouble did not clear for the device.

To recalibrate a device after cleaning:

1. Clean the detector.
2. Press the Menu button on the control panel, then select Diagnostics.
3. Select Recalibrate Device.
4. Choose the loop the device is on. Note: If your panel only has one loop, the loop selection screen does not display. Go to the next step.
5. Choose the device (number) that you want to recalibrate, then press Enter.
6. Run the device maintenance report to print a list of detector sensitivity and compensation readings.