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STANDARD**

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186-4**

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**Fire safety for buildings — Code of  
practice —**

**Part 4: Selection, installation and  
maintenance of automatic fire detection  
and alarm system**

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## Foreword

Rwanda Standards are prepared by Technical Committees and approved by Rwanda Standards Board (RSB) Board of Directors in accordance with the procedures of RSB, in compliance with Annex 3 of the WTO/TBT agreement on the preparation, adoption and application of standards.

The main task of technical committees is to prepare national standards. Final Draft Rwanda Standards adopted by Technical committees are ratified by members of RSB Board of Directors for publication and gazettment as Rwanda Standards.

DRS 186-4 was prepared by Technical Committee RSB/TC 28, *Fire safety*.

In the preparation of this standard, reference was made to the following standard:

IS 2189:2008; *Selection, installation and maintenance of automatic fire detection and alarm system - Code of practice*

IS 11360, *Specification for smoke detectors for use in automatic electrical fire alarm system*.

IS 2175, *Specification for heat sensitive fire detectors for use in automatic fire alarm system*.

The assistance delivered from the above source is hereby acknowledged with thanks.

This third edition cancels and replaces the second edition (RS 186-4: 2018), Clause 1 and Clause 4 which have been technically revised.

DRS 186 consists of the following parts, under the general title *Fire safety for buildings — Code of practice*:

- *Part 1: General principles of fire grading and classification*
- *Part 2: Details of construction*
- *Part 3: Fire safety in public buildings*
- *Part 4: Selection, installation and maintenance of automatic fire detection and alarm system*
- *Part 5: Exit requirements and personal hazard*

## Committee membership

The following organizations were represented on the Technical Committee on Fire safety (RSB/TC 28) in the preparation of this standard.

Bank of Kigali (BK)

City of Kigali

CrossTech

Institution of Engineers Rwanda (IER)

Ministry of Infrastructure (MININFRA)

PRIME Insurance Ltd

Rwanda Defence Force (RDF)

Rwanda Energy Group (REG)

Rwanda Environment Management Authority (REMA)

Rwanda Housing Authority (RHA)

Rwanda National Police (RNP)

Rwanda Social Security Board (RSSB)

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Société Rwandaise d'Assurance (SONARWA)

University of Rwanda - College of Science and Technology (UR - CST)

Rwanda Standards Board (RSB) – Secretariat



# Fire safety for buildings — Code of practice — Part 4: Selection, installation and maintenance of automatic fire detection and alarm system

## 1 Scope

**1.1** This Draft Rwanda Standard covers the minimum requirements for planning, design, selection, installation and maintenance of fire detection and alarm systems.

**1.2** It covers systems capable of providing signals to alarm in the event of a fire, to initiate operations of ancillary services, such as fire extinguishing systems and other necessary precautions but it does not cover the ancillary services. It covers fire detection and alarm system installed in buildings of different types.

## 2 Normative reference

The following referenced document is indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 7240, *Fire detection and alarm systems* (applicable parts)

## 3 Terms and definitions

For the purposes of this standard, the following terms and definitions apply.

### 3.2

#### **activation device (Trigger device)**

device capable of being operated automatically or manually to initiate an alarm that is, detector, a manual (fire alarm) call point or a pressure switch

### 3.3

#### **addressable device**

fire alarm system component with discrete identification that can have its status individually identified 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 identified at the control and indicating equipment

### 3.5

#### **air sampling-type detector**

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 fire products

### 3.6

#### **alarm zone**

geographical sub-division of the protected premises, in which the fire alarm warning can be given separately, and independently, of a fire alarm warning in any other alarm zone

### 3.7

#### **alert tone**

attention getting signal to alert occupants of the pending transmission of a voice message

### 3.8

#### **analogue initiating device (sensor)**

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

#### **enunciator**

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**

organization, office, or individual responsible for approving equipment, materials, an installation or a procedure



**3.13****automatic fire direction 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**

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

**3.16****ceiling height**

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 over current 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**

device that responds to more than one form of fire phenomena or use more than one 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**

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**

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**

visual representation of output data, other than printed copy

### 3.26

#### **electrical conductivity heat detector**

line-type or spot-type sensing element in which resistance varies as a function of temperature

### 3.27

#### **ember**

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**

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**

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**

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 firefighting 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**

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**

combination of components intended to give an audible and visible and/or other perceptible alarm for fire. The system may also initiate other ancillary action

### 3.37

#### **fire rating**

The classifications 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**

device that responds when its operating element becomes heated to a predetermined level

### 3.40

#### **flame**

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

### 3.41

#### **flame detector**

radiant energy-sensing fire detector that detects the radiant energy emitted by the flame

**3.42****flame detector sensitivity**

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**

fire detector that detects either abnormally high temperature, rate of temperature rise, or both

**3.45****ionization smoke detection**

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 present criteria

Note 1 to entry: It is suggested that the use of such detectors be discouraged/avoided, as they have a radioactive source. Multi-function detections 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 inspection and tests, required to keep the fire alarm system and its component parts in an operative conditional 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**

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**

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**

principle of using a light source and a photosensitive sensor onto which, the principal portion of 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**

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**

source of electrical operating power, including the circuits and terminals connecting it to the dependent system components

### 3.55

#### **projected beam-type detector**

type of photoelectric light obscuration smoke detector wherein the beam spans the protected area

**3.56****protected premises**

physical location protected by a fire alarm system

**3.57****Radio Alarm System (RAS)**

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 announced by a radio alarm supervising station receiver (RASSR) located at the central station

**3.58****rate-of-rise detector**

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**

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 ceiling**

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****stopping ceiling**

ceiling that has a slope

**3.64**

**smoke detector**

device that detects visible or invisible particles of combustion

**3.65**

**smooth ceiling**

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**

horizontally measured dimension related to the allowable coverage of fire detectors

**3.67**

**spark**

moving ember

**3.68**

**spark/ember detector**

radiant energy sensing fire detector that is designed to detect sparks, 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**

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**

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 Requirements****4.1 General**

**4.1.1** Automatic fire detection and alarm system should consist of fire detection and manual call points connected by appropriate cables to sector/zonal panels which in turn are connected to control and indicating equipment (C and I).

**4.1.2** 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.

**4.1.3** If the required number 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.

**4.1.4** 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**

**4.2.1.1** In most of the buildings an alarm of fire may initiate a number of different activities, for example, provision of assistance, commencement of firefighting operations and emergency evacuation procedures, summoning of fire brigade, etc. It is essential that these activities are well co-ordinated.

**4.2.1.2** In the pre-planning of emergency procedures for a building, it is 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 into.

**4.2.1.3** 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.

**4.2.1.4** 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.

### 4.3 Detection zones that contain non-addressable automatic detection system

4.3.1 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 2 000 m<sup>2</sup>;
- b) if the total area of a building is less than 300 m<sup>2</sup>, a zone can cover more than one floor;
- c) if the total area of a building is more than 300 m<sup>2</sup>, 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;
- f) 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;
- i) the entire electrical installation pertaining to the entire fire alarm system as described above shall be independent of other systems;
- j) when a signal of fire is given it is necessary that there shall be no confusion about the zone from which it is received;
- k) to allow quick location of fire, the zone shall be small enough to facilitate fire rescue operation/response.
- l) adequate fire separation between the zones shall be provided;
- m) in larger premises, the fire alarm system shall be designed and installed to fully function in compatible with the emergency procedures, consequently this will allow identification of the zone from which an alarm is originated ;
- n) in the case of two stage alarms, clear and unambiguous signals shall indicate which emergency procedure to be adopted throughout each zone;
- o) for large 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;
- p) the division of sectors/zones shall be decided based on careful analysis on the type of risk, access to zones with to the main circulation routes and the main control as well as signage.;
- q) identical signals shall be used for different zones within same premises unless the background noise in one or more zones have different sounders.;
- r) for buildings with multiple usage, no zone shall be designed to include areas with more than one type of occupancy;

- s) areas with special risks shall be designed as separate zone within large protected area; and
- t) where a zone extends beyond a single compartment, the zone boundaries shall be the boundaries of the fire compartments

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

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

#### 4.4 Size and number of zones

**4.4.1** 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.

**4.4.2** To prevent misleading indication of the position of the fire, the manual call points shall be indicated in the control equipment separately from the detectors in zones, which are protected, by both detectors and manual call points. The circuits for the detectors and call points shall be different in case of conventional detection systems.

### 5 Automatic fire detectors

#### 5.1 Heat detectors

##### 5.1.1 General

**5.1.1.1** All Heat detectors shall meet the requirements of the relevant part of ISO 7240. Whereas fixed temperature heat detectors are designed to operate when the temperature of the detector exceeds a predetermined value, Rate-of-rise temperature-cum-fixed detector shall be 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
- b) When temperature at the detector exceeds a predetermined value.

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

- a) generator enclosure;
- b) turbine enclosure;
- c) oven and furnace area; and
- d) kitchen hood and other place as per the requirement where automatic fire extinguishing/suppression systems are used.

**5.1.1.3** 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.

**5.1.1.4** 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.

### **5.1.2 Heat detectors application**

Heat detectors 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.

## **5.2 Smoke detectors**

### **5.2.1 Spark/Ember detector**

**5.2.1** 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  $\mu\text{m}$  and 2.0  $\mu\text{m}$  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 burn, precipitate a much larger fire or explosion. Spark/ember detectors include the following:

- a) ambient light; and
- b) electromagnetic interference (EMI, RFI); and electrostatic discharge in the fuel stream.

**5.2.2** All Spark/Ember detectors shall meet the requirements of the relevant part of ISO 7240.

### **5.2.2 UV flame detector**

**5.2.2.1** UV Flame detector makes use of ultraviolet sensitive photocathode for detecting flame. It has a narrow spectral sensitivity of 185  $\mu\text{m}$  to 260  $\mu\text{m}$  which is insensitive to visible light.

**5.2.2.2** All UV Flame detectors shall meet the requirements of the relevant part of ISO 7240.

### 5.2.3 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. Flame detectors are suitable for:

- a) high-calling, 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, 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.

## 5.3 Choice of fire detector

### 5.3.1 General

**5.3.1.1** 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.

**5.3.1.2** 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.

#### 5.3.1.3 A combination of various detectors is necessary due to the following factors:

- a) performance of the contents for each part of the building with respect to their susceptibility to heat, smoke and water damage
- b) processes taking place or planned to take place in building; and
- c) design of the building.

**5.3.1.4** 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.

**5.3.1.5** 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.

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

**5.3.1.7** 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 the factors listed below. However, other factors such as cost, suitability for the environment and maintenance requirements shall also need to be considered.

- a) speed of response required;
- b) need to minimize false alarms; and
- c) nature of the fire hazard.

**5.3.1.8** 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 earlier reliable warning.

**5.3.1.9** Each type of detector responds at a different rate to different kinds of fire. With a slowly somnolent 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.

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

## **5.3.2 Life safety installation**

**5.3.2.1** Whenever optical density of smoke exceeds 0.1dB/m (10 m visibility), temperature rises beyond 66 °C and concentration of carbon monoxide in atmosphere exceeds 0.04 %, 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 emanate from smoke and toxic fumes;
- b) smoke and lethal gases travel rapidly to areas away from fire due to strong convection currents, which threatens the life of the occupants even at faraway places; and
- c) detectable quantity of smoke from a hostile fire precedes detectable heat level and the development of lethal atmosphere.

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

- a) pay attention to detection of smoke and to protect escape routes;
- b) ensure operation of detectors on escape route before optical density exceeds 0.05 dB/m that is, visibility falls below 20 m; and
- c) take into account any scheme of pressurization/smoke control while installing detectors

**5.3.2.3** 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.

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

### 5.3.3 Property safety installation

**5.3.3.1** Installation of fire detectors enables early detection and easy extinction by reducing delay between ignition and start of firefighting measures. 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

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

**5.3.3.3** Archives, high value libraries, and museums with high value combustibles should be protected by combination of heat, flame and smoke detectors.

**5.3.3.4** The heat detectors should be used on the racks and cupboards and smoke detectors in open space on the ceiling. Flame detectors should be used where height of the ceiling is more than 9 m.

**5.3.3.5** Flammable liquid in small quantities stored in confined spaces 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 Sitting of fire detectors

### 6.1 General

**6.1.1** 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. A record of this should be maintained in the control centre. For example:

- a) Z1/SDI/20 meaning Smoke Detector, Ionization, Zone 1, and 20<sup>th</sup> Detector;
- b) Z2/SDOT/3 meaning Smoke Detector Optical, Zone 2, 3<sup>rd</sup> Detector;
- c) Z4/HFT/4 meaning Fixed Temperature Heat Detector, Zone 4, 4<sup>th</sup> Detector; and
- d) Z3/HRR/2 meaning Rate of Rise Heat Detector, Zone 3, 2<sup>nd</sup> Detector etc.

**6.1.2** Heat and smoke detectors depend on convection to transport hot gases and smoke from the fire to the detectors. Spacing and sitting of detectors should 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 part of the enclosed areas, and it is here, therefore, that heat and smoke detectors need to be sited

Spacing and sitting of detectors shall consider the following constraints for optimum protection:

- a) heights of the ceiling (more the height means more cooling of hot gases, thus diluting the performance of the detectors);
- b) effects of stratification (where smoke does not rise to the ceiling at all);
- c) type of roof (with beams extending deep below, etc.);

- d) air movement (within the protected area below the detectors);
- e) supply air inlets (in the vicinity of detectors), HVAC systems (with high air change rates); and
- f) obstructions (in the path of rise of hot gases and smoke like ducts, machinery parts, false ceilings, light fixtures, etc.).

## **6.2 Sitting and spacing of detectors (common to all types of smoke and heat detectors)**

**6.2.1** Under flat ceilings, the horizontal distance between any point in a protected area and the detector nearest to that point shall not exceed length of 7.5 m in case of smoke detector, and length of 5.3 m in case of heat detector.

**6.2.2** 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 should be spaced between 7.5 m and 8.5 m of distance for smoke detectors.

**6.2.3** Detectors shall not be mounted within distance of 500 mm from 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.

**6.2.4** 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 more than twice the depth of the obstruction.

**6.2.5** Where partitions or storage racks that reach within 300 mm of the ceiling, they shall be constructed as walls that extend to the ceiling for the purpose of sitting the detectors.

**6.2.6** Similarly, ceiling obstructions, such as structural beams, deeper than 10 percent of the overall ceiling heights shall be constructed as walls for the purpose of sitting the detectors, that is, each bay formed by such beams shall be treated as separate enclosure for provision/spacing of detectors.

**6.2.7** Detectors shall not be mounted within distance of 1 m from any air inlet (supply air inlets of HVAC system) or a forced ventilation system.

**6.2.8** Detector sitting shall be such that a clear space of 500 mm is maintained below each detector.

**6.2.9** 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.

**6.2.10** 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.

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

**6.2.12** All unenclosed staircase shall have one detector at each main landing within the staircase.



**6.2.13** The detector shall also be provided in cable tunnels, ducts, false floors, AC and AHU (Air Handling Unit) room, long AC return ducts and distribution boards.

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

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

**6.2.16** 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.

**6.2.17** Voids as in false ceiling/flooring more than 800 mm height shall be protected with detectors spacing like in normal installation.

**6.2.18** 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.

**6.2.19** 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 corner within its zone of protection is not greater than 0.7 times the determined spacing.

Table 1 gives spacing parameter(s) at different ceiling heights for open areas under smooth and flat ceiling with no-forced ventilation/air-flows.

**Table 1 — Spacing(s) at different ceiling heights**

Type of detector	Spacing for ceiling height(s) m									Remarks
	Up to:	3.5	4.0	5.0	6.0	7.0	8.0	9.0	10.0	
Smoke detectors		9				7.5	6.5	6.0	5.0	The spacing in corridors should not be greater than 3S/2
Heat detectors	Grade (time instant 20 s)	7	No chance	6	5	5	4	3	-	
	Grade (time instant 40 s)	6	5.5	5	4	3.5	3	-	-	Spacing from the boundary wall should be kept S/2
	Grade (time instant 60 s)	5	4.5	4	3	3.5	-	-	Nil	
NOTE 1 The spacing has been adopted from charts of Fire Detecting Institute of America, adopting the parameters mentioned in 7.3 (nearest/rounded off values).										

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

## 6.2.1 Compensation to the spacing of detectors.

### 6.2.1.1 Height consideration

Spacing of 7.5 m in length for smoke detectors is valid up to a height of 7m only and that of 5.3 m in length 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:

- smoke detectors for ceiling heights between 5 m and 7 m, the spacing should be 3.5 m length;
- beyond 10 m ceiling height, the only beam detectors or aspirating type detection systems;
- heat detectors for ceiling heights between 5 m and 7 m; the spacing should be 3.5 m length; and
- heat detectors should not be install beyond 7 m ceiling heights.

### 6.2.1.2 High air movement consideration

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.

- 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;
- detectors shall be so mounted as to favour the air flow towards return air openings;
- the above provisions shall not disturb the normal population (count) of detector, which is provided assuming that air-handling systems are off; and
- after designing the detector spacing, it shall be cross-checked to ensure that there I at least one smoke detector for every 100 m<sup>2</sup> or one heat detector for every 50 m<sup>2</sup> or one heat detector for every 50 m<sup>2</sup> of the compartment area.

Table 2 — Modified spacing for high air movement areas

Air changes/h Inside block	Multiplying factor for modified	
	Spacing	Area coverage
< 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
60.0	0.38	0.15

### 6.2.2 Additional requirements for optical beam detectors

Optical beam-type detectors shall be sited in such a way that no point in the protected space is farther than 7.5 m from the nearest point of optical beam as follows:

- a) 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 of 7.5 m may be increased to 8.5 m;
- b) 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 % of the height of the above beam from ground level;
- c) 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;
- d) transmitters, receivers and/or reflectors shall be mounted on a solid construction which shall withstand vibrations, temperatures or any imposed load;
- e) the path length of the optical beam shall be within the limits specified by the manufacturers;
- f) beam detection area shall not exceed the detection zone in which it is installed;
- g) the effects of stratification shall be fully evaluated when locating the detectors;
- h) if mirrors are used with the projected beams (reflective beam detectors), the shall be installed as per manufacturer's recommendations;
- i) 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;
- j) 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; and
- k) the light path of projected beam detectors (reflective beam detectors) shall be kept clear of opaque obstacles at all times.

### 6.2.3 Additional requirements for aspirating type detection systems

**6.2.3.1** 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 below are applicable.

- a) 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; and air sampling detectors shall give a trouble signal if the airflow within the enclosure is outside the manufacturer's specified range.

**6.3.3.2** 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.

- a) 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;
- b) maximum air sample transport time from the farthest sampling point shall not exceed 120 s; and
- c) air sampling detectors shall give a trouble signal if the airflow within the enclosure is outside the manufacturer's specified range.

#### **6.2.4 Sitting of flame detectors**

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

- a) size of the fire requiring detection,
- b) fuel involved,
- c) sensitivity of detectors,
- d) distance between the fire and detector,
- e) radiant energy absorption of the atmosphere,
- f) presence of other sources of emission,
- g) purpose of detection system, and
- h) response time required.

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

**6.2.4.3** 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.

**6.2.4.4** 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.

**6.2.4.5** 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.

**6.2.4.6** 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;

**6.2.4.7** 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;

**6.2.4.8** 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

**6.2.4.9** 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.

### **6.2.5 Sitting of spark/ember detectors**

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

- a) size of the spark or ember that is to be detected;
- b) fuel involved;
- c) sensitivity of detectors;
- d) distance between the fire and the detector;
- e) radiant energy absorption of the atmosphere;
- f) presence of other sources of emission; and
- g) purpose of detection system.

**6.2.5.2** The system design 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.

**6.2.5.3** 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.

### **6.2.6 Sitting of manual call points**

Sitting manual call point shall be done based on sound engineering evaluations taking into account the following:

- a) 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;
- b) 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;
- c) 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;
- d) 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<sup>2</sup>;
- e) manual call points shall be housed in dust proof and moisture proof enclosure properly sealed with appropriate material;

- f) manual call point shall be located preferably near entry to staircases at various levels; and
- g) the glass surface shall be 30 cm<sup>2</sup> minimum in area and glass thickness shall not exceed 2 mm.
- h) once the glass is broken the alarm shall sound on the floor as well as on the Control and Indicating equipment 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.

### **6.2.7 Detectors (smoke) in ventilation ducts**

**6.2.7.1** The sampling inlet probe and the holes in the probe shall be installed, according to the manufacturer's specifications.

**6.2.7.2** 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

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

**6.2.7.4** The probe shall cover at least two third of the wider dimension of the duct and the length of the probe

## **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 ensure that they are properly sited, mounted and connected.

**7.2.2** Restorable heat detectors and restorable elements of combination detectors should be tested and reset with precaution by a heat source, such as a hair dryer, or a shielded heat lamp until it responds 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 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 check whether the contact operates properly and then reinserting 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,
- b) a manufacturer's/supplier's approved calibrated sensitivity test instrument,
- c) approved control equipment arranged to the purpose, or
- d) other approved calibrated sensitivity test method.

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

**NOTE** Detector sensitivity cannot be tested on 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 test/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 be on call at all times and that request over the telephone for emergency service should be executed promptly, within 24 h.

Servicing 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 General**

**7.4.1.1** 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.

**7.4.1.2** The routine to be adopted in individual premises may vary with the use of the premises; equipment installed in corrosive or dirty environmental conditions may be checked more thoroughly and at more frequent intervals.

Care should be taken that all equipment are properly reinstated after testing and the occupants of the premises should be notified of any test of the system that may result in the sounders being operated.

#### **7.4.2 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

#### **7.4.3 Monthly 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 month, 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, to sound the alarm and operate other warning devices.
- b) if there is more than one zone on a system having a monitored wiring, each unmonitored zone should be tested every month, but without sounding the alarm more than once.
- c) for systems having monitored wiring and up to 13 zones, each zone should be tested in turn but if there are more than 13 zones, more than one zone may need to be tested in any month 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 shall be 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;

- d) 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 notice should be recorded in the log book and reported to the responsible person, and action should be taken to correct it.

#### **7.4.4 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;
- 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; and
- f) a visual inspection should be made that structural or occupancy changes have not affected the requirements for the siting 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 defects should be recorded in the log book and reported to the responsible person, and action should be taken to correct it.

#### 7.4.5 Annual inspection tests

The following checks and test sequence should be carried out:

- a) the instruction and test routines detailed in 7.4.4
- b) operation of at least 20 % 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 clause 7.2.2 - 7.2.5 in respect of heat detectors and clause 7.2.6 and 7.2.7 in respect of smoke detectors;
- d) visual inspection should be made to confirm that all cable fittings and equipment are secure, undamaged and quantity 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; and
- f) on completion of the annual inspection, the entry should be made in register in respect of defects found. After the defects are rectified the entries should then again be made.

#### 7.5 General points about detectors

It is essential (particularly for installations involving life hazard) to ensure specified 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 specified. It is essential to apply frequent sensitivity checks and routine tests as prescribed in the standard so that the correct sensitivity levels/degree are maintained during the entire service span of the installation as specified in clause 7.2.7.

## **7.6 Cleaning and maintenance**

**7.6.1** 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.

**7.6.2** 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 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 fire condition should be tested in accordance with the provisions contained in this standard 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.

## Annex A (informative)

### Merits and relative demerits of various types of detectors

Type of detector	Suitability and merits	Unsuitability and demerits
Smoke detectors (General)	Slow burning fires, smoldering fires 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 smoked 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. Usages of these detectors are on way to phase out due to radiation problems.
Optical smoke detector	General purpose smoke detector — better for smoldering fires	Area 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
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 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.	Air-sampling detectors are not suitable if the air movement due to HVAC requirements is outside the range specified by the manufacturers
Hear detectors (general)	Clean burning fires, such as those involving certain flammable liquids. Areas subject t to smoke, steam, dust or dirt during normal use,	Unlikely to respond to smoldering and slow burning fires, unsuitable for high value areas where a small fire can cause

	fires that evolve heat and flame rapidly, suitable for rooms where heat producing equipment like kitchen, pantry, boilers, DG sets, etc, are installed/used.	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.
Intra 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 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, are welding, etc, can cause false alarms and hence usage in such areas to be avoided Blinded by thick smoke and oil vapours on optics.
IR/IR flame detector	High speed, moderate sensitivity, low false alarm rate, most suitable for chemical and hydrocarbon flame 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.
UV/IR detector	Highest speed, highest sensitivity and low false alarm rate.	Blinded by thick smoke and oil vapours on optics. Suitable for indoor/outdoor applications.
IR/IR/IR (IR3)	Highest speed, highest sensitivity, lowest false alarm rate. Most suitable for chemical and hydrocarbon flames in particular as received signal 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,	Extraneous sources of radiant emissions that have been identified as

	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.	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 application other than what is specified

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