Retail Characteristics Impact Detector Selection

Understanding detector technology is key to designing automatic fire alarm systems for retail and other similar applications.

Designing fire alarm systems for atriums, lobbies and other types of high-ceiling facilities can be tricky. This is especially true when considering potential challenges such as extreme temperatures, high air velocity and potential smoke stratification during a fire.

Beam smoke detectors are valuable components in these applications because they offer unique capabilities that can overcome many of the challenges associated with high-ceiling structures. It is important, therefore, that fire alarm designers gain an understanding of the technology and limitations of specific smoke detectors when selecting and applying them to fire alarm systems.

Projected beam smoke detectors consist of a transmitter that projects an infrared beam across the protected area to a receiver containing a photosensitive cell, which monitors the signal strength of the light beam. Some beam detectors consist of a transmitter and a receiver in one unit, with a reflector used on the other end to return the light. One of the advantages of units such as these is that wiring across the room (transmitter to receiver) is no longer required.

The detector works on the principle of light obscuration. The photosensitive element of the beam smoke detector sees light produced by the transmitter in a normal condition. The receiver is calibrated to a preset sensitivity level based on a percentage of total obscuration. The manufacturer determines this sensitivity level based on the length of the beam (the distance between the transmitter and receiver).

Typically, the installer can select from more than one setting based on the length of the beam used in a given application. For Underwriters Laboratories® (UL)-listed detectors, the sensitivity setting must comply with UL Standard 268, Smoke Detectors for Fire Protective Signaling Systems.

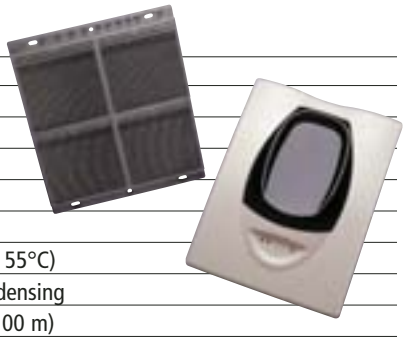
Operational Characteristics

Beam smoke detectors are sensitive to the cumulative obscuration (a measure of the percentage of light blockage) presented by a smoke field. This cumulative obscuration is created by a combination of smoke density and the linear distance of the smoke field across the projected light beam.

Because the sudden and total obscuration of the light beam is not a typical smoke signature, the detector will generally see this as a trouble condition, not an alarm. This threshold is typically set by the manufacturer at a sensitivity level that exceeds 90 percent

Reflected Type Beam Smoke Detector BEAM1224S:

The BEAM1224S is a 4-wire, single-ended, reflected type beam smoke detector that includes an 8" reflector and an integral sensitivity test.



BEAM1224S	
Detection:	Infrared Beam
Wiring:	4-wire
Operating Voltage:	15 to 32 VDC
Alarm Current:	38.5 mA max. avg.
Standby Current:	17 mA max. @ 24 VDC
Trouble Current:	8.5 mA max. @ 24 VDC
Temperature Range:	-22°F to 131°F (-30°C to 55°C)
Humidity Range:	10% to 93% RH noncondensing
Range:	16 ft. to 328 ft. (5 m to 100 m)
Sensitivity:	Level 1 - 25%; Level 2 - 30%; Level 3 - 40%; Level 4 - 50%; Acclimate Level 1 - 30-50%; Acclimate Level 2 - 40-50%
Dimensions:	Detector: 10" H x 7.5" W x 3.3" D (254 mm x 191 mm x 84mm); Reflector, 16-230 ft.: 7.9" H x 9.1" W (200 mm x 230 mm)

total obscuration. This minimizes the possibility of an unwanted alarm due to the blockage of the beam by a solid object, such as a sign or ladder inadvertently placed in the beam path.

Very small, slow changes in the quality of the light source are also not typical of a smoke signature. These changes may occur because of environmental conditions, such as dust and dirt accumulation on the transmitter and/or receiver's optical assemblies. An Automatic Gain Control (AGC) typically compensates for these changes.

When the detector is first turned on and put through its set-up program, it assumes the light signal level at that time as a reference point for a normal condition. As the quality of the light signal degrades over time, perhaps due to dust, the AGC will compensate for this change. The rate of compensation is limited to ensure that the detector will be sensitive to slow or smoldering fires. When the AGC can no longer compensate for the loss of signal, such as with an excessive accumulation of dirt, the detector will signal a trouble condition.

Accessories to the beam smoke detector may include remote annunciators and remote test stations that allow for the periodic electronic and/or sensitivity testing of the detector. Intelligent fire alarm systems can give the beam smoke detector a

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discrete address to provide better annunciation of the fire location. Conventional systems may also remotely annunciate through the use of relays.

Spot-Type vs. Beam Detector Applications

Like spot-type smoke detectors, beam smoke detectors are inappropriate for outdoor applications. Environmental conditions, such as temperature extremes, rain, snow, sleet, fog and dew, can interfere with the proper operation of the detector. Outdoor conditions make smoke behavior impossible to predict.

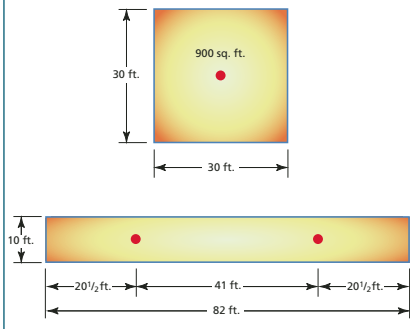
Spot-type smoke detectors are considered to have a maximum coverage of 900 square feet or 30 feet by 30 feet. The maximum length between detectors is 41 feet when the width of the area being protected does not exceed 10 feet, as in a hallway.

Beam smoke detectors generally have a maximum range of 330 feet and a maximum distance between detectors of 60 feet. This gives the beam smoke detector theoretical coverage of 19,800 square feet. Manufacturer's recommendations and other factors, such as room geometry, may impose practical reductions of this maximum coverage.

Even with these reductions, a beam smoke detector can cover an area that would require a dozen or more spot-type detectors, which generally decrease in response as their distance from the fire increases. The advantage is that fewer devices mean lower installation and maintenance costs.

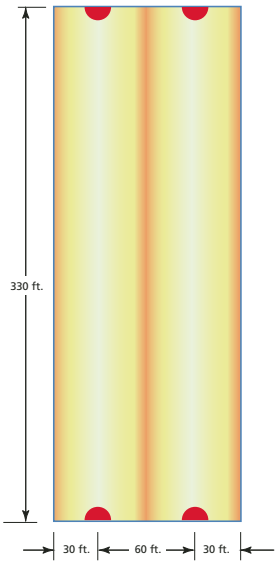
When fires start at or near floor level, the smoke produced will rise to or near the ceiling. Typically, the column of smoke begins to spread out as it travels from its point of origin, forming a smoke field in the shape of an inverted cone. The density of the smoke field can be affected by the rate of growth of the fire. Fast fires tend to produce more uniform density throughout the smoke field than slow-burning fires where there may be dilution at the upper elevations of the smoke field.

Spot-type smoke detectors



NFPA 5.6.5.1.2
Smoke Heat Detector Spacing Layout in Irregular Area

Beam smoke detectors



In many high-ceiling applications, such as retail space, beam smoke detectors may be more responsive to slow or smoldering fires than spot-type detectors because they are looking across the entire smoke field intersecting the beam. Spot-type detectors can only sample smoke at their particular "spot." The smoke that enters the chamber may be diluted below the alarm threshold, which is the level of smoke needed for an alarm.

Detector of Choice

The major limitation of projected beam smoke detectors is that these units are line-of-sight devices and are, therefore, subject to interference from any object or person entering the beam path. This may make its use impractical in occupied areas with normal ceiling heights.

However, many facilities have areas where beam smoke detectors are the detector of choice. High-ceiling areas, such as atriums in multi-level facilities, lobbies, gymnasiums, sports arenas, museums, factories and warehouses might be candidates for beam smoke detectors.

Many of these applications present special problems for the installation of spot-type detectors (e.g., high air velocity, stratification, hostile environments, sensitivity, location, spacing and mounting) and even greater problems for their proper maintenance. The use of beam smoke detectors may reduce these problems because fewer devices are required and the devices can be mounted on walls, which are more accessible than ceilings. LS