Chapter 17, Initiating Devices

Summary. Chapter 17 was Chapter 5 in NFPA 72-2007. The term “authority having jurisdiction” is replaced in some sections by the term “other governing laws, codes, or standards”. Nominal smoke detector spacing is 30 feet plus or minus 18 inches. Additional smoke detector location and spacing information. Additional guidelines regarding smoke detection installed during construction. New gas detection section. Manual fire alarm box height and color changed to match the building code.

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17.1.2 The requirements of Chapters 4 and Chapter 6 10, 12, 21, 23, and 24 shall also apply unless they are in conflict with this chapter.

17.4.6 Initiating devices shall be installed in all areas, compartments, or locations where required by other NFPA codes and standards or as required by the authority having jurisdiction other governing laws, codes, or standards.

17.4.8 Where in-duct smoke detectors are installed in concealed locations more than 10 ft (3.0 m) above the finished floor or in arrangements where the detector’s alarm or supervisory indicator is not visible to responding personnel, the detectors shall be provided with remote alarm or supervisory indication in a location acceptable to the authority having jurisdiction.

17.4.9 Where required by 17.4.8 and unless the specific detector alarm or supervisory signal is indicated at the control unit, remote alarm or supervisory indicators shall be installed in an accessible location and shall be clearly labeled to indicate both their function and the air-handling unit(s) associated with each detector. Subsection 17.4.9 was added by a tentative interim amendment (TIA). See page 1.

17.5.3.1 Total (Complete) Coverage. If Where required by laws, codes, or standards, and unless otherwise modified by 17.5.3.1.1 through 17.5.3.1.5, total coverage shall include all rooms, halls, storage areas, basements, attics, lofts, spaces above suspended ceilings, and other subdivisions and accessible spaces, as well as the inside of all closets, elevator shafts, enclosed stairways, dumbwaiter shafts, and chutes.

17.5.3.1.1 Where inaccessible areas are constructed of or contain combustible material, unless otherwise specified in 17.5.3.1.2, they shall be made accessible and shall be protected by a detector(s).

17.5.3.2* Partial or Selective Coverage. Where codes, standards, or laws, or authorities having jurisdiction require the protection of selected areas only, the specified areas shall be protected in accordance with this Code.

17.5.3.3.1 Detection installed for reasons of achieving specific fire safety objectives, but not required by any laws, codes, or standards, shall meet all of the requirements of this Code, with the exception of the prescriptive spacing criteria of 5.6.5 and 5.7.3.2.3 Chapter 17.
17.6.1.4* Spot-type heat detectors shall include in their installation instructions, technical data, and listing documentation the operating temperature and RTI (response time index) as determined by the organization listing the device. The requirement for RTI documentation shall have an effective date of July 1, 2008.

A.17.6.1.4 In order to predict the response of a heat detector using current fire modeling programs and currently published equations describing plume dynamics, two parameters must be known: operating temperature and response time index (RTI). The RTI is the quantification of the rate of heat transfer from the ceiling jet to the detector sensing element per unit of time, expressed as a function of ceiling jet temperature, ceiling jet velocity, and time. Spot-type heat detectors manufactured prior to July 1, 2008, were not required to be marked with an RTI.

17.6.2 Temperature.

17.6.2.1 Classification. Heat-sensing fire detectors of the fixed-temperature or rate-compensated, spot type shall be classified as to the temperature of operation and marked with a color code in accordance with Table 17.6.2.1.

17.6.2.2 Marking.

17.6.2.2.1 Color Coding.

17.6.2.2.1.1 Heat-sensing fire detectors of the fixed temperature or rate-compensated, spot type shall be marked with a color code in accordance with Table 17.6.2.1.

17.6.2.2.2 Operating Temperature.

17.6.2.2.2.1 Heat-sensing fire detectors shall be marked with their listed operating temperature. Spot-type heat detectors shall also be marked with their RTI (response time index). The RTI marking requirements shall have an effective date of July 1, 2008.

17.6.2.2.2.2 Heat-sensing fire detectors where the alarm threshold is field adjustable shall be marked with the temperature range.

17.6.2.2.3 Spot-type heat detectors shall also be marked with their RTI.

17.6.2.3* Ambient Ceiling Temperature. Detectors having fixed-temperature or rate-compensated elements shall be selected in accordance with Table 17.6.2.1 for the maximum expected ambient ceiling temperature. The temperature rating of the detector shall be at least 20°F (11°C) above the maximum expected temperature at the ceiling.

Table 17.6.2.1 Temperature Classification and Color Code for Heat-Sensing Fire Detectors

17.6.3 Location and Spacing.

17.6.3.1 Smooth Ceiling.

17.6.3.1.1* Spacing. One of the following requirements shall apply:

(1) The distance between detectors shall not exceed their listed spacing, and there shall be detectors within a distance of one-half the listed spacing, measured at right angles from all walls or partitions extending upward to within the top 15 percent of the ceiling height.
(2) All points on the ceiling shall have a detector within a distance equal to or less than 0.7 times the listed spacing (0.7S).

17.6.3.1.2 Irregular Areas. For irregularly shaped areas, the spacing between detectors shall be permitted to be greater than the listed spacing, provided that the maximum spacing from a detector to the farthest point of a sidewall or corner within its zone of protection is not greater than 0.7 times the listed spacing.

17.6.3.2* Solid Joist Construction.

17.6.3.2.1 Spacing. The spacing of heat detectors, where measured at right angles to the solid joists, shall not exceed 50 percent of the smooth ceiling listed spacing permitted under 5.6.5.1.1 and 5.6.5.1.2.

17.6.3.2.2 Location. In the case of solid joist construction, Detectors shall be mounted at the bottom of the joists.

17.6.3.3.2 Location. In the case of beam construction Where beams are less than 12 in. (300mm) in depth and less than 96 in. (2.44 m) on center, detectors shall be permitted to be installed on the bottom of beams.

17.6.3.4* Sloping Ceilings (Peaked and Shed).

17.6.3.4.1 Spacing.

17.6.3.4.1.1 Roof Ceiling Slope Less Than 30 Degrees. For a roof ceiling slope of less than 30 degrees, all detectors shall be spaced using the height at the peak. For a roof slope of greater than 30 degrees, the average slope height shall be used for all detectors other than those located in the peak.

17.6.3.4.1.2 Ceiling Slopes of 30 Degrees or Greater. All detectors, other than those located in the peak, shall be spaced using the average slope height or the height of the peak.

17.6.3.4.1.3 Spacing shall be measured along a horizontal projection of the ceiling in accordance with the type of ceiling construction.

17.6.3.5 High Ceilings.

17.6.3.5.1* On ceilings 10 ft to 30 ft (3.0m to 9.1 m) high, heat detector linear spacing shall be reduced in accordance with Table 17.6.3.5.1 prior to any additional reductions for beams, joists, or slope, where applicable.

17.6.3.5.2* Spacing Minimum. The minimum spacing of heat detectors shall not be required to be less than 0.4 times the height of the ceiling.

17.6.3.7 Other Applications. Where a detector is used in an application other than open area protection, the manufacturer’s published instructions shall be followed.

17.7.1.6 Smoke detectors shall be installed in all areas where required by applicable other governing laws, codes, or standards or by other parts of this Code.

17.7.1.11* Protection During Construction.

A.17.7.1.11 Construction debris, dust (especially gypsum dust and the fines resulting from the sanding of drywall joint compounds), and aerosols can affect the sensitivity of
smoke detectors and, in some instances, cause deleterious effects to the detector, thereby significantly reducing the expected life of the detector.

17.7.11.1 Where detectors are installed for signal initiation during construction, they shall be cleaned and verified to be operating in accordance with the listed sensitivity, or they shall be replaced prior to the final commissioning of the system.

17.7.11.2 Where detectors are installed but not operational during construction, they shall be protected from construction debris, dust, dirt, and damage in accordance with the manufacturer’s recommendations and verified to be operating in accordance with the listed sensitivity, or they shall be replaced prior to the final commissioning of the system.

17.7.11.3 Where detection is not required during construction, detectors shall not be installed until after all other construction cleanup of all trades is have completed cleanup.

Exception:

Where required by the authority having jurisdiction for protection during construction. Detectors that have been installed during construction and found to have a sensitivity outside the listed and marked sensitivity range shall be cleaned or replaced in accordance with Chapter 10 at completion of construction.

17.7.3.1.4* If the intent is to protect against a specific hazard, initiate action when smoke/fire threatens a specific object or space, the detector(s) shall be permitted to be installed closer in close proximity to the hazard that object or space in a position where the detector can intercept the smoke.

A.17.7.3.1.4 There are some applications that do not require full area protection, but do require detection, to initiate action when specific objects or spaces are threatened by smoke or fire, such as at elevator landings that have ceilings in excess of 15 ft (4.6 m) and for protection of fire alarm control units. In high-ceiling areas, to achieve the desired initiation, such as for elevator recall and protection of fire alarm control units (FACUs), detection should be placed on the wall above and within 60 in. (1.52 m) from the top of the elevator door(s) or FACU.

17.7.3.2* Spot-Type Smoke Detectors.

17.7.3.2.1* Spot-type smoke detectors shall be located on the ceiling or not less than 100 mm (4 in.) from a sidewall to the near edge or, if on a sidewall, between 100 mm and 300 mm (4 in. and 12 in.) the ceiling and 12 in. (300 mm) down from the ceiling to the top of the detector.

A.17.7.3.2.1 Refer to Figure A.17.7.3.2.1 for an example of proper mounting for detectors. Sidewall detectors mounted closer to the ceiling will respond faster.

17.7.3.2.3.1* In the absence of specific performance-based design criteria, smooth ceiling smoke detectors shall be permitted to be located using spacing shall be a nominal 30 ft (9.1 m) spacing.

A.17.7.3.2.3.1 The 30 ft (9.1 m) spacing is a guide for prescriptive designs. The use of such a spacing is based upon customary practice in the fire alarm community.
Where there are explicit performance objectives for the response of the smoke detection system, the performance based design methods outlined in Annex B should be used. For the purposes of this section, “nominal 30 ft (9.1 m)” should be determined to be 30 ft (9.1 m) +/-5 percent [+/-18 in. (460 mm)].

**FIGURE A.17.7.3.2.1 Example of Proper Mounting of Smoke Detectors.**

### 17.7.3.2.4.2 For level ceilings, the following shall apply:

1. For ceilings with beam depths of less than 10 percent of the ceiling height (0.1 \(H\)), smooth ceiling spacing shall be permitted. Spot-type smoke detectors shall be permitted to be located on ceilings or on the bottom of beams.

2. For ceilings with beam depths equal to or greater than 10 percent of the ceiling height (0.1 \(H\)), and beam spacing equal to or greater than 40 percent of the ceiling height (0.4 \(H\)), spot-type detectors shall be located on the ceiling in each beam pocket the following shall apply:
   - Where beam spacing is equal to or greater than 40 percent of the ceiling height (0.4 \(H\)), spot-type detectors shall be located on the ceiling in each beam pocket.
   - Where beam spacing is less than 40 percent of the ceiling height (0.4 \(H\)), the following shall be permitted for spot detectors:
     - Smooth ceiling spacing in the direction parallel to the beams and at one-half smooth ceiling spacing in the direction perpendicular to the beams
     - Location of detectors either on the ceiling or on the bottom of the beams

3. *For beam pockets formed by intersecting beams, including waffle or pan-type ceilings, For waffle or pan-type ceilings with beams or solid joists no greater than 600 mm (24 in.) deep and no greater than 3.66 m (12 ft) center-to-center spacing, the following shall be permitted: the following shall apply:

   **A.17.7.3.2.4.2(3)** The geometry and reservoir effect is a significant factor that contributes to the development of velocity, temperature, and smoke obscuration conditions at smoke detectors located on the ceiling in beam pocket areas or at the bottom of beams as smoke collected in the reservoir volume spills into adjacent pockets. The waffle- or pan-type ceiling created by beams or solid joists, although retarding the initial flow of smoke, results in increased optical density, temperature rise, and gas velocities comparable to unconfined smooth ceilings.

   For waffle- or pan-type ceilings with beams or solid joists, an alternative smoke detector grid arrangement (such as a shifted grid), with detectors located to take advantage of the channeling effect due to the reservoirs created by the beam pockets, will improve detector response and might allow greater spacing. See Figure A.17.7.3.2.4.2(3)(a) and Figure A.17.7.3.2.4.2(3)(b) for an example of shifted grids. The alternative smoke detector grid arrangement and spacing should be justified by an engineering analysis comparing the alternative smoke detector grid arrangement with the performance of smoke detectors on a level ceiling of equal height using 30 ft (9.1 m) smoke detector spacing.
Figure A.17.7.3.2.4.2(3)(a) illustrates the reservoir and channeling effect that results from the deep beam configuration.

The strongest gas flows occur in a direction perpendicular to the beam opposite the fire location. The weaker flow occurs in a directional 45 degrees off the beam grid; however, the reservoir effect accounts for higher concentrations of smoke eventually flowing from the strong area reservoirs into the weak area reservoirs.

Figure A.17.7.3.2.4.2(3)(b) is a generic example illustrating how a smoke detection grid using 30 ft (9.1 m) spacing can be shifted to take advantage of the channeling and reservoir effect to optimize detection response. In the circle, the fire is split into four beam bays that must fill with smoke before appreciable flows occur into the next adjoining eight beam bays.

This represents the worst case scenario for smoke to reach the detectors on the circle. The three other fire locations shown require the fire to initially fill only one or two bays before spilling to adjacent bays.

**FIGURE A.17.7.3.2.4.2(3)(a) Reservoir and Channeling Effect of Deep Beams.**

**FIGURE A.17.7.3.2.4.2(3)(b) Shifted Smoke Detection Grid to Optimize Detection for Deep Beam Effects.**

(a) For beam depths less than 10 percent of the ceiling height (0.1 $H$), spacing shall be in accordance with 17.7.3.2.4.2(1).

(b) For beam depths greater than or equal to 10 percent of the ceiling height (0.1 $H$), spacing shall be in accordance with 17.7.3.2.4.2(2).

(4) *For corridors 15 ft (4.6 m) in width or less having ceiling beams or solid joists perpendicular to the corridor length, the following shall be permitted apply:*

(a) Smooth ceiling spacing shall be permitted including those provisions permitted for irregular areas in 5.6.5.1.2, substituting “selected spacing” for “listed spacing”.

(b) Location of spot-type smoke detectors on ceilings, sidewalls, or the bottom of beams or solid joists.

(5) For rooms of 900 ft$^2$ (84 m$^2$) or less, only one smoke detector shall be required the following shall be permitted:

(a) Use of smooth ceiling spacing

(b) Location of spot-type smoke detectors on ceilings or on the bottom of beams

17.7.3.2.4.3* For sloped sloping ceilings with beams running parallel to up the slope, spacing shall comply with the following shall apply:

A.17.7.3.2.4.3 The spacing guidelines in 5.7.3.2.4.3 are based on a detection design fire of 100 kW. For detection at a larger 1 MW fire, the following spacings should be used:

(1) For beamed ceilings with beams running parallel to (up) the slope, with slopes 10 degrees or less, spacing for flat-beamed ceilings should be used. For ceilings with slopes greater than 10 degrees, twice the smooth ceiling spacing should be used in the direction parallel to (up) the slopes, and one-half the spacing should be used in the direction perpendicular to (across) the slope. For slopes greater than 10 degrees, the detectors located at a distance of one half the spacing from
the low end are not required. Spacing should be measured along the horizontal projection of the ceiling.

(2) For beamed ceilings with beams running perpendicular to (across) the slope, for any slope, smooth ceiling spacing should be used in the direction parallel to the beams (across the slope), and one half the smooth ceiling spacing should be used in the direction perpendicular to the beams (up the slope).

A smoke detector should be placed within each beam channel. Computer modeling has shown that parallel beams (upslope) are very effective at channeling smoke, and smoke spillover is rarely detectable in adjacent parallel pockets.

(1) The spacing for level beamed ceilings shall be used. Spot-type detector(s) shall be located on the ceiling within beam pocket(s).
(2) The ceiling height shall be taken as the average height over slope.
(3) For slopes greater than 10 degrees, the detectors located at one half the spacing from the low end shall not be required.
(3) Spacings shall be measured along a horizontal projection of the ceilings.
(4) Smooth ceiling spacing shall be permitted within beam pocket(s) parallel to the beams.
(5) For beam depths less than or equal to 10 percent of the ceiling height (0.1 \( H \)), spot-type detectors shall be located with smooth ceiling spacing perpendicular to the beams.
(6) For beam depths greater than 10 percent of the ceiling height (0.1 \( H \)), the following shall apply for spacing perpendicular to the beams:
   (a) For beam spacing greater than or equal to 40 percent of the ceiling height (0.4 \( H \)), spot-type detectors shall be located in each beam pocket.
   (b) For beam spacing less than 40 percent of the ceiling height (0.4 \( H \)), spot-type detectors shall not be required in every beam pocket but shall be spaced not greater than 50 percent of smooth ceiling spacing.

17.7.3.2.4.4* For sloped sloping ceilings with beams running perpendicular to across the slope, spacing shall comply with the following shall apply:

   a.17.7.3.2.4.4 Irregular area spacing guidance for level beam ceilings can be used. Computer modeling has shown that spot type detectors should be located on the bottom of perpendicular beams.

(1) The spacing for level beamed ceilings shall be used. Spot-type detector(s) shall be located at the bottom of the beams.
(2) The ceiling height shall be taken as the average height over slope.
(3) Spacing shall be measured along a horizontal projection of the ceiling.
(4) Smooth ceiling spacing shall be permitted within beam pocket(s).
(5) For beam depths less than or equal to 10 percent of the ceiling height (0.1 \( H \)), spot-type detectors shall be located with smooth ceiling spacing.
(6) For beam depths greater than 10 percent of the ceiling height (0.1 \( H \)), spot-type detectors shall not be required to be located closer than (0.4 \( H \)) and shall not exceed 50 percent of smooth ceiling spacing.

17.7.3.2.4.5* For sloped ceilings with beam pockets formed by intersecting beams, the following shall apply:
A.17.7.3.2.4.5 Computer modeling has shown that spot-type detectors should be located on the bottom of perpendicular beams and should be aligned with the center of pocket, as shown, in Figure A.17.7.3.2.4.5.

**FIGURE A.17.7.3.2.4.5 Spot-Type Detector Spacing for Sloping Ceilings with Beam Pockets.**

17.7.6.3.3.2 Air-sampling or projected beam smoke detectors shall be installed in accordance with the manufacturer’s published instructions.

17.7.7.4* All component controls and software shall be protected from unauthorized changes. All changes to the software or component settings shall be tested in accordance with Chapter 14.

A.17.7.7.4 Video image smoke detection control and software should be protected from tampering by passwords, software keys, or other means of limiting access to authorized/qualified personnel. Component settings include any control or programming that might affect the operation of coverage of the detection. This includes, but is not limited to, camera focus, field of view, motion sensitivity settings, and change of camera position. Any changes in component settings or ambient conditions that affect the design performance of the detector should initiate a trouble signal.

17.8.5.4* All component controls and software shall be protected from unauthorized changes. All changes to the software or component settings shall be tested in accordance with Chapter 14.

A.17.8.5.4 Video image flame detection control and software should be protected from tampering by passwords, software keys, or other means of limiting access to authorized/qualified personnel. Component settings include any control or programming that might affect the operation of coverage of the detection. This includes, but is not limited to, camera focus, field of view, motion sensitivity settings, and change of camera position. Any changes in component settings or ambient conditions that affect the design performance of the detector should initiate a trouble signal.

**17.10 Gas Detection.**

17.10.1 **General.** The purpose and scope of Section 17.10 shall be to provide requirements for the selection, installation, and operation of gas detectors.

17.10.2 **Gas Characteristics and Detector Selection.**

17.10.2.1 Gas detection equipment shall be listed for detection of the specific gas or vapor to be encountered.

17.10.2.2 Any gas detection systems installed on a fire alarm system shall comply with all the applicable requirements of Chapters 1, 10, 14, 17, and 23 of this Code.

17.10.2.3 The requirements of this Code shall not apply to gas detection systems used solely for process control.

17.10.2.4* The selection and placement of the gas detectors shall be based on an engineering evaluation.

A.17.10.2.4 The engineering evaluation should include, but is not limited to, the following:

1. Structural features, size, and shape of the rooms and bays
(2) Occupancy and uses of areas
(3) Ceiling heights
(4) Ceiling shape, surface, and obstructions
(5) Ventilation
(6) Ambient environment
(7) Gas characteristics of the gases present
(8) Configuration of the contents in the area to be protected
(9) Response time(s)

17.11 Other Fire Detectors.

17.11.1 Detectors that operate on principles different from those covered by Sections 17.6 through 17.8 shall be classified as “other fire detectors.”

17.11.2* “Other fire detectors” shall operate where subjected to the abnormal concentration of combustion effects that occur during a fire such as water vapor, ionized molecules, or other phenomena for which they are designed.

A.17.11.2 Examples of such combustion effects are water vapor, ionized molecules, or other phenomena for which they are designed. The performance characteristics of the detector and the area into which it is to be installed should be evaluated to minimize nuisance alarms or conditions that would interfere with operation.

17.11.5.2 Detectors shall not be spaced beyond their listed or approved maximums.

17.11.5.3 The location and sensitivity of the detectors shall be the result of based on an a documented engineering evaluation that includes the manufacturer’s installation instructions and the following:

(1) Structural features, size, and shape of the rooms and bays
(2) Occupancy and uses of the area
(3) Ceiling height
(4) Ceiling shape, surface, and obstructions
(5) Ventilation
(6) Ambient environment
(7) Burning characteristics of the combustible materials present
(8) Configuration of the contents in the area to be protected

17.14.1.1* Unless installed in an environment that precludes the use of red paint or red plastic, manual fire alarm boxes shall be red in color.

A.17.14.1.1 In environments where red paint or red plastic is not suitable, an alternative material, such as stainless steel, could be used as long as the box meets the requirements of 17.14.5.

17.14.1.2 Manual pull stations for initiating other than fire alarm shall be permitted if the devices are differentiated from the manual fire alarm boxes by a color other than red and labeling.

A.5.13.5 Manual fire alarm boxes should be of contrasting color to the background on which they are mounted.

17.14.1.3 Manual fire alarm boxes shall be mounted on a background of contrasting color.
17.14.4 The operable part of each manual fire alarm box shall be not less than 1.1 m (3 ½ ft) 42 in. (1.07 m) and not more than 1.37 m (4 ½ ft) 48 in. (1.22 m) above floor level.

17.15 Fire Extinguisher Electronic Monitoring Device. A fire extinguisher electronic monitoring device shall indicate those conditions for a specific fire extinguisher required by NFPA 10, Standard for Portable Fire Extinguishers, to a fire alarm control unit or other control unit.

5.17 Mass Notification Systems.

See Annex E.