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IS 2189 (2008): Selection, Installation and Maintenance of Automatic Fire Detection and Alarm System Code of Practice [CED 22: Fire Fighting]

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(चौथा पुनरीक्षण)

Indian Standard

SELECTION, INSTALLATION AND MAINTENANCE OF AUTOMATIC FIRE· DETECTION AND ALARM SYSTEM- CODE OF PRACTICE

(Fourth Revision)

ICS 13.220.10

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

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FOREWORD

This Indian Standard (Fourth Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Fire Fighting Sectional Committee had been approved by the Civil Engineering Division Council.

The purpose of a fire detection and alarm system is to detect fire at the earliest practicable moment and to give an alarm so that appropriate action can be taken (for example, evacuation of occupants, summoning the fire fighting organization, triggering of extinguishing processes, etc). An alarm system may be activated by automatic detection devices or by manual operation of manual call points.

This standard covering the requirements of heat sensitive fire detectors was first published in 1962 and revised in 1976, 1988 and 1999. The present revision includes modifications with regard to terminology, inclusion of probe type high temperature bi-metal heat detector, optical smoke detector, spark/ember detector, UV flame detector, IR flame detector etc, and figures for arrangement for smoke detectors and addressable fire detection and alarm systems.

The general principles given below are for guidance to design and construction of fire detection and alarm systems. A fire detection and alarm system should:

a) detect quickly enough to fulfil its intended functions;
b) reliably transmit the detection signal;
c) translate this signal into a clear alarm indication that will attract the attention of the user in an immediate and unmistakable way and indicate the location of fire and initiate operation of ancillary service, such as fire extinguishing system, etc;
d) remain insensitive to phenomena other than those where its function is to detect; and
e) signal immediately and clearly and supervise fault that might jeopardize the correct performance of the system.

A fire detection and alarm system should be reliable and not liable to disturbance by any other systems whether associated with it or not, should not be rendered inoperative partially or totally by the fire or the phenomenon which it is designed to detect before the fire or phenomenon has been detected and should be able to fulfil its functions without errors or omissions.

Compliance of components with this standard does not necessarily ensure the compatibility of components with each other. Compatibility should be considered when designing a system. Satisfactory operation of an installed system should be tested after the completion of the installation.

Any fault affecting a part of fire detection and alarm system should not result in cascades of other faults in the system as a whole or should not create indirect hazards inside/outside the system.

Multiplexed fire detection system can be used provided the basic operation concepts given in this standard are fulfilled.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values *(revised)*'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

SELECTION, INSTALLATION AND MAINTENANCE OF AUTOMATIC FIRE DETECTION AND ALARM SYSTEM - CODE OF PRACTICE

(Fourth Revision)

1 SCOPE

1.1 This standard covers the planning, design, selection, installation and maintenance of tire detection and alarm systems. It is applicable to simple systems with a few manual call points as well as to complex installations comprising addressable control and indicating panel, non-addressable detectors, manual call points, control and indication panels. It covers systems capable of providing signals to initiate, in the event of a fire, the operation of ancillary services, such as fire extinguishing systems and other necessary precautions but it does not cover the ancillary services. It covers tire detection and alarm system installed in buildings of different types including those installed in industries.

1.2 This standard covers minimum level of protection. Nothing in this standard prevents to install systems designed for higher degree of protection, for special risks, etc.

2 REFERENCES

The standards listed below contain provisions which, through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below:

IS No.	*Title*
2175: 1988	Specitication for heat sensitive fire detectors for use in automatic fire alarm system *(second revision)*
8757: 1999	Glossary of terms associated with tire safety *(first revision)*
11360: 1985	Specitication for smoke detectors for use in automatic electrical tire alarm system
12456: 1988	Code of practice for tire protection of electronic data processing installations

3 TERMINOLOGY

3.0 For the purpose of this standard, the following detinitions and definitions given in IS 8757 shall apply.

3.1 Acknowledge - To contirm that a message or signal has been received, such as by the pressing of a button or the selection of a software command.

3.2 Activation Device (Trigger Device) - Device capable of being operated automatically or manually to initiate an alarm that is, detector, a manual (tire alarm) call point or a pressure switch.

3.3 Addressable Device - A fire alarm system component with discrete identitication that can have its status individually identitied or that is used to individually control other functions.

3.4 Addressable System - System in which signals from detectors, manual call points, or any other devices are individually identitied at the control and indicating equipment.

3.5 Air Sampling-Type Detector - A detector that consists of a piping or tubing distribution network that runs from the detector to the area(s) to be protected. An aspiration fan in the detector housing draws air from the protected area back to the detector through air sampling ports, piping, or tubing. At the detector, the air is analyzed for tire products.

3.6 Alarm Zone - Geographical sub-division of the protected premises, in which the tire alarm warning can be given separately, and independently, of a fire alarm warning in any other alarm zone.

3.7 Alert Tone - An attention getting signal to alert occupants of the pending transmission of a voice message.

3.8 Analog Initiating Device (Sensor) - An initiating device that transmits a signal indicating varying degrees of conditions as contrasted with a conventional initiating device which can only indicate an on-off condition.

3.9 Annunciator - A unit containing one or more indicator lamps, alphanumeric displays, graphical displays or other equivalent means in which each indication provides status information about a circuit, condition or location.

3.10 Approved — Acceptable to the authority having jurisdiction.

3.11 Audibility — Property of a sound which allows it to be heard among other sounds in the background.

3.12 Authority having Jurisdiction — The organization, office, or individual responsible for approving equipment, materials, an installation or a procedure.

3.13 Automatic Fire Detection and Alarm System — Fire alarm system comprising components and sub-system required for automatically detecting a fire, initiating an automatic alarm for fire and initiating other action as required.

3.14 Automatic Fire Signal — Alarm of fire originated by an automatic device, given audibly and/or visibly.

NOTE — The system may also include manual fire alarm call points.

3.15 Ceiling — The upper surface of a space, regardless of height. Areas with a suspended ceiling have two ceilings, one visible from the floor and one above the suspended ceiling.

3.16 Ceiling Height — The height from the continuous floor of a room to the continuous ceiling of a room or space.

3.17 Circuit — Assembly of fire alarm components supplied from the same control equipment and protected against overcurrent by the same protective device(s) or current limitation arrangements.

3.18 Circulation Area — Area (including a stairway) used mainly as a means of access between a room and an exit from the building or compartment.

3.19 Combination/Multifunction Detector — A device that either responds to more than one of the fire phenomena or employs more than one operating principle to sense one of these phenomena. Typical examples are a combination of a heat detector with a smoke detector or a combination of rate-of-rise and fixed-temperature heat detector.

3.20 Commissioning — Process by which it is determined that the installed system meets the defined requirements.

3.21 Control Centre — Permanently staffed room within or near the premises at risk for the receipt of emergency calls and equipped with means for indicating the situation in each of the protected premises, and the communications needed for transmission of calls for assistance to emergency services.

3.22 Control Unit — A system component that monitors inputs and controls outputs through various types of circuits.

3.23 Detection Zone — Sub-division of the protected premises such that the occurrence of fire within it will be indicated by a fire alarm system separately from an indication of fire in any other sub-division.

3.24 Detector — A device suitable for connection to a circuit that has a sensor that responds to a physical stimulus such as heat or smoke or flame.

3.25 Display — The visual representation of output data, other than printed copy.

3.26 Electrical Conductivity Heat Detector — A line-type or spot-type sensing element in which resistance varies as a function of temperature.

3.27 Ember — A particle of solid material that emits radiant energy due to either its temperature or the process of combustion on its surface.

3.28 Emergency Voice/Alarm Communications — Dedicated manual or automatic facilities for originating and distributing voice instructions, as well as alert and evacuation signals pertaining to a fire emergency, to the occupants of a building.

3.29 Evacuation — The withdrawal of occupants from a building.

3.30 Evacuation Signal — Distinctive signal intended to be recognized by the occupants as requiring evacuation of the building.

3.31 Exit Plan — A plan for the emergency evacuation of the premises.

3.32 False Alarm — Alarm of fire that is, false, because the fire reported does not and did not exist. This false alarm may arise by malicious, mistaken or accidental intent.

3.33 Fault Signal — A distinctive audible and visual signal indicating occurrence of a fault within the system (for example, break in electric circuit, short circuit or fault in power supply).

3.34 Fire Alarm Control and Indicating Equipment — Equipment through which fire detectors may be supplied with power and which:

a) is used to accept a detection signal and actuate a fire alarm signal;
b) is able to pass on the fire detection signal, through the fire alarm routing equipment, to the fire fighting organization or to automatic extinguishers;

c) is used to monitor automatically the correct functioning of the system; and

d) is used to indicate or display the location of fire/ alarm activation device.

3.35 Fire Alarm Signal - A signal initiated by a fire alarm-initiating device, such as a manual fire alarm box, automatic fire detector, water flow switch, or other device in which activation is indicative of the presence of a fire or fire signature.

3.36 Fire Alarm System - A combination of components for giving an audible and visible and/or other perceptible alarm of fire. The system may also initiate other ancillary action.

3.37 Fire Rating - The classification indicating in time (hours) the ability of a structure or component to withstand a standardized fire test. This classification does not necessarily reflect performance of rated components in an actual fire.

3.38 Fire Safety Functions - Building and fire control functions that are intended to increase the level of life safety for occupants or to control the spread of the harmful effects of fire.

3.39 Fixed Temperature Detector - A device that responds when its operating element becomes heated to a predetermined level.

3.40 Flame - A body or stream of gaseous material involved in the combustion process and emitting radiant energy at specific wavelength bands determined by the combustion chemistry of the fuel. In most cases, some portion of the emitted radiant energy is visible to the human eye.

3.4t Flame Detector - A radiant energy-sensing fire detector that detects the radiant energy emitted by the flame.

3.42 Flame Detector Sensitivity - The distance along the optical axis of the detector at which the detector can detect a fire of specified size and fuel within a given time frame.

3.43 Floor - Area contained on each storey of the building.

3.44 Heat Detector - A fire detector that detects either abnormally high temperature or rate of temperature rise, or both.

3.45 Ionization Smoke Detection - The principle of using a small amount of radioactive material to ionize the air between two differentially charged electrodes to sense the presence of smoke particles. Smoke particles entering the ionization volume decrease the conductance of the air by reducing ion mobility. The reduced conductance signal is processed and used to convey an alarm condition when it meets preset criteria.

NOTE - It is suggested that the use of such detectors be discouraged/avoided, as they have a radioactive source. Multi-function detectors may be used instead.

3.46 Line Detector - Detector which responds to the phenomenon sensed in the vicinity of a continuous line.

3.47 Maintenance - Repair service, including periodic inspections and tests, required to keep the fire alarm system and its component parts in an operative condition at all times, and the replacement of the system or its components when they become undependable or inoperable for any reason.

3.48 Manual Call Point - A manually operated device used to initiate an alarm signal. It can be manual alarm system or part of automatic alarm system.

3.49 Mimic Panel - A panel in which the floor/area plans of the premises are projected to reduced scale to enable easy identification of the sector/zone.

3.50 Multi-Sensor Fire Detector - Fire detector that monitors more than one physical and/or chemical phenomenon associated with fire. Typical examples are a combination of a heat and smoke detector or combination of heat and gas detectors.

3.51 Photoelectric Light Obscuration Smoke Detection - The principle of using a light source and a photosensitive sensor onto which the principal portion of the source emissions is focused. When smoke particles enter the light path, some of the light is scattered and some is absorbed, thereby reducing the light reaching the receiving sensor. The light reduction signal is processed and used to convey an alarm condition when it meets preset criteria.

3.52 Photoelectric Light-Scattering Smoke Detection - The principle of using a light source and a photosensitive sensor arranged so that the rays from the light source do not normally fall onto the photosensitive sensor. When smoke particles enter the light path, some of the light is scattered by reflection and refraction onto the sensor. The light signal is processed and used to convey an alarm condition when it meets preset criteria.

3.53 Point Detector - Detector which responds to the phenomenon sensed in the vicinity of a fixed point.

3.54 Power Supply - A source of electrical operating power, including the circuits and terminals connecting it to the dependent system components.

3.55 Projected Beam-Type Detector - A type of photoelectric light obscuration smoke detector wherein the beam spans the protected area.

3.56 Protected Premises - The physical location protected by a fire alarm system.

3.57 Radio Alarm System (RAS) - A system in which signals are transmitted from a radio alarm transmitter (RAT) located at the protected premises through a radio channel to two or more radio alarm repeater station receivers (RARSR) and that are annunciated by a radio alarm supervising station receiver (RASSR) located at the central station.

3.58 Rate-of-Rise Detector - A device that responds when the temperature rises at a rate exceeding a predetermined value.

3.59 Search Distance - Distance which has to be travelled by a searcher within a zone in order to determine visually the position of fire.

3.60 Sector - A sub-division of the protected premises larger than a zone. A larger floor may be demarcated into *sectors, that* is, addressed part of the floor. A sector will normally contain many zones.

3.61 Shapes of Ceilings - The shapes of ceilings can be classified as sloping or smooth.

3.62 Short Circuit Isolators - Devices which may be connected into a transmission path of a fire detection and fire alarm system, to limit the consequences of low parallel resistance faults between the lines of this transmission path.

3.63 Sloping Ceiling - A ceiling that has a slope.

3.64 Smoke Detector - A device that detects visible or invisible particles of combustion.

3.65 Smooth Ceiling - A ceiling surface uninterrupted by continuous projections, such as solid joists, beams, or ducts, extending more than 100 mm below the ceiling surface.

3.66 Spacing - A horizontally measured dimension related to the allowable coverage of fire detectors.

3.67 Spark - A moving ember.

3.68 Spark/Ember Detector - A radiant energy-sensing fire detector that is designed to detect sparks or embers, or both. These devices are normally intended to operate in dark environments and in the infra-red part of the spectrum.

3.69 Spark/Ember Detector Sensitivity - The number of watts (or the fraction of a watt) of radiant power from a point source radiator, applied as a unit step signal at the wavelength of maximum detector sensitivity, necessary to produce an alarm signal from the detector within the specified response time.

3.70 Standby Supply - Power supply, commonly from a rechargeable battery, which is automatically connected to the fire alarm system when the normal power supply fails.

3.71 Trouble Signal - A signal initiated by the fire alarm system or device indicative of a fault in a monitored circuit or component.

3.72 Zone - Area or space that has a group of automatic and/or non-automatic fire detection devices for which there is a separate common display in the control and indicating equipment.

4 GENERAL REQUIREMENTS

4.1 Automatic fire detection and alarm system consists of fire detectors and manual call points connected by appropriate cables to sector/zonal panels which in tum are connected to control and indicating equipment (C and I). The equipment and cables of automatic fire detection and alarm system should be independent of any other system or cables, and should not be shared with any other system.

NOTE — Where analog addressable fire alarm system is used, which consists of addressable devices and suitable control panel, zoning and number of detectors shall be as per 4.2.4.

4.1.1 If the requirement of detectors in any area is less than 20, division into zones/sectors may not be necessary. Similarly, sectorization may not be necessary if the number of zones is not very large and in case of bigger premises, the premises may be divided into wings and each wing may have sectors/zones.

4.1.2 Size of the conventional panels is normally referred by number of zones. Each zone can be connected with the conventional detectors not exceeding 20.

4.2 Detection Zones

4.2.1 General

a) In most of the buildings an alarm of fire may initiate a number of different activities, for example, provision of assistance, commencement of fire fighting operations and emergency evacuation procedures, summoning of fire brigade, etc. It is essential that these activities are well co-ordinated. In the pre-planning of emergency procedures for a building it is therefore important, for ease of communication and synchronization of effort, to fix a convenient number of easily identifiable sectors/zones, which the building can be divided.

b) In order to direct those responding to a fire alarm signal to the area of fire, all buildings with the exception of smaller ones need to be divided into detection zones. The zones need to be small enough for a fire to be located quickly. Even if the system is addressable, zoning indications needs to be provided as this often provides a quicker indication of the location of a fire than typical addressable text displays. Zone indicators also provide a simple 'at a glance' overview of the extent of fire or smoke spread. Also this would enable fire fighters who are not familiar with the building to proceed to the location of fire.

4.2.2 Requirements for detection zones that contain non-addressable automatic detection system are given below:

a) The floor area of a single zone shall not exceed 2000 m^2.

b) If the total area of a building is less than 300 rn-, a zone can cover more than one floor.

c) If the total area of a building is more than 300 m', each zone shall be restricted to a single floor.

d) Voids, if any, above or below the floor area of a room can be included in the same zone as of the room provided that the voids and the room *constitute* a *single compartment.*

e) The search distance, that is, the distance that has to be travelled by anyone responding to a fire alarm signal after entry to the zone in order for the location of the fire to be determined visually, shall not exceed 30 m.

t) Automatic fire detectors within any enclosed stairwell, lift well or other enclosed shaft-like structures shall be considered as a separate zone.

g) If manual call points are located on the landings of an enclosed staircase, such points at each level shall be incorporated within the zone that serves the adjacent accommodation on that level.

h) The detectors and manual call points within sectors/zones shall be wired to the control and indicating equipment.

j) The entire electrical installation pertaining to the entire fire alarm system as described above shall be independent of other systems.

k) When a signal of fire is given it is necessary that there shall be no confusion about the zone from which it is received.

m) To facilitate response by persons providing assistance, the zone shall be small enough for a fire located quickly.

n) It is advisable to provide adequate fire separation between the zones.

p) In larger premises, the fire alarm system shall be so designed and arranged that it is fully compatible with the emergency procedures and provides at some central or convenient point, or points, an indication of the zone from which an alarm has originated.

q) In the case of two stage alarms, clear and unambiguous signals shall indicate the emergency procedure to be adopted throughout each zone.

r) If the requirement of detectors or call points is less than 20 in any area, division of the area into zones is not necessary. Similarly, sectorization is not necessary if the number of zones is not very large.

s) For larger systems covering more than one building it may be necessary to create sectors in addition to zones in order to restrict the number of zones from which alarms originate simultaneously or in succession.

t) It is not always possible to provide definite guidelines regarding the requirements for the division of sectors, etc, as stated above due to the fact that the configurations are not same for all risks. The division into zones and/or sectors shall be decided based on careful consideration on the type of risk and accessibility of zones in respect of main circulation routes and the main control and indicating equipment.

u) In general, the signals used in different zones in the same premises shall be the same unless the background noise in one or more zones is such as to require different sounders.

v) The zoning arrangement for systems in multiple occupations shall take into account the fact that all the premises may not be occupied at the same time. No zone shall include areas in more than one occupancy.

w) Remote indicator lamps outside doors of rooms, cabins, etc, within a zone may be useful, if doors are likely to be locked. Making an area easier to search, the us.e of remote indicator lamps reduce the need for a large number of smaller zones.

x) Where a special risk is present within a large protected area, for example, a spray painting both in engineering workshop and it is considered important to obtain rapid identification of fire in that risk, such special risk shall be deemed as a separate zone.

y) Where a zone extends beyond a single compartment, the zone boundaries shall be the boundaries of the fire compartments.

NOTES

1 It is permissible to have two complete fire compartments in one zone, or two complete zones in one fire compartment.

2 It is not permissible to have a zone, which extends into parts of two compartments, or a compartment, which extends into parts of two zones.

z) If the arrangement of an area is complex and time is likely to be wasted in search for the fire, notwithstanding any limits shown above, the area shall be further sub-divided into zones that are easier to search.

4.2.3 Size and Number of Zones (Protected with Manual Call Points)

a) In systems containing only manual call points, location of a fire is usually known to the person operating the call point. As it is often difficult to get information in time to the safety personnel, the restriction on the size and number of zones shall also apply to the systems protected with manual call points only.

b) To prevent misleading indication of the position of the fire, it is advisable that manual call points be indicated in the control equipment separately from the detectors in zones, which are protected, by both detectors and manual call points. It is strongly recommended that the circuits for the detectors and the call points shall be different in case of conventional detection systems.

4.2.4 Size of the Analog Addressable Panel is *normally referred* by *number* of signalling Line Circuit (Loop). Loop shall be of Class A wiring. Class A wiring, win be return loop. Tapping may be used from the loop as Class B wiring.

NOTE — Refer Fig. 1 for wiring details.

4.2.4.1 Length of the loop shall not exceed more than 3 000 m where size of wire shall not be less than 1.5 rnm-or manufacturer recommended length and size may be considered

4.2.4.2 Number of addressable detectors and devices per loop shall be as per manufacturer's recommendation. It is recommended that number of detectors per loop may not be exceeding 90 percent of the full capacity. The number of detector and devices per loop varies from 128 per loop, 99 Smoke Detectors, 99 Devices and 159 Detectors and 159 Devices. Based on the manufacturer design some devices need external power supply and some devices supported by loop power.

4.2.4.3 Each loop should not be divided into more than 8 fire zones. Minimum two isolators are required per zone. It is recommended that a pair of fault isolator modules be employed for every 20-30 detectors/manual call points.

4.2.4.4 In partially addressable system zone addressable module are used in the loop to connect non-addressable fire detection devices. Wherever non-addressable detectors are connected provisions of 4.1.1 to 4.2.3 are to be followed.

4.3 The sounders for fire alarm should be electronic hooters/horns/electric bell having a frequency range of 500 to I 000 Hz. The sound of the fire alarm should be continuous although the frequency and amplitude may vary. If a two tone alarm is used, at least one of the major frequencies should be within the frequency range of 500 to I 000 Hz. The distribution of fire alarm sounders should be such that the alarm is heard at all sites which can be occupied within the protected area.

A minimum sound level of either 65 dB (A) or 5 dB (A) above any other noise likely to persist for a period longer than 30 s, whichever is greater should be produced by the sounders at any point which can be occupied in a building. Sounders should be suitably distributed throughout the building in regard to attenuation of sound caused by walls, floors ceilings and partitions. If the fire routine for the premises requires the audible alarm to arouse sleeping persons, the minimum sound level should be 75 dB (A) at the bed head with all doors shut. A large number of quieter sounders rather than a few very loud sounders may be preferable to prevent noise levels in some areas from becoming too loud. In siting sounders in corridors to serve the surrounding rooms, account should be taken of the attenuation of the sounder frequency by any dividing element. Most single doors will give attenuation greater than 20 dB. Thus it is unlikely that sounder noise levels in a room will be satisfactory if more than one dividing wall or door separates it from the nearest sounder. At least one sounder for each fire compartment will be necessary. Sound levels exceeding 120 dB (A) in areas which are occupied may produce hearing damage.

4.4 Besides, the control centre, which may be located anywhere on the ground floor or even the basement, wherever necessary repeater or annunciated panel should be provided near the main entrance so that the maintenance staff notices the fault condition or isolation, if any, for rectification.

4.5 A control centre should be provided preferably on the ground floor where mimic panels, control and indicating equipment and other equipment associated with it should be installed.

5 AUTOMATIC FIRE DETECTORS

5.1 The types of detectors covered in the standard are given in 5.1.1 and 5.1.2.

5.1.1 Heat Detectors

See IS 2175.

5.1.1.1 Fixed temperature

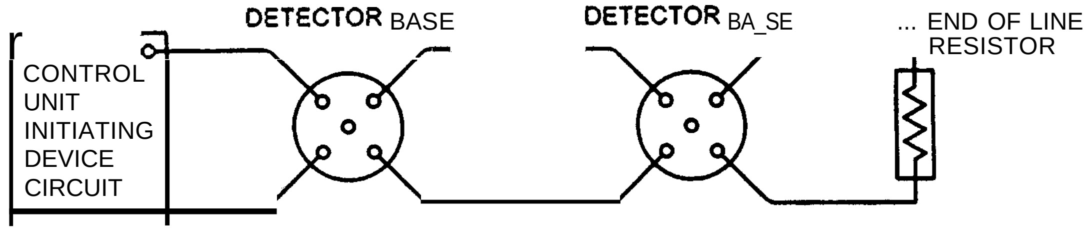
The fixed temperature heat detectors are designed to operate when the temperature of the detector exceeds a predetermined value.

5.1.1.2 Rate-oj-rise temperature-cum-jixed temperature detector

The detectors are designed to operate within a given time:

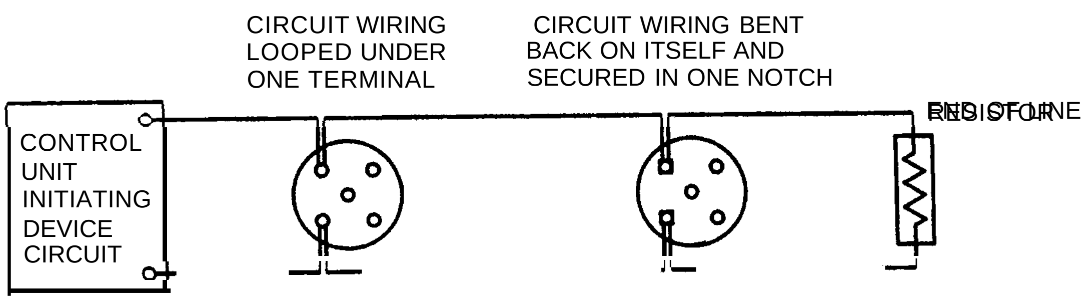
a) when the rate of temperature rise at the detector exceeds a predetermined value regardless of the actual temperature; and

CONVENTIONAL (NON - ADDRESSABLE)
DETECTION SYSTEM - CLASS B WIRING

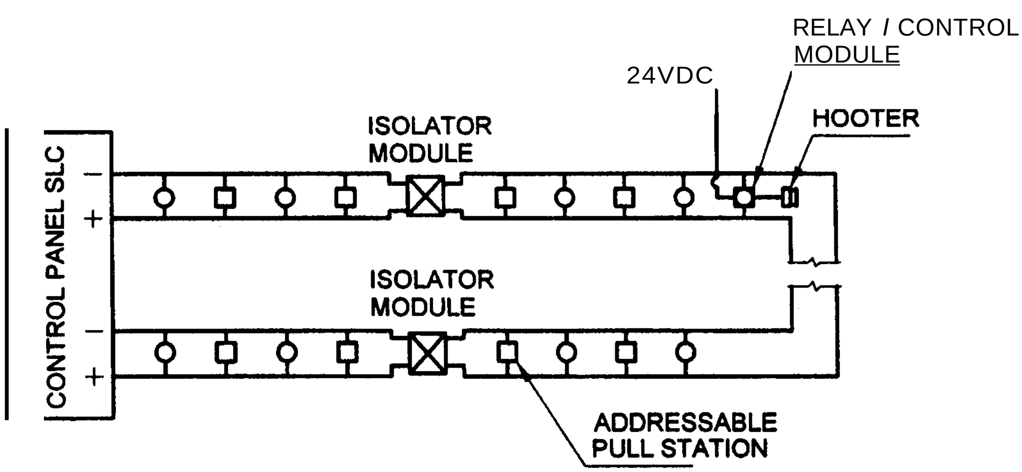


1A Correct Wiring Method - Two-Wire Detectors

CONVENTIONAL (NON - ADDRESSABLE)
DETECTION SYSTEM· CLASS B WIRING

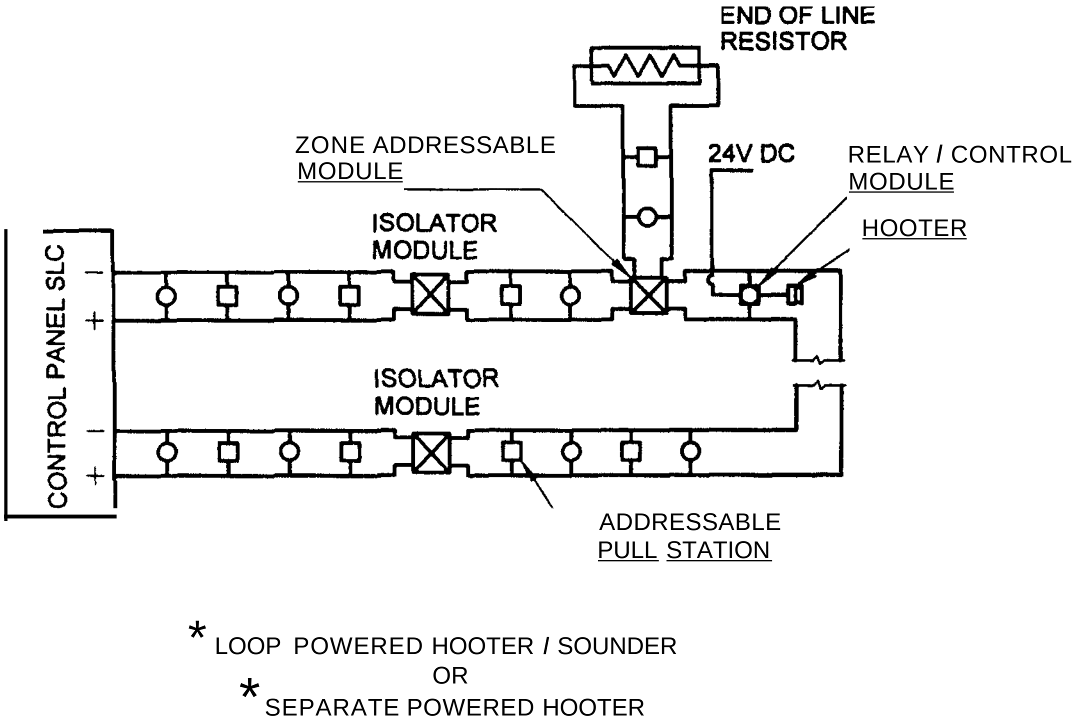


1B Incorrect Wiring Method - Two-Wire Detectors



* LOOP POWERED HOOTER / SOUNDER
OR
*SEPARATE POWERED HOOTER

1C Addressable Fire Detection and Alarm System - Class A Wiring



1D Addressable Fire Detection and Alarm System - Class A Wiring with Class B Tapping

FIG. 1 WIRING DETAILS FOR FIRE DETECTION AND ALARM SYSTEM

b) when temperature at the detector exceeds a predetermined value.

5.1.1.3 Probe type high temperature hi-metal heat detector

Bi-metal heat detectors are resettable and highly suitable to use above 80°C where electronic components cannot be used. The following are type of application for which probe type high temperature heat detectors are suitable.

Generator enclosure, turbine enclosure, oven and furnace area, kitchen wood and other places as per the requirement where automatic fire extinguishing/ suppression systems are used.

5.1.1.4 Linear heat sensing cables

Linear heat sensing cables can be broadly divided into two categories. Digital or analogue, depending upon the principle by which the sensing cable registers a change in temperature.

Digital sensor consists of two core cable in which the conductors are separated by a heat sensitive insulator. When a specified temperature is reached, the cable insulation breaks down and an alarm is indicated. In the case of analogue sensor, cores are separated by a negative temperature co-efficient polymer whose resistance will reduce in proportion to the temperature increase.

These cables are used for detecting fire and overheating in certain specific occupancies such as:

a) cables tunnels, trays and vaults;
b) material conveyors;
c) bulk storage multi-racked areas;
d) rim seals of floating roof tanks storing hazardous chemicals; and
e) a few other special occupancies.

5.1.1.5 Heat detectors application

These are suitable for use in situation where sufficient heat is likely to be generated and damage caused by heat generated by the fire constitutes main hazard. This is to be minimized through early detection. In many buildings, especially non-air-conditioned buildings, these conditions prevail where heat detectors can be advantageously used. Heat detectors are however, not suitable for protection of places where larger losses can be caused by small fires and where safety of life is involved.

5.1.2 Smoke Detectors

See IS 11360.

5.1.2.1 Ionization smoke detectors

Detectors employing ionization chamber(s) as sensing means for detecting aerosols given-off by fires.

5.1.2.2 Optical (photoelectric) smoke detectors

A detector whose operation is based on light attenuation by smoke and/or light scattering by smoke particles.

5.1.3 Air Sampling Type Detector

Laser type smoke detectors are used in this type of detection system. A detector that consists of a piping or tubing distribution network that runs from the detector to the areas to be protected. An aspiration fan in the detector housing draws air from the protected area back to the detector through air sampling ports, piping or tubing. At the detector, the air is analyzed for fire products. Typical application of the systems is where a trace of smoke needs to be detected, where high airflow can make traditional smoke detector inadequate.

5.1.3.1 Smoke detectors application

Ionization smoke detectors respond quickly to smoke containing small particles normally produced in clean burning fires, but may respond slowly to optically dense smoke which may be produced by smouldering materials. Certain materials like PVC, when overheated, produced mainly large particles to which ionization detectors are less sensitive. Optical smoke detectors respond quickly to smoke, that is optically dense. Both types of detectors have a sufficiently wide range of responses to be of general use. While selecting the detector, 5.2 to be taken into account.

5.1.4 Spark/Ember Detector

A spark/ember-sensing detector usually uses a solid state photodiode or phototransistor to sense the radiant energy emitted by embers. Typically between 0.5 μ and 2.0 μ in normally dark environments. These detectors can be made extremely sensitive (microwatts), and their response times can be made very short (microseconds). Spark/ember detectors are installed primarily to detect sparks and embers that could, if allowed to continue to bum, precipitate a much larger fire or explosion. Spark/ember detectors are typically mounted on some form of duct or conveyor, monitoring the fuel as it passes by. Usually, it is necessary to enclose the portion of the conveyor where the detectors are located, as these devices generally require a dark environment. Extraneous sources of radiant emissions that have been identified as interfering with the stability of spark/ember detectors include the following:

a) Ambient light;

b) Electromagnetic interference (EMI, RFI); and

c) Electrostatic discharge in the fuel stream.

5.1.5 UV Flame Detector

UV Flame detector makes use of ultraviolet sensitive photocathode for detecting flame. It has a narrow spectral sensitivity of 185 to 260 urn which is insensitive to visible light.

5.1.5.1 IR Flame detector

Single or multiple wavelength infra-red flame detector sense wavelength in the infra-red spectrum. Almost all the materials that participate in the flaming combustion emit ultraviolet radiation to some degree during flaming combustion, whereas only carbon-containing fuels emit significant radiation at the 4.35 micron (carbon dioxide) band used by many detector types to detect a flame.

The following are types of application for which flame detectors are suitable:

a) High-ceiling, open-spaced buildings, such as warehouses and aircraft hangers;

b) Outdoor or semi-outdoor areas where winds or draughts can prevent smoke from reaching a heat or smoke detector;

c) Areas where rapidly developing flaming fires can occur, such as aircraft hangers, petrochemical production areas, storage and transfer areas, natural gas installations, paint shops, or solvent areas;

d) Areas needing high fire risk machinery or installations, often coupled with an automatic gas extinguishing system; and

e) Environments those are unsuitable for other types of detectors.

Some extraneous sources of radiant emissions that have been identified as interfering with the stability of flame detectors include the following:

a) Sunlight;

b) Lightning;

c) X-rays;

d) Gamma rays;

e) Cosmic rays;

t) Ultraviolet radiation from arc welding;

g) Electromagnetic interference (EMI, RFI);

h) Hot objects; and

j) Artificial lightning.

5.2 Choice of Fire Detector

Fire detectors are designed to detect one or more of three characteristics of a fire that is smoke, heat or radiation (flame). No one type of detector is the most suitable for all applications and final choice is dependent on the individual circumstances. It is often useful to employ a combination of different types of detectors. Most fire detectors are affected not only by the level of the detected phenomena but also by the behaviour of the phenomena with time. In some cases it is the rate of change of phenomena; in others it is the effect, for example, delays in smoke entry or thermal lags.

Every fire alarm system is a compromise. It is possible to increase the sensitivity of detectors but that would probably increase the frequency of false alarms.

It is possible to reduce the losses by reducing the spacing between the detectors or using several.types of detectors in the same area but these would increase the cost of the system.

It is possible to increase the frequency of testing but this might lead to increased disturbances on the premises.

Since each type of detector has its own advantages and disadvantages, and no one type of detector is most suitable for all applications, the choice of a detector to be used for a particular application is always a compromise. Final choice will depend primarily on: (a) the speed of response required; (b) the need to minimize false alarms; and (c) the nature of the fire hazard. However, other factors such as cost, suitability for the environment and maintenance requirements shall also need to be considered.

In any automatic detection system a detector has to discriminate between a fire and the normal environment existing within the building. The system chosen shall have detectors that are suited to the conditions and that provide the earliest reliable warning.

Each type of detector responds at a different rate to ditTerent kinds of fire. With a slowly smoldering fire such as the initial stages of a fire involving cardboard, a smoke detector would probably operate first. A fire that evolves heat rapidly and with very little smoke could operate a heat detector before a smoke detector could operate first.

In general, smoke detectors would give appreciably faster responses than heat detectors but may be liable to give false alarms.

A combination of various detectors is necessary. The likely fire behaviour of the contents of each part of the buildings, the processes taking place or planned and the design of the building shall be considered. The susceptibility of the contents to heat, smoke and water damage shall also be considered.

NOTE - Choice of detectors based on all the above considerations for any particular application has been shown in Annex A. However, this shall be purely considered as a guideline for selection.

5.2.1 Life Safety Installation

Whenever optical density of smoke exceeds 0.1 dB/m (10 m visibility), temperature rises beyond 66°C and concentration of carbon monoxide in atmosphere exceeds 0.04 percent, and human survival is endangered. An alarm should be initiated before these limits are reached so that the occupants are able to escape to safety. Time overriding priority is to be given for detection of smoke because of the following factors:

a) Main threat to life in a fire emergency emanates from smoke and toxic fumes;
b) Smoke and lethal gases travel rapidly to areas away from fire due to strong convection currents threaten the life of the occupants even at far away places; and
c) Detectable quantity of smoke from a hostile fire precede detectable heat level and the development of lethal atmosphere.

In a life safety installation, it is, therefore, essential to:

1) pay primary attention to early detection of smoke and to protect escape routes including those areas from which the routes might be hazarded by smoke detectors;
2) ensure operation of detectors on escape route before optical density exceeds 0.05 dB/m that is, visibility falls below 20 m; and
3) take into account any scheme of pressurization/ smoke control while providing detectors there.

5.2.1.1 Heat detectors are not suitable for detecting fire in slow burning/air-conditioned premises where temperatures required to operate them may only be reached after the smoke density in the escape route/ circulation areas has reached to the critical level.

5.2.1.2 Heat detectors are suitable in compartments where heat producing equipment (for example, kitchen and pantry, etc) are used in closets or other unsupervised spaces compact areas with low value contents.

5.2.2 Property Safety Installation

People are not always present, mobile or alert in all parts of premises, housing property even during normal occupancy hours. Premises may remain unattended or unsupervised for long and short periods. When fire starts in such areas it gets time to grow to a stage where it cannot be easily extinguished. Installation of fire detectors enables early detection and easy extinction by reducing delay between ignition and start of fire fighting measures. As rapid and extensive loss of property is caused by flaming combustion, detectors should be efficient in detecting flaming fire to keep losses to a minimum. It is important to minimize incidence of false alarms particularly when detectors are hooked up to actuate means of automatic extinction. Automatic extinction should generally be initiated only on confirmation of two detecting signals to avoid possibility of false actuation.

5.2.2.1 Computer/EDP centre/other electronic equipment which have a very high value should be protected by smoke detectors.

5.2.2.2 Archives, high value libraries, and museums with high value combustibles should be protected by combination of heat, flame, smoke detectors. The heat detectors should be used on the racks and cupboards and smoke detectors in open space on the ceiling. Flame detectors may be used where height of the ceiling is more than 9 m.

5.2.2.3 Flammable liquid in small quantities stored in confined spaces where ambient temperature is high or where chances of rapid heat build-up exist (such as garages, repair shops, store areas, battery rooms, etc) heat or flame detectors should be provided.

6 SITING OF FIRE DETECTORS

6.1 At the time of installation and prior to commissioning, every fire detector should be allotted an identification number, preceded by alphabetic initials showing the type of detectors, for example, Z1/SOI/20 meaning Smoke Detector, Ionization, Zone 1, 20th Detector. Z2/SDOT/3 meaning Smoke Detector Optical, Zone 2, 3rd Detector. HFT/4 (Fixed Temperature Heat Detector, 4th Detector) HFR Rate of Rise Heat Detector, etc. A record of this should be maintained in the control centre.

6.2 Heat detectors should be so installed that the sensing element is not less than 25 mm and not more than 150 mm below the ceiling/roof level. For smoke detectors, the sensing element should not be less than 25 mm and not more than 600 mm below the ceiling/roof level except as necessary by site test. Where possibility of stratification exists, the level of stratification should be determined by measuring the vertical gradient of smoke density and additional detector provided below the stratifying level if considered necessary by the site test.

6.3 Siting and Spacing Requirements of Detectors Covering General Cases

6.3.1 General

a) Heat and smoke detectors depend on convection to transport hot gases and smoke from the fire to the detectors. Spacing and siting of detectors need to be based on the need to restrict the time taken for this movement and to ensure that the products of combustion reach the detectors in adequate concentration. In a building, the hottest gas and the greatest concentration of smoke will generally form at the highest parts of the enclosed areas, and it is here, therefore, that heat and smoke detectors need to be sited.
b) There are other constraining factors in siting the detectors like the height of the ceiling (more the height means more cooling of hot gases, thus diluting the performance of the detectors), effects of stratification (where smoke does not rise to the ceiling at all), type of roof (with beams extending deep below, etc), air movement (within the protected area below the detectors), supply air inlets (in the vicinity of detectors), HVAC systems (with high air change rates), obstructions (in the path of rise of hot gases and smoke like ducts, machinery parts, false ceilings, light fixtures, etc). Spacing and siting of detectors shall address all these issues for optimum protection.

6.3.2 Siting and spacing of detectors (common to all types of smoke and heat detectors):

a) Under flat ceilings, the horizontal distance between any point in a protected area and the detector nearest to that point shall not exceed (1) 7.5 m in case of smoke detector, and (2) 5.3 m in case of heat detector.
b) In case of a sloping roof or pitched ceiling (where the distance between the top of apex and bottom of the roof exceeds 600 mm), spacing of detectors at or in the vicinity of apex may be spaced between 7.5 m and 8.5 m for smoke detectors.
c) Detectors shall not be mounted within 500 mm of any walls, partitions or obstructions to flow of smoke or hot gases, such as structural beams and ductwork, where the obstructions are greater than 250 mm in depth.
d) Where structural beams or ductwork for light fittings or any other ceiling attachments, not greater than 250 mm depth, create obstacles to the flow of smoke, detectors shall not be mounted closer to the obstruction than twice the depth of the obstruction.
e) Where partitions or storage racks that reach within 300 mm of the ceiling, they shall be construed as walls that extend to the ceiling for the purpose of siting the detectors.
t) Similarly, ceiling obstructions, such as structural beams, deeper than 10 percent of the overall ceiling height shall be construed as walls for the purpose of siting the detectors, that is, each bay formed by such beams shall be treated as

separate enclosure for provision/spacing of detectors.

g) Detectors shall not be mounted within I m of any air inlet (supply air inlets of HVAC system) or a forced ventilation system.

h) Detector siting shall be such that a clear space of 500 mm is maintained below each detector.

j) Where detectors are constrained to be fixed to the wall, they shall be sited in such a way that the top of the detection element is between 150 mm and 300 mm below the ceiling and the bottom of the detection element is above the level of door opening. Additional detector shall be placed on the ceiling at a position 1.5 m from any opening which might act like a flue.

k) A detector shall be placed on the protected side of the premises on the ceiling 1.5 m from any door, window or any opening in the wall partitions separating the protected premises from the other premises.

m) All stairwells, lift shafts, other utility shafts, etc, shall have a detector at the top. Lift machine rooms shall be provided with a detector.

n) All unenclosed staircase shall have one detector at each main landing within the staircase.

p) The detector shall also be provided in cable tunnels, ducts, false floors, AC and AHU room, long AC return ducts and distribution boards.

q) No detector shall be subjected to any interior decoration treatment, that is, painting, alteration of exterior cover, etc, to conform with the environment.

r) Every enclosure (that is, room or cabin) shall have a detector at ceiling level and also under false ceiling, if provided.

s) Where there is more than one such enclosure per floor, a response indicator shall be installed at the entrance to such enclosures to indicate where the detector has actuated. This arrangement shall also be followed in case of all concealed detectors in false floors, plenums, shafts, tunnels, etc.

t) Voids as in false ceiling/flooring more than 800 mm shall be protected with detectors with spacing like in normal installation. However, voids as in false ceiling/flooring less than 800 mm height need not necessarily have independent coverage unless the void is such that the spread of fire products between the rooms or compartments take place through it. Bathroom, lavatories, WC, etc, however, need not be protected.

u) For irregular shaped areas, the spacing between the detectors may be greater than the determined spacing provided the maximum spacing from the detector to the farthest point of a side wall or comer within its zone of protection is not greater than 0.7 times the determined spacing.

Table I gives spacing parameter(s) at different ceiling heights for open areas under smooth and flat ceiling with no-forced ventilation/air-flows.

NOTE - Refer Fig. 2 for the arrangement details of the detectors.

6.3.3 Compensation to the Spacing of Detectors

a) *Height consideration*

Spacing of 7.5 m for smoke detectors is valid up to a height of 7 m only and that of 5.3 m for heat detectors is valid only up to a height of 5 m. Beyond these heights, spacing between the detectors shall be adjusted as follows:

I) Smoke detectors for heights between 7 m and 10 m - 5 m spacing

Beyond 10m height - Only beam detectors or aspirating type detection systems

2) Heat detectors for heights between 5 m and 7 m - 3.5 m spacing

Beyond 7 m height - Not allowed to install heat detectors

b) *High air movement consideration*

I) Spacing between detectors shall be suitably reduced in areas where high air movement or where high air changes prevail. Modified values of spacing are given in the Table 2.

2) Detectors shall not be located in the vicinity of supply air diffusers. Minimum distance between the detector and the air inlets/ diffusers shall be at least 1.5 m.

3) Detectors shall be so mounted as to favour the air flow towards return air openings.

4) The above provisions shall not disturb the normal population (count) of detectors, which is provided assuming that air-handling systems are off.

5) After designing the detector spacing, it shall be cross-checked to ensure that there is at least one smoke detector for every 100 m^2 or one heat detector for every 50 m' of the compartment area.

6.3.4 Additional Requirements for Optical Beam Detectors

a) Optical beam-type detectors shall be sited in such a way that no point in the protected space

Table 1 Spacing(s) at Different Ceiling Heights

(Clause 6.3.2)

Type of Detector		Spacing for Ceiling Height(s), m								Remarks
									10.0	
(I)									(9)	(10)
Smoke detectors conforming to IS 11360 (both ionization and optical type)									5.0	The spacing in corridors should not be greater than *3S/2*
Heat detectors conforming tolS2175	Grade 1 (time instant 205)	7	No chance	6	5	5	4	3	Nil	Spacing from the boundary wall should bekeptSI2
	Grade 2 (time instant 40 s)	6	5.5	5	4	3.5	3	Nil	Nil	
	Grade 3 (time instant 60 s)	5	4.5	4	3	3.5	Nil	Nil	Nil	

NOTES

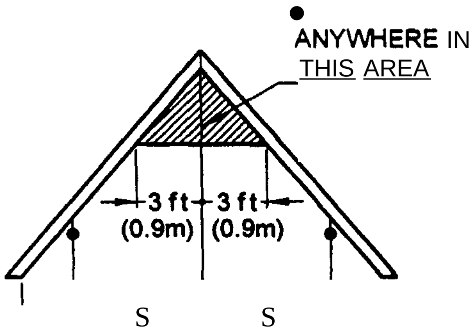
I The spacings have been adopted from charts of Fire Detection Institute of America, adopting the parameters mentioned in 6.3 (nearest/rounded offvalues).

2 It is presumed that 'No chance' means 'No change'.

Table 2 Modified Spacing for High Air Movement Areas

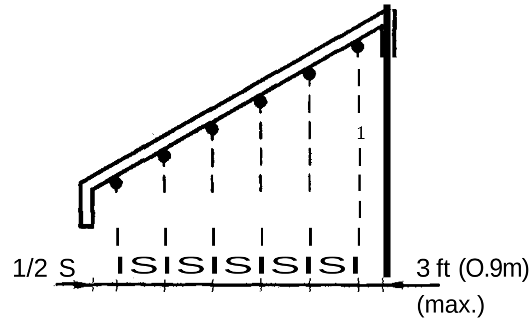
[Clause 6.3.3(b)(l)]

Air Changes/h Inside Block	Multiplying Factor for Modified Spacing	(Area Coverage)
(I)	(2)	(3)
Less than 7.5	1.00	(1.00)
8.5	0.95	(0.91)
10.0	0.91	(0.83)
12.0	0.83	(0.70)
15.0	0.74	(0.55)
20.0	0.64	(0.40)
30.0	0.50	(0.25)
60.0	038	(0.15)



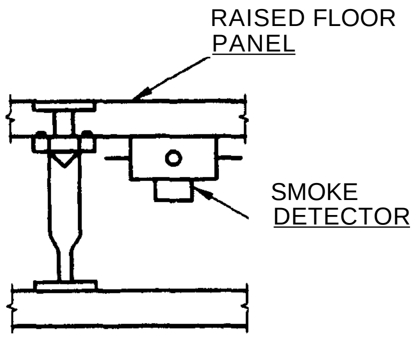
S = SPACE BETWEEN DETECTORS
• = SMOKE DETECTOR OR HEAT DETECTOR

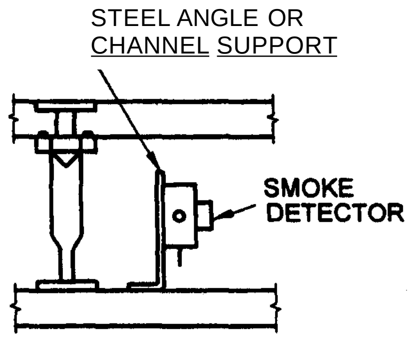
2A Smoke or Heat Detector Spacing Layout, Sloped Ceiling (Peaked Type)



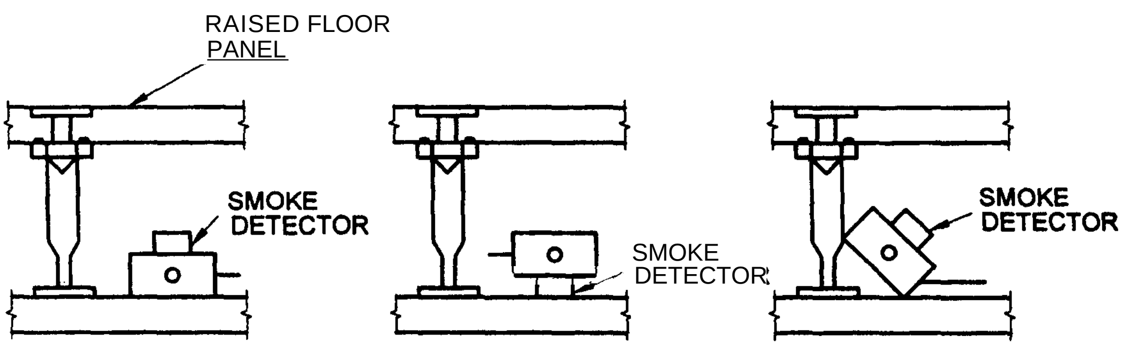
S = SPACE BETWEEN DETECTORS
• = SMOKE DETECTOR OR HEAT DETECTOR

2B Smoke or Heat Detector Spacing Layout, Sloped Ceiling (Shed Type)





2C Above False Ceiling/Below False Floor Mounting Arrangement of Smoke Detector - Permitted



2D Above False Ceiling/Below False Floor Mounting Arrangement of Smoke Detector - Not Permitted

FIG. 2 MODIFIED VALUES OF SPACING BETWEEN FIRE DETECTORS is farther than 7.5 m from the nearest point of optical beam.

b) In case of a sloping roof or pitched ceiling (where the distance between the top of apex and bottom of the roof exceeds 600 mm), distance stated in (a) above may be increased to 8.5 m.

c) Where optical beam type smoke detectors are used at more than 600 mm from ceiling level in order to provide supplementary detection of rising smoke within a high space (like Atrium etc), the width of the area protected on each side of optical beam shall be regarded as 12.5 percent of the height of the above beam from ground level.

d) Where there is a probability of people walking through the beam or where the beam is likely to be obstructed by forklifts, etc, detectors shall be mounted at a suitable height.

e) Transmitters, receivers and/or reflectors shall be mounted on a solid construction which shall withstand vibrations, temperatures or any imposed load.

f) The path length of the optical beam shall be withir the limits specified by the manufacturers.

g) Beam detection area shall not exceed the detection zone in which it is installed.

h) The effects of stratification shall be fully evaluated when locating the detectors.

j) If mirrors are used with the projected beams (reflective beam detectors), they shall be installed as per manufacturer's recommendations.

k) Projected beam detectors and their mirrors (reflective beam detectors) shall be mounted on stable surfaces to prevent false or erratic operation due to vibrations and movements in the vicinity.

m) The beam shall be designed so that small angular movements of the light source or receiver do not prevent operation due to smoke and do not cause nuisance alarms.

n) The light path of projected beam detectors (reflective beam detectors) shall be kept clear of opaque obstacles at all times.

6.3.5 Additional Requirements for Aspirating Type Detection Systems

a) When an aspirating type smoke detection system is intended to provide general area protection, each aspirating sampling point shall be regarded as a point type smoke detector, provided that a single sampling point has equivalent sensitivity to a point type smoke detector. Accordingly, all requirements specified under items (a) to (j) above are applicable.

   However, as the detector actually draws samples of air through sampling points (holes in pipe work), it shall be possible to mount the sampling points flush with a ceiling, provided otherwise the system's effectiveness is confirmed by the manufacturer.

b) If the system is intended to co-exist with other types of detection system for specific application within the protected area, installation shall comply with the manufacturer's specifications.

c) Maximum air sample transport time from the farthest sampling point shall not exceed 120 s.

d) Air sampling detectors shall give a trouble signal if the airflow within the enclosure is outside the manufacturer's specified range.

6.3.6 Siting of Flame Detectors

6.3.6.1 General

a) The location and spacing of the detectors shall be based on sound engineering evaluations taking into account the following:

   1) Size of the fire requiring detection,
   2) Fuel involved,
   3) Sensitivity of detectors,
   4) Distance between the fire and detector,
   5) Radiant energy absorption of the atmosphere,
   6) Presence of other sources of emission,
   7) Purpose of detection system, and
   8) Response time required.

b) Certain flame detectors respond to the instantaneous level of radiation received while others depend upon the level received over a period.

c) In either case the response will depend on the distance between the flame detector and the fire, since the radiation level received is inversely proportional to the square of this distance. Increased distance from the fire will, therefore, lead to an increase in the size of the fire at detection.

d) A clear line of sight to the area being protected is of great importance but at the same time care shall be exercised to avoid a direct line of sight to likely sources of non-fire radiation to prevent false alarms.

6.3.6.2 Spacing guideline

a) Sufficient number of detectors shall be used and they shall be positioned such that no point requiring detection in the hazard area is obstructed or outside the field of view of at least one detector;

b) In applications where, the fire to be detected could occur in an area not on the optical axis of the detector, the distance shall be reduced or alternatively more detectors added to compensate for the angular displacement of the fire;

c) The spacing of the detectors shall vary from fuel to fuel. It is, therefore, necessary to fix the distances as per the recommendations of the manufacturers;

d) The location of the detectors shall also be such that structural members or any other opaque objects or materials do not impede their line of sight; and

e) When installed outdoors, detectors shall be shielded to prevent diminishing sensitivity due to rain, snow, ice, etc, and allow a clear vision of the hazard area.

6.3.7 Siting of Spark/Ember Detectors

a) The location and spacing of the detectors shall be based on sound engineering evaluations taking into account the following:
   1) Size of the spark or ember that is to be detected,
   2) Fuel involved,
   3) Sensitivity of detectors,
   4) Distance between the fire and the detector,
   5) Radiant energy absorption of the atmosphere,
   6) Presence of other sources of emission,
   7) Purpose of detection system, and
   8) Response time required.

b) The system design shall specify the size of spark or ember of the given fuel that the system is to detect.

c) Spark detectors shall be positioned so that all the points within the cross-section of the conveyance duct, conveyor or chute, where the detectors are located, are within the field of view of at least one detector.

d) In any case the response will depend on the distance between the detector and the fire, since the radiation level received is inversely proportional to the square of this distance. Increased distance from the fire will, therefore, lead to an increase in the size of the fire at detection.

6.3.8 Siting of Manual Call Points

Manual call points shall be so located that, to give an alarm, no person in the premises has to travel distance of more than 30 m to reach them. When manual call points are also installed external to the building, the travel distance shall be 45 m.

Where necessary, the travel distance may require to be reduced to less than 30 m, for example, where there is difficulty in free access within the risk or in potentially dangerous risks.

Call points shall be fixed at a height of 1.4 m above the surrounding floor level, at easily accessible, well-illuminated and conspicuous positions, which are free of obstructions.

Where the call points are not visible from the front as in the case of a long corridor, they shall be surface mounted or semi-recessed in order to present a side profile area of not less than 750 mm'.

Manual call points shall be housed in dust pre of and moisture proof enclosure properly sealed with rubber lining.

Manual call point shall be located preferably near entry to staircases at various levels.

The glass surface shall be minimum 30 em' in area and glass thickness shall not exceed 2 mm. Once the glass is broken the alarm shall sound on the floor as well as on the Control and Indicating equipments and light shall glow to indicate its operation. The alarm shall be maintained by the control and indicating equipment even if someone presses the button subsequently.

6.3.9 ComputeriEDPIOther Electronic Equipment Installed in Air-Conditioned Areas

Fire alarm system and detection network shall, in addition to the requirements of this standard, comply with various provisions listed under 8 of IS 12456. Where the requirements differ, those specified in IS 12456 shall prevail.

6.3.10 Detectors (Smoke) in Ventilation Ducts

a) Smoke detectors or probes shall be installed in straight stretches of ductwork, at a distance from the nearest bend, corner or junction of at least three times the width of the duct; and

b) The suitability of the smoke detector for duct type application shall be evaluated within the parameters defined by the manufacturers.

The sampling inlet probe and the holes in the probe shall be arranged, according to the manufacturers specifications, to cover as much of the duct as possible. This provision normally calls for the probe to cover the wider dimension of the duct and the length of the probe shall be at least two-thirds of that dimension.

7 INSPECTION, TESTING AND MAINTENANCE

7.1 General

Even a well designed and properly installed automatic fire alarm system will not be able to render reliable and trouble-free service unless high standard of maintenance and supervision are ensured during the entire service period of the system. Regular inspections and scheduled preventive maintenance are critical and should include all the components of the system.

7.2 Initial Installation Inspection Tests

7.2.1 After installation, a visual inspection of all the detectors should be made to make sure that they are properly sited. Each detector should be inspected to ensure that it is properly mounted and connected.

7.2.2 Restorable heat detectors and restorable elements of combination detectors should be tested by a heat source, such as a hair dryer, or a shielded heat lamp until it responds, making sure that the sensing element is not damaged. After each heat test, the detector should be reset. Precautions should be taken to avoid damage of the non-restorable fixed temperature element of a combination rate of rise/ fixed temperature detector.

7.2.3 Non-resettable fixed temperature heat detectors which are not to be heat-tested should be tested mechanically or electrically for fire alarm function.

7.2.4 Heat detectors with replaceable fusible alloy element should be tested first by removing the element to see whether contact operate properly and then re-inserting them in proper position.

7.2.5 In periodic testing, heat detectors should be visually examined for damage or other conditions (such as heavy coats of paints, etc) likely to interface with the correct operation.

7.2.6 Each smoke detector should be tested to initiate an alarm at its installed location with smoke or other approved aerosol which demonstrates that the smoke can enter the chamber and initiate an alarm.

7.2.7 In order to ensure that each smoke detector is within its sensitivity range, it should be tested using either:

a) a calibrated test method, or
b) a manufacturer's/supplier's approved calibrated sensitivity test instrument, or
c) approved control equipment arranged for the purpose, or
d) other approved calibrated sensitivity test method.

7.2.7.1 Detectors found to have sensitivity outside the approved range should be replaced.

NOTE - Detector sensitivity cannot be tested or measured using any spray/smoke producing device that administers an unmeasured concentration of aerosol/smoke into the detector.

7.3 Servicing/Periodical Maintenance

7.3.1 To ensure that regular and reliable servicing/ maintenance of the systems and its components is carried out; any of the following methods should be adopted:

a) Through an agreement/contract with the competent contractor who should attend to the maintenance/repair, when necessary, promptly, and
b) Where no such service contract can be entered into for any reason, at least one qualified employee of the user with suitable experience of electrical equipment should undergo special training to deal with all aspects of basic servicing and maintenance, including routine sensitivity tests/checks of the detectors, as and when required.

7.3.2 For institutional occupancies, such as hospitals, hotels, old people's homes, etc, the provision should include a requirement that an engineer should be on call at all times and that request over the telephone for emergency service should be executed promptly, within 24 h. Serving arrangement should be made immediately on completion of the installation whether the premises are occupied or not. If the premises are not occupied, special precautions should be taken, if necessary, to protect the system against damage by dampness or other causes.

7.4 Maintenance Schedule

7.4.1 It is the responsibility of the user of the equipment to ensure that proper instructions are obtained from the manufacturer/supplier or installer regarding the routine attention and test procedures.

7.4.2 The routine to be adopted in individual premises may vary with the use of the premises; equipment installed in corrosive or dirty environmental conditions will need to be checked more thoroughly and at more frequent intervals than that in clear and dry situations. Care should be taken that all equipments are properly reinstated after testing. The occupants of the premises should be notified of any test of the system that may result in the sounders being operated.

7.4.3 Daily Attention by User

A check should be made every day to ascertain that:

a) the panel indicates normal operation; if not, that any fault indicated is recorded in the log book and is receiving urgent attention; and

b) any fault warning recorded the previous day has received attention.

7.4.4 Weekly Attention by the User

The following tests should be made every week to ensure that the system is capable of operating under alarm conditions:

a) Once a week, at least one trigger device or end of line switch on one zone circuit should be operated to test the ability of the control and indicating equipment to receive a signal and to sound the alarm and operate other warning devices. If there is more than one zone on a system having unmonitored wiring, each unmonitored zone should be tested each week, but without sounding the alarm more than once. For systems having monitored wiring and up to 13 zones, each zone should be tested in tum but if there are more than 13 zones, more than one zone may need to be tested in any week so that the interval between tests on one zone does not exceed 13 weeks. It is preferable that each time a particular zone is tested; a different trigger device is used. An entry should be made in the log book quoting the particular trigger device that has been used to initiate the test. If the operation of the alarm sounders and/or the transmission of the alarm signal has been prevented by disconnection, then a further test should be carried out to prove the final reinstatement to the sounders, and if permissible, the alarm transmission circuits.

b) A visual examination of the battery and connection should be made to ensure that they are in good condition. Action should be taken to remedy any defect, including low electrolyte level.

Any defect noticed should be recorded in the log book and reported to the responsible person, and action should be taken to correct it.

7.4.5 Quarterly Inspection and Test by the User

The following check-list and test sequence should be carried out:

a) Entries in the log book since the previous inspection should be checked and any necessary action taken.

b) Batteries and their connections should be examined and tested to ensure that they are in good serviceable condition.

c) Where applicable, secondary batteries should be examined to ensure that the specific gravity of electrolyte in each cell is correct. Necessary remedial action should be taken and an appropriate entry made in the log book. Care should be taken to ensure that hydrometers, vessels, etc, used in the servicing of alkaline secondary cells are not contaminated by acid and *vice versa.* Contamination of electrolyte can ruin a cell.

d) Primary batteries, including reserves, should be tested to verify that they are satisfactory for a further period.

e) The alarm function of control and indicating equipment should be checked by the operation of a trigger device in each zone as described. The operation of alarm sounders and any link to a remote manned centre should be tested. An ancillary function of the control panel should also be tested where practicable. All fault indicators and their circuits should be checked preferably by simulation of fault conditions. The Control and Indicating equipment should be visually inspected for signs of moisture ingress and other deterioration.

t) A visual inspection should be made that structural or occupancy changes have not affected the requirements for the sting of trigger devices (manual call points, smoke detectors and heat detectors). The visual inspection should also confirm that a clear space of at least 750 mm radius is preserved in all directions below every detector, that the detectors are preferably sited and that all manual call points remain unobstructed and conspicuous.

Any defect should be recorded in the log book and reported to the responsible person, and action should be taken to correct it.

7.4.6 Annual Inspection Tests

The following checks and test sequence should be carried out:

a) The instruction and test routines detailed in 7.4.5(a) to (t).

b) Operation of at least 20 percent of the detectors in an installation should be checked each year and the selection should be done in such a way that all the detectors in an installation shall have been checked once in every 5 years - replacement by a new one.

c) Each detector should be checked for correct operation using specified test equipment and method, except non-resettable detectors. The checks to be carried out are specified in 7.2.2 to

7.2.5 in respect of heat detectors and, 7.2.6 and 7.2.7 in respect of smoke detectors.

d) Visual inspection should be made to conftrm that all cable ftttings and equipment are secure, undamaged and adequately protected.

e) At least once in every three years at the annual inspection, the electrical installation should be tested. Any defect should be recorded in log book and suitable remedial action should be taken.

f) On completion of the annual inspection, the entry should be made in register in respect of defects found. After the defects are rectifted, the entries should then again be made.

7.5 General Points About Detectors

It is essential (particularly for installations involving life hazard) to ensure specifted range of sensitivity of the detectors being installed and that the correct degree of sensitivity is maintained. Users should satisfy themselves on this point. Sensitivity range should be checked on equipment as already specifted. It is essential to apply frequent sensitivity checks and routine tests as prescribed in the Code so that the correct sensitivity levels/degree is maintained during the entire service span of the installation (*see* 7.2.7).

7.6 Cleaning and Maintenance

Detectors require periodic cleaning to remove dust or dirt that has accumulated. The frequency of cleaning depends upon the type of detector and local ambient conditions. In any case, the interval should not exceed a period of 3 months. For each detector, the cleaning, checking, operating and sensitivity adjustment should be attempted only after consulting manufacturer's instructions. These instructions should detail methods such as creating vacuum to remove loose dust and insects, and cleaning heavy greasy deposits, following partial disassembly or the cleaning or the washing of detectors to remove contamination, the sensitivity test requirements in accordance with the relevant clauses should be performed.

7.7 Tests Following an Alarm or Fire

All detectors suspected of exposure to a ftre condition should be tested in accordance with the provisions contained in this Code pertaining to annual inspection tests. In addition, a visual check of the battery charger should be carried out to ensure perfect serviceability. However, a check should be made to the extent of damage, if any, to the cables and other components and also the operation of the systems as a whole.

7.8 System Disconnection During Testing

Care should be taken to minimize the disruption of the normal use of the building by alarm sounding during detector testing. If detectors are removed for testing or servicing, replacement detectors should be provided.

7.9 Spares

It may not be necessary to keep spares in premises other than covers for manual call point and fuses and other essential spares which should be worked out based on installation.

ANNEXA

(Clause 5.2)

MERITS AND RELATIVE DEMERITS OF VARIOUS TYPES OF DETECTORS

Type of Detector	*Suitability and Merits*	*Unsuitability and Demerits*
(1)	(2)	(3)
Smoke detectors (general)	Slow burning fires, smoldering fires, for most of the areas where principal fire hazard is not from the presence of flammable liquids. Fires involving wood, paper, textile, etc, in earlier stages	Not sensitive for clean burning fires which does not produce smoke particles; areas in which the principal fire hazard is the presence of flammable liquids or gases that produce little smoke during a fire
Ionization smoke detector	General purpose smoke detector - better for smoke containing small particles, such as rapidly burning fast flaming fires	Less sensitive to the larger particles found' in optically dense smoke of similar mass, such as can result from smoldering fires including those involving polyurethane foam, or overheated PVC. Areas subject to smoke, steam, dust or dirt during normal use. Usage of these detectors are on way to phase out due to radiation problems
Optical smoke detector	General purpose smoke detector - better for smoldering fires	Areas subject to smoke, steam, dust or dirt during normal use
Light scattering type (smoke detector)	Sensitive to light coloured smoke	Less sensitive to very dark smoke which absorbs light rather than scattering it
Light obscuration type (smoke) detector	Sensitive to very dark smoke which absorbs light rather than scattering it	Areas subject to smoke, steam, dust or dirt during normal use
Photo-thermal multi-criteria detector	General purpose detector - good for smoldering and fast flaming fires, optically dense smoke	Areas subject to smoke, steam, dust or dirt during normal use, less sensitive to small particles found in clean burning fires that produce little visible smoke
Optical beam smoke detector	Large and high rooms, open plan spaces with relatively high ceilings (for example warehouses), fires not involving production of smoke (with built in thermal turbulence detection). Suited for applications where anticipated fire would produce black smoke. Sensitive to cumulative obscuration presented by a smoke field	Areas subject to smoke, steam, dust or dirt during normal use. Less sensitive to colour of smoke. Cannot detect clean colourless smoke
Aspirating (air-sampling) type smoke detector	They are suitable for use where usage of other types of smoke detectors present difficulties, such as aesthetics, height and temperature of the	Air-sampling detectors are not suitable if the air movement due to HVAC requirements is outside the range specified by the manufacturers

Type of Detector (1)	*Suitability and Merits* (2)	*Unsuitability and Demerits* (3)
	enclosure. Sampling points can be located almost anywhere unlike detectors which cannot be installed on walls, storage racks, machinery space, floor voids, etc. Each sampling point is a detector itself. Suitable for cold storage. Higher sensitivity levels, ease of installation and most suitable for protection of high value and critical equipment	
Heat detectors (general)	Clean burning fires, such as those involving certain flammable liquids. Areas subject to smoke, steam, dust or dirt during normal use, fires that evolve heat and flame rapidly, suitable for rooms where heat producing equipment like kitchen, pantry, boilers, DG sets, etc, are installed/used	Unlikely to respond to smoldering and slow burning fires, unsuitable for high value areas where a small fire can cause major damage. Areas in which presence of smoke can pose a potential threat to the occupants
Rate-of-rise heat detector	Areas subject to smoke, steam, dust or dirt during normal use	Areas subject to rapid changes of temperature or temperatures over 43°C
Fixed temperature heat detector	Areas subject to smoke, steam, dust or dirt and rapid changes of temperature during normal use	
Multi-sensor fire detector	Combines the characters of two types of detectors, each of which responds to different physical and/or chemical characteristics of fire. The purpose of combining sensors in this way is to enhance the performance of the system in detection of fire or its resistance to at least certain categories of false alarms or both. There is significant potential for reduction of many types of false alarm. It is also possible to disable an individual sensor depending on the circumstances at the place of installation	
Flame detectors (general)	High ceiling, open spaced buildings like warehouses/aircraft hangers, outdoor/semi-outdoor areas, areas where rapidly developing flames occur like petrochemical/refinery/gas installations/paint shops, etc	Not sensitive to smoldering/slow burning fires and hence cannot be called general purpose detectors. Not suitable for the type of fires where. flaming can occur only after substantial release of smoke
Infra red flame detector	Same as above, these detectors penetrate through smoke well. High speed, moderate sensitivity. Suitable for indoor/outdoor applications	Affected by temperature range in the vicinity, subject to false alarms caused by blackbody radiation like heaters, incandescent lamps, halogen lamps, flickering sunlight, etc and hence usage

Type of Detector (1)	*Suitability and Merits* (2)	*Unsuitability and Demerits* (3)
		in such areas to be avoided. Sensitive to **IR** radiation from sources like any hot surface, ovens, furnaces, lamps, etc. also and due care shall be taken while installation
Ultraviolet flame detector	Highest speed, highest sensitivity. Suitable for indoor applications	Not sensitive for high ceiling, etc, as the radiation from fire is attenuated by smoke. Random UV radiation from sources, such as lightning, arc welding, etc, can cause false alarms and hence usage in such areas to be avoided. Blinded by thick smoke and oil vapours on optics
lRflR flame detector	High speed, moderate sensitivity, low false alarm rate, most suitable for chemical and hydrocarbon flames in particular as signal received is processed at two sensors. Suitable for indoor/outdoor applications	Somewhat affected by temperature range in the vicinity, suffer from atmospheric attenuations, especially on long range detection applications
UVfIR detector	Highest speed, highest sensitivity and low false alarm rate	Blinded by thick smoke and oil vapours on optics. Suitable for indoor/outdoor applications
lRfIR/IR (IR3) detector	Highest speed, highest sensitivity, lowest false alarm rate. Most suitable for chemical and hydrocarbon flames in particular as signal received is processed at three sensors	No significant disadvantages. Suitable for indoor/outdoor applications
Spark detector	Spark detectors are suitable for detection of sparks some types of duct or conveyor, monitoring the fuel, etc, as it passes by. Usually, it is necessary to enclose the portion of the conveyor where the detectors are located, as these devices generally require a dark environment	Extraneous sources of radiant emissions that have been identified as interfering with the stability of spark detectors include: (a) ambient light (b) electromagnetic interference (EMI, RFI), and (c) electrostatic discharge in the fuel stream
Ember detector	Same as above except that ember detectors can also detect fires in lit environment like coal conveyors, etc	Detector window clarity shall always be ensured
Linear heat sensing cables	Cables tunnels, trays and vaults, material conveyors, bulk storage multi-racked areas, rim seals of floating roof tanks storing hazardous chemicals, and a few other special occupancies	Not suitable at all applications other than what is specified

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