



# D Series Smoke and Heat Detector

**Application Bulletin**

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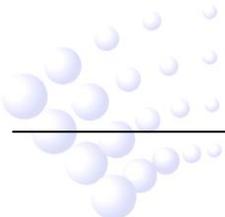
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## Section 1 Overview of D Series Smoke and Heat Detectors

The D Series family of detectors is comprised of a variety of detection technologies to meet the needs of the fire protection community. The detectors are constructed of a white, high-impact polymer. All detectors plug into DB-M01 mounting base. The table below lists the available detector models.

**D Series Smoke and Heat Detectors Model Description**

<b>Model</b>	<b>Description</b>
DI-M9103	Intelligent Combination 15° F(8.3°C)per minute Rate-of-Rise, and 135° F (57°C) Fixed-Temperature Heat Detector
DI-M9102	Intelligent Photoelectric Smoke Detector
DI-M9101	Intelligent Combination Photoelectric Smoke and 135° F (57°C) Fixed-Temperature Heat Detector
DC-M9103	Conventional Combination 15° F (8.3°C)per minute Rate-of-Rise, and 135° F (57°C) Fixed-Temperature Heat Detector
DC-M9102	Conventional Photoelectric Smoke Detector
DC-M9101	Conventional Combination Photoelectric Smoke and 135° F (57°C) Fixed-Temperature Heat Detector

D series of smoke and heat detectors 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.

DI-M9103/M9102/M9101 are intelligent addressable devices. The addressing is electronic and can be configured using a hand held tool P-9910B, refer to the P-9910B programmer operation manual for detail information. DC-M9103/M9102/M9101 are conventional devices.

The D series detectors provide a red LED indicate the detector's condition. The LED indicator displays the following states:

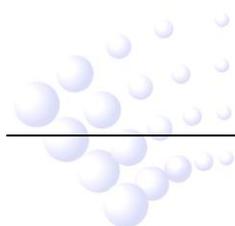
DI-M9101,DI-M9102 and DI-M9103:

- Normal: Red LED flashing or off, modified by the hand held tool P-9910B
- Alarm/active: Red LED steady

DC-M9101, DC-M9102 and DC-M9103:

- Normal: Red LED flashing • Alarm/active: Red LED steady

Multiple sensing technologies are incorporated into DI/DC-M9101detectors, which makes them suitable for a wide range of applications. The tables Smoke Detector Application section of this document list the applications suitable for the DI/DC-M9101.



## Section 2 Heat Detector Applications

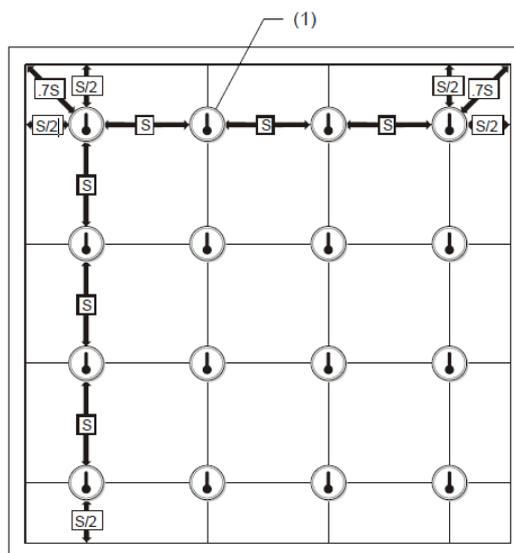
**WARNING:** These detectors are intended for use with ionization and/or photoelectric smoke detectors. A heat detector by itself does not provide life safety protection.

Heat detectors sense change in air temperature and initiate alarm conditions 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 20o F (11o 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. The operating temperature range is 32°F to 100°F (0°C to 37.8°C).

### 2.1 Spacing of Heat Detectors

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

Figure 1: Listed heat detector spacing



(1) Heat detector

S = Listed spacing between detectors

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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).

Figure 2: Detector circle of coverage

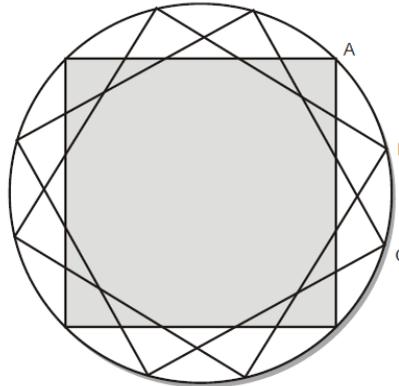
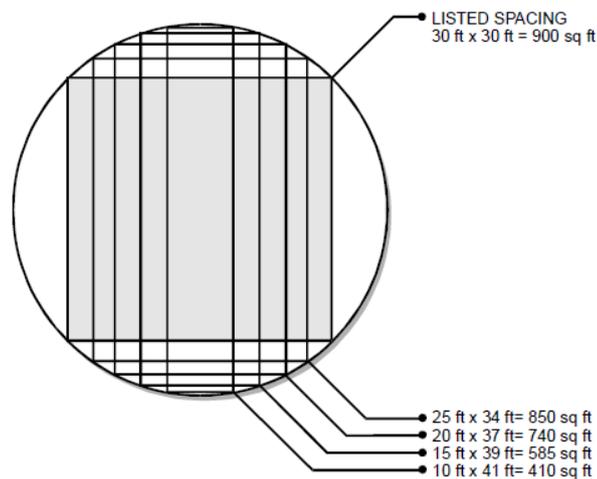


Figure 3: Alternative heat detector coverage configurations



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.

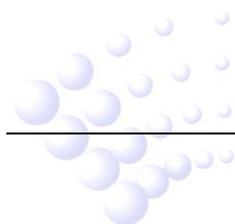
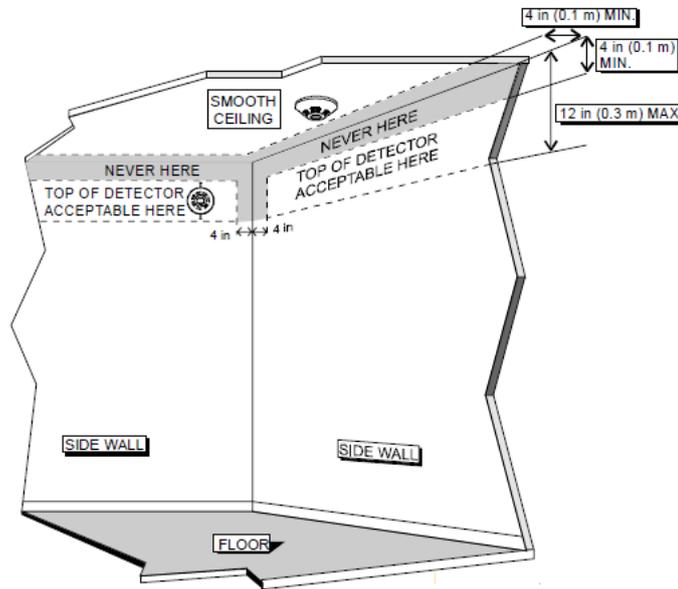
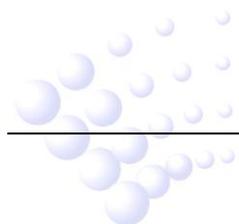
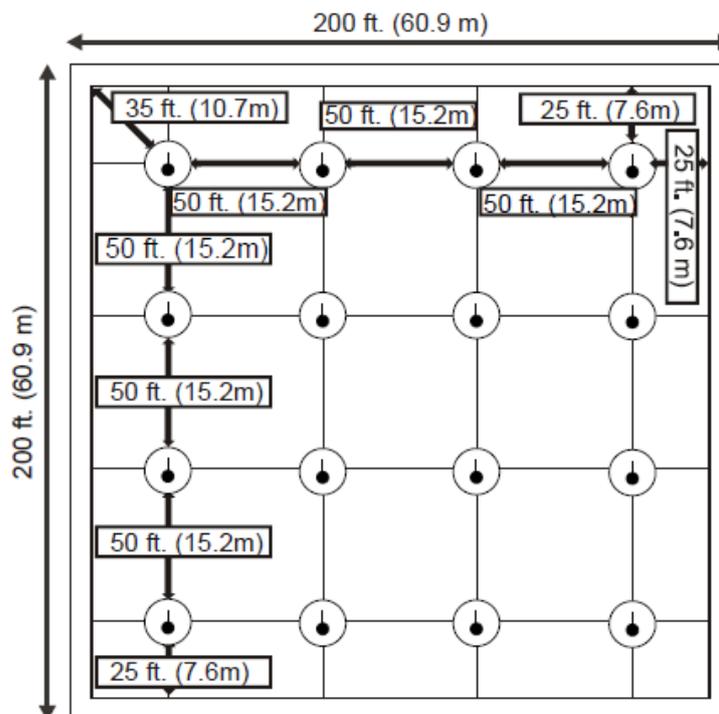


Figure 4: Detector placement near ceiling or wall joints



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).

Figure 5: Heat detectors spacing example



## 2.2 Ceiling Heat 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.

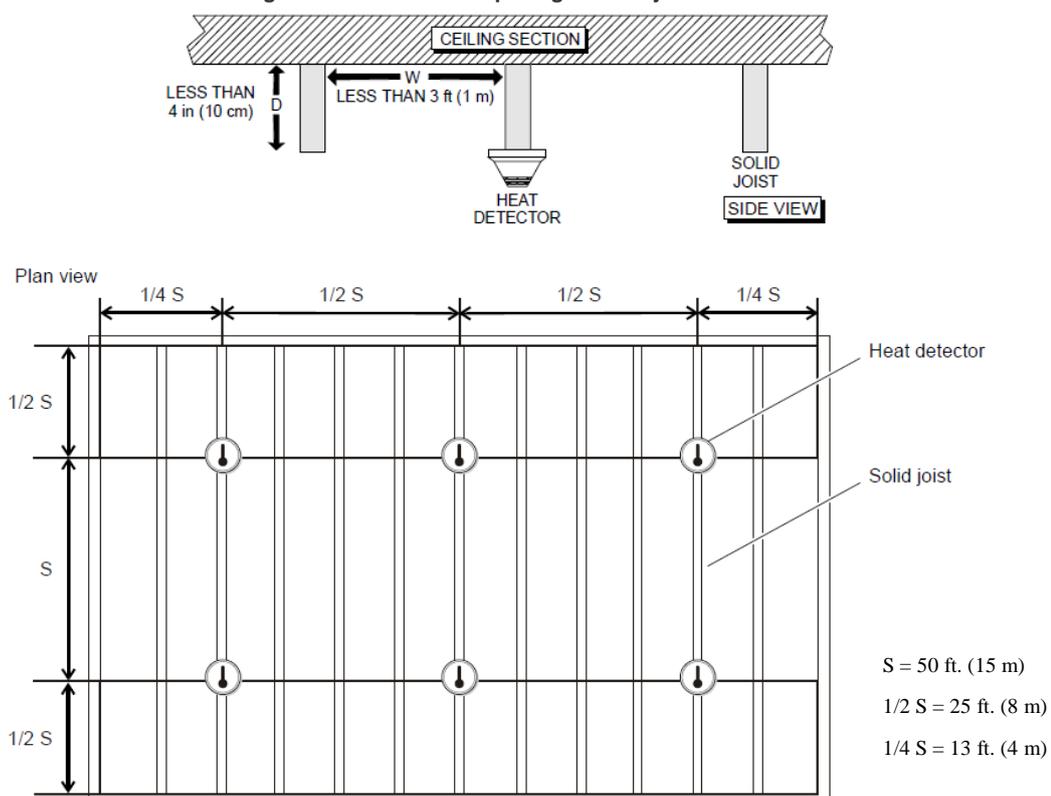
Spot type detector ceiling height reduction percentages

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)
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)

## 2.3 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.

Figure 6: Heat detector spacing — solid joist construction



## 2.4 Exposed beams

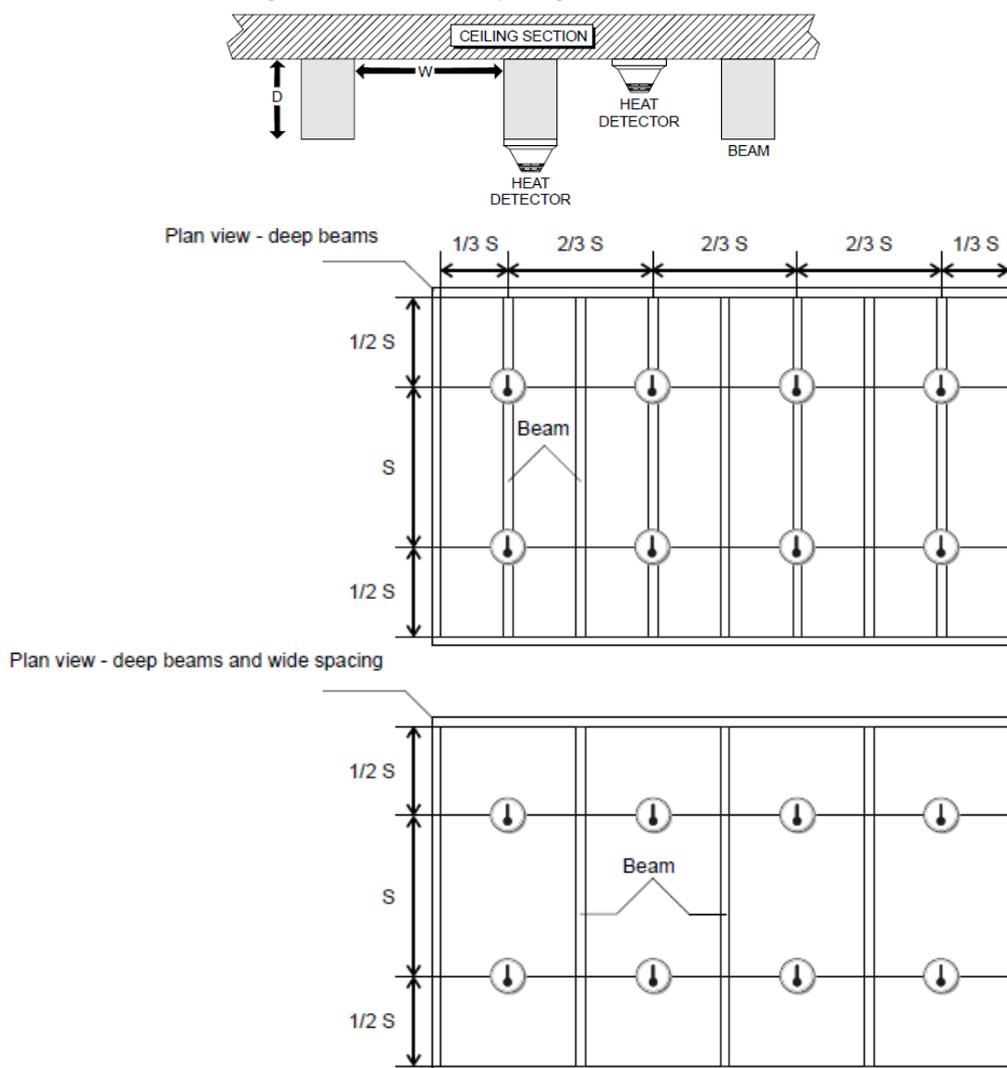
Exposed beams may impede the flow of heat to the detectors. Beams are defined as members extending 4 in. (10 cm) or more down from the ceiling and spaced more than 3 ft. (1 m) apart. The spacing of heat detectors must be reduced by 33% in the direction perpendicular to the beam. Detectors can be mounted 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

Figure 7: Heat detector spacing — beam construction



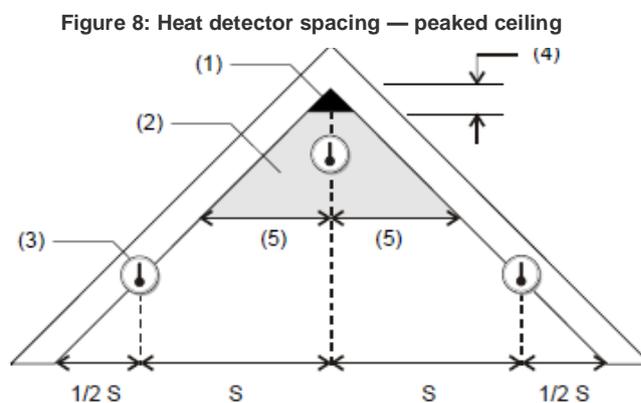
$S = 50$  ft. (15 m)  $2/3 S = 33$  ft. (10 m)  $1/2 S = 25$  ft. (8 m)  $1/3 S = 17$  ft. (5 m)

## 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.

## 2.5 Sloped Ceiling

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.



- |   |                                |
|---|--------------------------------|
| (1) Do not mount detectors in this area   | $S = 50 \text{ ft. (15 m)}$    |
| (2) Mount detectors anywhere in this area | $1/2 S = 25 \text{ ft. (8 m)}$ |
| (3) Heat detector                         |                                |
| (4) 4 in. (100 mm)                        |                                |
| (5) 36 in. (910 mm)                       |                                |

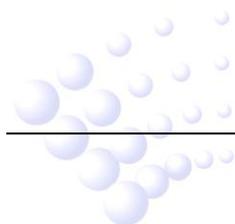
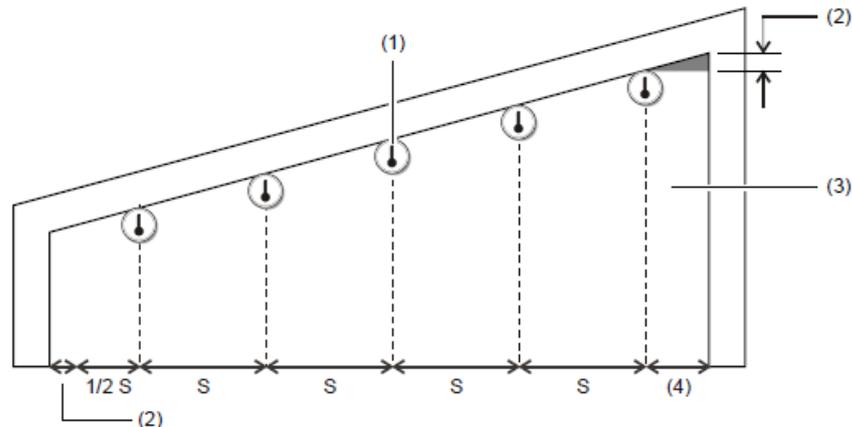


Figure 9: Heat detector spacing — sloped ceiling



- (1) Heat detector S = 50 ft. (15 m)  
(2) 4 in. (100 mm) 1/2 S = 25 ft. (8m)  
Do not mount detectors in this area  
(3) Mount detectors anywhere in this area  
(4) 36 in. (910 mm) max.

## Section 3 Smoke Detector Applications

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.

### 3.1 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

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The smoke detector signals a dirty sensor trouble to the control panel when it reach the preset limit. The dirty sensor trouble indicates the detector is in need of servicing.

### 3.2 Spacing of smoke detectors

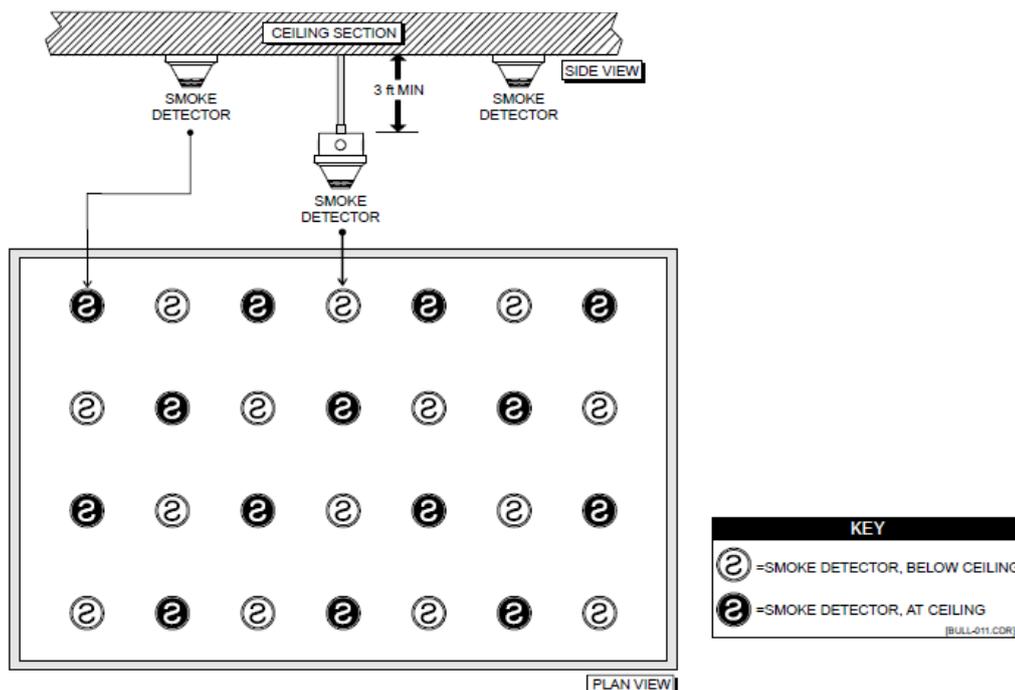
The spot type smoke detector spacing recommendation of 30 ft. (9.1 m) is based upon the detector installation on a smooth ceiling that is 10 ft. (3 m) high. Detector coverage is typically represented as a square, because most structures have flat sidewalls. Like spot type heat detectors, smoke detector 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.

### 3.3 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.

Figure 10: Smoke detector compensation for stratification



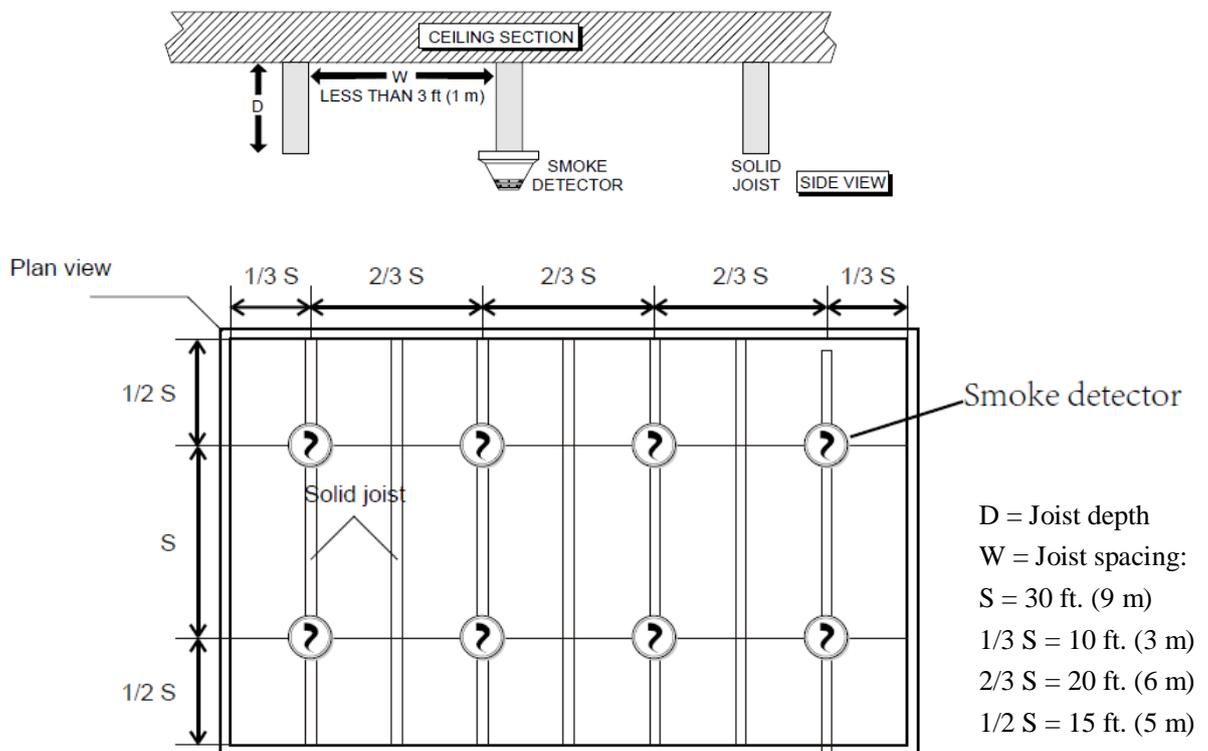
## 3.4 Partitions

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.

## 3.5 Exposed solid joists

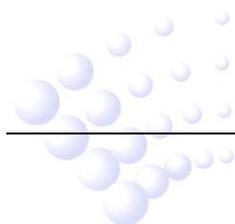
Exposed solid ceiling joists may impede the flow of smoke to detectors. When spacing spot type smoke detectors, a joist is defined as any solid member extending 8 in. (20 cm) or more down from the ceiling and spaced less than 3 ft. (1 m) apart. Note that this definition differs from the one used in locating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

Figure 11: Smoke detector spacing — solid joist construction



## Notes

- 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.



## 3.6 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.

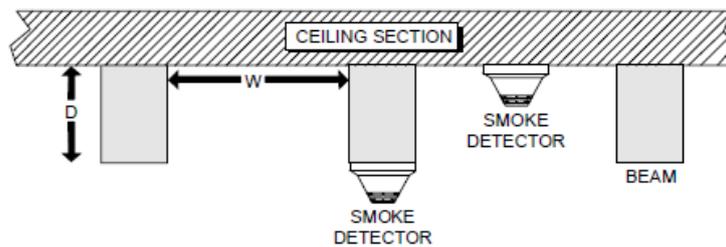
Smoke detectors should be mounted on the ceiling within each bay if the ratio of beam depth (D) to ceiling height (H),  $D/H$ , is greater than 0.1, and the ratio of beam spacing (W) to ceiling height (H),  $W/H$ , is greater than 0.4. Smoke detectors should be mounted on the bottom of each beam if either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

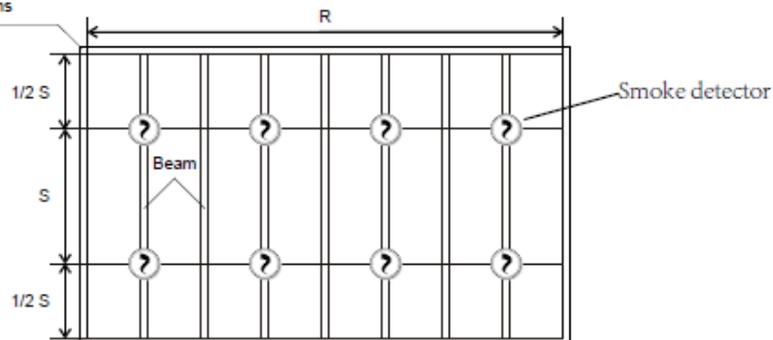
$D/H > 0.1$  and  $W/H > 0.4$  then mount the detector on the ceiling

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

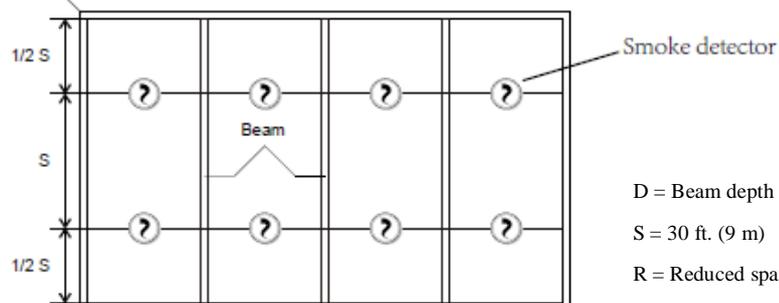
Figure 12: Smoke detector spacing — beam construction



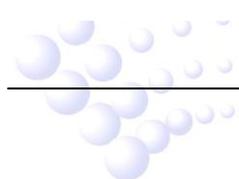
Plan view - deep beams



Plan view - deep beams and wide spacing



D = Beam depth W = Beam spacing  
 S = 30 ft. (9 m) 1/2 S = 15 ft. (5 m)  
 R = Reduced spacing (see notes below)



## 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.

### 3.7 Sloped ceilings

Rooms with peaked ceilings must have the first row of detectors placed within 3ft. (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 are identical to that used for spot type heat detectors.

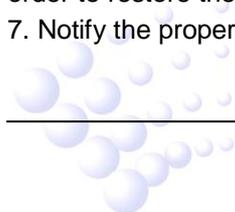
### 3.8 Effects of heating, ventilating, and air conditioning (HVAC) systems

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.

## Section 4 Initial installation testing

### To perform 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 that are 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 an smoke aerosol spray, a smoke generator, or the Test fire detector tester per the manufacturer's instructions.
5. Activate rate-of-rise heat detectors using a hair dryer (maintaining a distance of three inches).
6. After you have finished testing the smoke and heat detectors, reset the control panel in order to restore the detectors to their normal state.
7. Notify the proper authorities that the system maintenance is complete.





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