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(तीसरा पुनरीक्षण)

Indian Standard

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

(Third Revision)

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BUREAU OF INDIAN STANDARDS
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FOREWORD

This Indian Standard (Third 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.

The general principles given below, are a guide 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 which its function is to detect; and

e) signal immediately and clearly and supervised fault that might jeopardise 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.

This standard covering the requirements of heat sensitive fire detectors was first published in 1962 and revised in 1976 and 1988. The present revision includes modifications with regard to the spacing at different ceiling heights and performance requirements for control and indicating equipments so as to bring in line with other International Standards.

The Committee responsible for preparation of this standard is given in Annex C.

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 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

(Third Revision)

1 SCOPE

1.1 This standard covers the planning, design, selection and installation of fire detection and alarm systems. It is applicable to simple systems with a few manual call points as well as to complex installations comprising detectors, manual call points; control and indicating equipment, etc. 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 fire detection and alarm systems 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 NORMATIVE REFERENCES

2.1 The Indian Standards listed in Annex A contain provisions which through references in this text, constitute provision 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 standard as given in Annex A.

3 TERMINOLOGY

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

3.1 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.

3.2 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.

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

3.3 Automatic Fire Signal

Alarm of fire originated by an automatic device, given audibly and/or visibly.

3.4 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.

3.5 Fire Alarm Control and Indicating Equipments

Equipments 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, and

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

3.6 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 accident intent.

3.7 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).

3.8 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.

3.9 Floor

Area contained on each storey of the building.

3.10 Manual Call Point

Activating device for the manual operation of an automatic fire alarm system.

3.11 Manual Fire Alarm Device

Device, manually operated, which gives an audible and/or visible alarm of fire.

3.12 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 (*see* **3.13** and **3.14**) on fire.

3.13 Sector

A sub-division of the protected premises larger than a zone (*see* **3.15**). A larger floor may be demarcated into sectors that is addressed part of the floor. A sector will normally contain many zones.

3.14 Fire Alarm Sounder

Component of a fire alarm system to give an audible alarm of fire.

3.15 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 turn are connected to control and indicating equipment (C & 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.

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.

4.2 The protected area should be divided into zones in order that a clear indication can be given of that part of area from which the alarm has originated. Careful consideration is necessary in determining the arrangement of zones. Assessability, size the provisions for containment of smoke and fire and the fire route determined for the premises should all be taken into account. Zones should readily be accessible from the main circulation routes leading from the point where the control and indicating equipment is sited. A zone should be sufficiently limited in extent to enable the precise location of the origin of an alarm of fire to be quickly determined.

4.2.1 A zone should not extend beyond a single fire compartment, defined by the main walls, floor and ceiling of the compartment.

4.2.2 A zone should normally cover only one storey even where the fire compartment includes two or more storeys, except that where detectors are fitted in stairwells, lightwells, liftshafts and other flue like structures extending beyond one floor but within one fire compartment, the volume of the well or shaft may be considered as separate zone. If the total floor area of the building is 300 m^2 or less, then the building may be considered at a single zone even though there may be more than one storey.

4.2.3 One of the chief objectives of zoning is to make it easier to determine the position of fire. Where the configuration of a zone is complex, it may not be sufficient to apply the limitations of the area mentioned above. In such a case, the search distance, that is, the distance that has to be travelled inside the zone in order to visually determine the position of fire, should not exceed 30 m. Thus if a zone can be visually examined from an entry point without travel within a zone, an area limitation will apply but when the line of site is interrupted as by racking or partitioning, the distance limitation may apply. To meet this requirement in a zone sub-divided into rooms, it may be advisable to fit indicators external to doors to indicate whether detector within the room has operated. Note of fire alarm, sounders should be distinct from any other sounders likely to be heard.

4.3 The sounders for fire alarm should be electronic hooters/horns/electric bell having frequency range of 500 Hz to 1 000 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 1 000 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 larger 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 sitting sounders in corridors to serve the surrounding rooms, account should be taken of the attenuation of the sounder frequency of the 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 innunciated 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 in ground floor where mimic panels, control and indicating equipment and other equipment associated with it should be installed.

5 AUTOMATIC FIRE DETECTOR

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 of rise temperature-cum-fixed 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 also

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

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 of by fires.

5.1.2.2 *Optical (photo electric) smoke detectors*

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

5.2 Choice of Fire Detector

Fire detectors are designed to detect one or more characteristics of fire, smoke, heat or flame. Any single type of detector is not suitable for all applications and the final choice will depend on the individual circumstances. Usually combined use of different types of detectors is made to achieve appropriate standard of protection. The detectors working on different principles of operation will respond differently to a given fire situation. Also, a particular type of detector cannot detect a fire equally efficiently in all situations. The design goal of an installation may be the protection of life or property or both. This simple fact has wide and serious implications in the choice of detectors and warrants clear insight and understanding. Variable factors that define a fire situation and have influence on choice and selection of detectors include the burning behaviour of combustible contents, structural characteristics of the area to be protected, environmental conditions, process(es) carried out and ventilation including forced air flow. These factors vary from location to location leading to varying situations within the premises itself and necessitating the use of a combination of various type of detectors.

a) *Heat detectors* — 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.

b) *Smoke detectors* — 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.

5.2.1 *Life Safety Installation*

Whenever optical density of smoke exceeds 0.1 dB/m

(10 m visibility), temperatures 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 threatening 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 installation of life safety and 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 (optical and ionization type used alternately).

5.2.2.2 Archives, high value libraries, and museums with high value combustibles should be protected by combination of heat and smoke detectors. The heat detectors should be used on the racks and cupboards and smoke detectors in open space on the ceiling.

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, etc), heat 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, SD(I) 20 meaning Smoke Detector, Ionization — 20, SD (OT) 3(Smoke Detector Optical — 3), FT 2 (Fixed Temperature — 2), FR 1 (Fixed Temperature Rate of Temperature Rise — 1), 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 Spacing Requirements of Detectors Covering General Cases

The spacing is defined as distance to be kept between adjacent detectors. A fire is sized in terms of heat energy it releases per unit time. Fire sizes important for automatic detection and alarm vary from 105.5 kW (100 BTU/s) for small fires to 1 266 kW (1 200 BTU/s) for fast developing fires. A heat release rate of 527.5 kW (500 BTU/s) represents a fire of medium size and is taken as 'threshold of detection' thus covering majority of the cases. The detectors should be so spaced that detection occurs before fire intensity grows beyond 527.5 kW. Then, the fire could be controlled by first aid, fire fighting equipment. Fast fire growth rate (least value) has been considered along with temperature change of the order of 33.3°C.

This general criterion has been followed for spacing the detectors under a smooth and horizontal ceiling with no forced air-flow. Table 1 gives general values of 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

(*Clauses* 6.3, 6.3.2, 6.5 *and* 6.17)

All values in metres.

Type of Detectors		Spacing for Ceiling Height(s)								Remarks
		Up to 3.5	4.0	5.0	6.0	7.0	8.0	9.0	10.0	
(1)		(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Smoke detectors conforming to IS 11360 both ionization and optical type		9	No Chance	No Chance	No Chance	7.5	6.5	6.0	5.0	The spacing in corridors should, not be greater than 3 S/2;
Heat detectors conforming to IS 2175	Grade 1 (time instant 20 s)	7	No Chance	6	5	5	4	3	Nil	Spacing from the boundary wall should be kept S/2
	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	

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

NOTE — The spacings have been adopted from the charts published by Fire Detection Institute of America and adopted by NFPA (National Fire Protection Association of America). The spacing for parameters other than those considered here can be found from these charts.

6.3.1 In case of computer/EDP centre/other electronic equipment installed in air-conditioned areas, the following requirements should apply:

a) Both ionization and optical type (in the ratio of 1:1), smoke detector should be used on cross-zoning pattern.

b) Optical type detector should be used below false floor specially where cable joints exist;

c) The exact locations where detectors should be installed on ceiling/below false floor should be determined after observing/ studying air movements. This could be done by suitable smoke generating devices and observing smoke density by suitable measuring instruments; and

d) All the detectors in the rooms, below false floor, above false ceiling or generally hidden should have external response indicators sited at prominent place.

Table 2 Modified Spacing for High Air Movement Areas

(*Clause* 6.3.2)

(Not to be used for underfloor or above ceiling spaces.)

Air Changes/Hour	Multiplying Factor for Modified Spacing (Area of Coverage)
(1)	(2)
7.5 or less	1 (1)
8.6	0.95 (0.91)
10	0.91 (0.83)
12	0.83 (0.70)
15	0.74 (0.55)
20	0.64 (0.40)
30	0.50 (0.25)
60	0.38 (0.15)

NOTES

1 Detectors should not be located where air from supply diffusers could dilute smoke before it reach the detector. Detectors should be mounted so as to favour the air flow towards return openings. This is not to disturb the normal population (count) of detectors which is provided assuming that air handling system is off.

2 Rounding off values may be done to nearest to 0.25 m.

3 In above ceiling areas which are designed as common returns for HVAC Systems, the air circulating through them is usually at a higher velocity than would be prevalent in the room below. This should be taken into account by suitably reducing the spacing. It

for different rates of air change. Air change per hour is defined as 60 × volume per minute of air supply to the protected space divided by the volume of the protected space.

a) smoke may not be drawn into the areas when the ventilating system is off; and

b) the detector will be less responsive to a fire conditions in rooms of fire origin due to dilution.

6.4 Smoke/heat detectors should be located upon the ceiling not less than 100 mm from the side wall, or on the side walls between 100 and 300 mm from the ceiling.

NOTE — In case of solid joists, detectors should be mounted on the bottom of the joist; and where beams are less than 300 mm in depth and less than 2.5 m on centre to centre, detector should be mounted on the bottom of the beams.

6.5 Smooth Ceiling Spacing

a) The distance between the detectors should not exceed their spacing as specified in Table 1 and there should be detectors within a distance of one-half of the determined spacing, measured at right angle from all walls or partitions extending to within 450 mm of the ceiling, or

b) All points on the ceiling should have detectors within a distance equal to 0.7 times the specified spacing.

6.6 Irregular Area

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 furthest point of a side wall or corner within its zone of protection is not greater than 0.7 times the determined spacing.

6.7 Solid Joist Construction

The spacing of heat detectors, when measured at right angles to the solid joists, should not exceed 50 percent of the smooth ceiling spacing. The spacing of smoke detectors should not be affected if joists are 200 mm or less in depth. Where joists exceed 200 mm in depth, the spacing of smoke detectors in the direction perpendicular to the joist should be reduced by twice the depth of obstruction.

6.8 Beam Construction

For heat detectors, beam construction should be treated as a smooth ceiling if the beam projects not more than 100 mm below the ceiling. If the beam projects more than 100 mm below the ceiling, the spacing of heat detectors at right angles to the direction of the beam travel should not be more than two-thirds of the smooth ceiling spacing. If the beams projects more than 450 mm below and are more than 2.5 m on centres, each bay formed by beams should be treated a separate area.

NOTE — For smoke detectors, ceiling with beams/joist depth up to 200 mm should be considered as smooth ceiling. If beam depth exceed 200 mm, the spacing of smoke detectors (except that of the long projected beam type) should be reduced by twice the depth of obstruction. If the beams exceed 450 mm in depth and are more than 2.5 m on centres,each bay formed should be treated as separate enclosure requiring at least one smoke detector.

6.9 Sloped Ceilings

A row of detectors should first be spaced and located at or within 1m of the peak of the ceiling measured horizontally. The number and the spacing of additional detectors, if any, should be based on horizontal projection of the ceiling.

NOTE — For a roof slope of less than 30 degrees, all the detectors should be spaced utilizing the height of the peak. For roof slope greater than 30 degrees, the average slope height should be used for all detectors other than those located in the peak.

6.10 Where storage is done on racks or shelves, the height of the racks/shelves should be restricted to 1 m below the ceiling. If space is divided into sections by storage racks/shelves or partitions reaching to within 450 mm of the ceiling, the separate sections should be considered as separate enclosures.

6.11 Additional detector should be placed on the ceiling at a position 1.5 m from any opening which might act like a flue.

6.12 A detector should 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.

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

6.14 All unenclosed staircases should have one detector at each main landing within the staircase.

6.15 The detector should also be provided in cable tunnels, ducts, false floors, AC & AHU room, long AC return ducts and distribution boards.

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

6.17 Every enclosure (that is, room or cabin) should have a detector even though the area may be less than the maximum prescribed in Table 1.

6.18 Where there is more than one such enclosure (*see* 6.17) per floor, a response indicator should be installed at the entrance to such enclosures to indicate where the detector has actuated. This arrangement should also be followed in case of all concealled detectors in false floors, plenums, shafts, tunnels, etc.

6.19 Voids as in false ceiling/flooring not more than 800 mm height need not necessarily have independent coverage unless the void is such that the spread of fire products between rooms or compartments take place through it. Bathroom, lavatories, WC, etc, however, need not be protected.

7 SECTOR/ZONE PANELS AND C & I EQUIPMENT

7.1 The sector/zone panel should be installed on individual sector/zone of the building and should conform to the requirements given in Annex B.

7.2 The C & I equipment and other control panel should be wall mounting/floor standing type and should be made of mild steel sheet conforming to IS 513. The minimum thickness of sheet should be 1.6 mm. The colour should be fire red (Shade No. 536 of IS 5).

7.3 Electronic/Electric circuit should have relay conforming to the relevant Indian Standard.

7.4 Each sector/zone indicator, indicating fire should consist of two LED/filament bulbs conforming to relevant Indian Standards connected in parallel. In case of fault indicators, only one LED/filament bulb should be used — open and short circuit separately. Fire warning indicator should be clearly labelled and coloured red while fault warning indicator should be clearly labelled and coloured amber.

7.5 The sector panels should have the power capacity to be connected to all the zones in the sector. In addition, it should have facility for connections to external sounders.

7.6 If required, the panel should have additional capacity to operate auxiliary equipment like fire dampers, fire closers, ventilation and/or pressurizing fans, emergency light, smoke exhausters, etc. Failure rate of power at the local sector panel should be indicated in the main control room.

7.7 Fire Alarm/External Fire Alarm Sounders

A number of external fire alarm sounders are generally

7.8 Silencing

The operation of silencing switch either for general fire alarm sounders or for signal controlling internal audio alarm of C & I equipment (*see* 7.17) should cause an audible signal to be given in or near the C & I equipment. This audible signal which may be the same as that for fault warning, is intended to act as a remainder that the silencing switch has been operated, and should give a distinctive sound different from that of any other alarm sounder (external or internal to C & I equipment).

NOTE — The requirement given here are not necessary in systems where automatic re-set is provided.

7.9 Visual Alarm Signals

In general, visual signals should only be used to supplement audible alarms. A defect in visual alarm should not cause a defect in audible alarm or vice-versa. Only in special cases where audible alarm is ineffective, such as when the occupants are deaf, immobile, etc, visual alarms can be used in lieu of external alarm sounders.

7.10 Stages of General Fire Alarms

General fire alarm system through external sounders can be provided in either of the following ways:

a) *Single Stage Continuous Alarm* — In this scheme, a continuous alarm (evacuation alarm or signal) sounds in the sector/zone of fire and also on the C & I equipment (*see* 7.15) with a provision on C & I equipment to sound continuous general fire alarm throughout the protected premises. This is normally done, particularly in smaller premises, sparely populated premises or storage premises.

instructions issued for the use of the occupants.

a) Sounding of alarms can be so arranged that any alarm operates all the sounders throughout the premises. This grouping is particularly suitable for smaller premises.

b) Sounding of alarms can be so arranged that the alarms sound initially in the sector of fire origin or in this zone and on its adjoining areas, or in this zone and in specially selected areas of high flammability or difficult egress.

for changing the 'alert' signal to 'evacuate' signal in any area, either manually or after a pre-determined period, automatically. In deciding the time delay between 'alert' and 'general evacuation', consideration should be given to the communications that may be needed to control the evacuation.

The 'evacuation' signal should be continuous and intermittent 'alert' signal should have 'ON' and 'OFF' periods of 1.0 ± 0.5 s each.

In large installations and extensive high rise buildings, two-stage alarm scheme may be more desirable to evacuate first the sector/zone where fire exists, other high risk areas or restricted areas and simultaneously 'alert' other areas.

7.11 Special System

Here the alarm sounds only in the control centre of the C & I equipment and may also have public address facility to alert personnel who are mobile within or in the vicinity of the building.

7.12 Depending on the choice of the system, C & I equipment should have necessary controls. Where two stage alarm is chosen, zonal/sectors panels and C & I equipment are needed and in case of single stage zonal/ sector panels are not needed.

7.13 The system may also adopt any of the cabling scheme, that is connecting zones/sectors directly to the C & I equipment or through zone/sector control panels.

7.14 The audible and visual alarm state should be maintained by the sector/zonal control panels and control panel of C & I equipment without a continued signal from fire detector. The sound characteristics of the alarm should be similar throughout the protected premises.

7.15 Fire Alarm Intimation

The operation of fire detector/manual call point should initiate transmission of signal(s) resulting in :

a) an audible signal on the C & I equipment (internal audio alarm C & I equipment),
b) a visual signal in the C & I equipment,
c) at least one external alarm sounder,
d) a visible indication for each sector/zone in which a detector/mcp operations, and
e) an audible signal (alert) on sector/zonal panel concerned where sector/zonal panels have been provided.

7.16 In case of two stage alarm systems, if the alarm in the first instance is not acknowledged on C & I equipment, preferably within 60 s, a general evacuate alarm should sound on all the floors.

7.17 Silencing of Fire Alarm

The audible alarm(s) as specified in (a) and (b) of **7.15** should continue to operate until silenced manually. The alarm should not be silenced automatically. The operation of the silencing switch should automatically result in an audible/visual signal being given at C & I equipment until the fire alarm is reset.

NOTE — Provision in this clause are not necessary in case of automatic reset system.

7.18 The equipment should be so designed that, following the silencing of alarm sounders, in the event of subsequent operation of detector mcp in any other zone, further fire alarm as specified in **7.15**(a) and (b) should be given.

7.19 Any fault signal as specified in **7.22** which the C & I equipment may be giving should not prevent a fire alarm being given, if the detector actuates at the same time or subsequently from the other zone.

7.20 Fault Signals

An immediate fault warning should be given by (a) visible indicator (amber) on the sector/zone control panel (where provided), and (b) an audible alarm and visible indicator (amber) on the C & I equipment in the control centre. The audible alarm should be distinct from the fire alarm.

7.21 The zonal arrangement in the panel should be modular and mere replacement of fault module/relay plug in components should put the alarm system back in operation.

7.22 Fault warning should be given at C & I equipment in the event of the following occurrences:

a) Failure or disconnection of normal power supply,
b) Failure or disconnection of standby power supply,
c) Failure or disconnection of battery charging equipment,
d) Short-circuit or disconnection of the leads to trigger devices unless the fault condition reproduces the effect of the operation of a triggered device,
e) Removal of any triggered device of the plug in type or disconnection from its transmitter or power supply,
f) Short-circuit or disconnection of any of the leads to alarm sounders external to the control and indicating equipment but if the alarm sounders are connected by a ring circuit, disconnection need not be immediately indicated but should be capable of being detected by the routine test procedure,
g) Rupture or disconnection of any fuse on the operation of any protective devices that would prevent a fire alarm being given, and
h) Failure of a scanning device to interrogate the detector or zones at the correct time intervals or failure of any monitoring or interrogating system within the control

equipment, such as to prevent an alarm being given.

A facility may also be provided for sending fault signal to remote centre.

7.22.1 It is desirable to have distinct earth fault indication on the zone wiring.

7.23 A facility should be provided for deliberate isolation of zones/sectors. This facility should be inside the panel not easily accessible to people. Whenever isolation is used, this should be given visible indication.

7.24 Circuits and mechanical design of the panel should be such that the operation of one indicator does not prevent the proper and separate operation of the other indicators and the alarm is not inhibited by any defect/failure in the indicator.

7.25 Each fire/fault indicator should be clearly labelled with the zone address on a metal label from which the call originates.

7.26 'System on' and 'Standby on' indicators should be provided. Where system test key/switch is lockable, indicator should be provided.

7.27 Test facilities, should be provided to test alarm circuit sounder, indicator, etc.

7.28 The following should be provided :

a) Acknowledge button;
b) Where required, alarm cancel indicator;
c) Isolation/reset facility; and
d) Related fuses/protective devices

7.29 Sector/Zonal control panel should be provided with voltages appropriate to the rating of the inter-connected detectors. The voltage drop in the cable risers should be taken into account.

7.30 Fire Alarm (Sounder)

Depending on the floor area and its layout, external audible fire alarm sounders should be provided to give the required sound level with a minimum of a pair of sounders in parallel. The number of fire sounders should be sufficient to produce the sound levels as specified in **4.3**.

7.31 The circuit feeding power from control panel to these fire alarm devices should be a ring circuit. If a ring circuit is not provided, design provision to give fault signal on C & I equipment in the event of short circuit or disconnection should be made.

7.32 Manual Call Points

7.32.1 On each floor, one or more manual call points should be installed, preferably on the exit routes. Call points should be installed at a height of 1.4 m above the floor at an easily accessible well lit position free of all obstructions. The call points should form the integral part of fire detector system.

7.32.2 Manual call points should be of the wall mounting type. The housing should be dust proof and moisture proof properly sealed with rubber lining. The glass surface should be minimum 30 cm^2 in area and glass thickness should not exceed 2 mm. Once the glass is broken, the alarm should sound on the floor as well as on the C & I. equipment and light should glow to indicate its operation. The alarm should be maintained by the control and indicating equipment even if someone presses the button subsequently.

7.33 Control and Indicating Equipment Accessories and Controls

7.33.1 Control and indicating equipment should be installed in the control room on ground floor, or in the case of industrial premises, separate process control rooms are provided, and should be of the wall mounting/desk/floor standing type.

7.33.2 The manual controls for switching off/on, main/ standby power should not be accessible to outsiders.

7.33.3 All manual controls should be clearly labelled to indicate the mode of operation and their functions (metal label to be used).

7.33.4 The C & I equipment should have electronic/ electrical relays conforming to relevant Indian Standards and should have the following facilities :

a) A pair of red LED/bulb to indicate origin of fire and an amber LED/bulb to indicate the origin of fault;
b) A sounder with distinct audible sounds for fire and fault alarm;
c) Audible signal acknowledge/silence button and lamp/LED to indicate its operation, whenever necessary;
d) Voltmeter and ammeter should be provided on main dc power circuit;
e) 'Systems on' standby on indicators, test key/ button operation indicator and facility to isolate zonal/sector/ main control panel from the rest of the system;
f) Where sector panel is isolated, its signal should come on the main control panel and where zonal panel is isolated the signal should come on the sector panel;
g) Failure of any indicator circuit should not prevent the fire alarm from sounding, nor acknowledgement/silencing of the alarm from one zone should prevent another alarm

coming from the other zone on the same sector;

h) Switch to actuate alarms from C & I equipment to one or more sectors/zones;

j) Test facility to check fire alarm/fault circuit, indicators; and

k) The facility for indicators to acknowledge the operation of the ancillary system. (One colour code should be associated with one ancillary service and one or more indicator per zone.)

NOTE — In high rise/special buildings like educational, institutional, assembly, business, mercantile and hotels, a handset/two-way speaker with relevant indication switches should be provided for voice communication with different floors when the circuit is actuated by inserting the handset in manual call point socket. (This is not a part of the fire alarm system.)

7.33.5 All zonal/sector control panels and control and indicating equipment should be provided with proper earthing.

8 POWER SUPPLY

8.1 The system should derive its power from either:

a) the mains electricity supply single phase (normal supply), or

b) the standby power supply that should be immediately available in the event of failure of normal supply and should be automatically connected (automatic switch-over) so as to maintain the equipment in ready condition of taking the maximum load. The standby should be derived mostly from exclusive secondary batteries where captive power generation (like automatically started generation, continuously running generation) is readily and certainly available, such as in process plants, industrial complexes and other occupancies, a standby can be derived from there.

8.2 The C & I equipment should be connected to the mains via a switch-fuse reserved solely for the purpose, its cover being painted red and labelled 'FIRE ALARM''DO NOT SWITCH OFF'. Switch-fuse should be contained in a securely closed box and the condition of 'main-on' should be indicated by a new lamp. The voltage and ampere ratings should be compatible with the requirements of various parts of the system and the power capacity of the power supplies should meet the maximum load likely to be placed on the system.

8.3 The minimum capacity of the normal mains supply should be calculated so as to meet the total power consumption of the entire system in quescent condition plus that of all the sounders and 25 percent zones in alarm condition.

8.4 Main connection to the system should be arranged such that the mains supply to the system (which is through exclusive switch-fuse) is not interrupted as a result of switching off mains power to premises/other services. Provisions made for normal and standby power supply should be such that the switch-over from one supply to another is automatic and each is capable of supplying the largest load to be placed on them under normal, fire and fault conditions.

8.5 The standby power supply should be capable of maintaining the system in normal operation for a period of not less than 48 h after the failure of normal mains supply after which sufficient capacity would remain to provide full load operation for at least 30 minutes. The full load would be defined as that caused by the operation of all the alarm sounders operating simultaneously, operation of a detector in at least 25 percent of zones (with a minimum of two zones) and the operation of the fault indicator. The operation of trigger devices in further zones should not result in cancellation of fire alarms existing at that time.

NOTE — Where failure of normal mains supply is not likely to be made good within 24 h due to long unattended/unoccupied periods, the system inspection frequency need to be arranged at intervals such that in the event of normal mains supply failure, at least 24 h standby capacity remains at the time of next inspection.

8.6 Standby power supply derived from exclusive back-up batteries should have provision of automatic charging and automatic load switch-over whenever normal mains supply fails. It should be ensured that charging conditions are matched to the system. The rate of battery charging should be such that, having discharged to its final voltage, the battery can comply with the recommendations of **8.5** after a charging period of 24 h.

8.7 The voltage of the batteries should be monitored and low voltage indicated on C & I equipment.

9 CABLES AND THEIR INSTALLATION AND CIRCUITS

9.1 Cables

The cables should conform to the following :

a) PVC insulated copper conductor cables conforming to IS 694 having minimum 1 mm^2 cross-sectional areas, if stranded, at least 0.5 mm^2 cross-section should be used.

b) Rubber insulated braided cables conforming to IS 9968 (Part 1).

c) Armoured PVC/rubber insulated cables conforming to IS 1554 (Part 1).

9.2 The cables used should be exclusively for fire detection system. The multicore cables should not be shared for other low voltage or high voltage circuits.

Cables/wiring should be laid down in metallic/rigid PVC conduits.

9.3 Cables connected to detectors should be given 'S' loop on both sides of the detectors which should be properly clamped to the ceiling. Loop should also be left where cables connect sounders, panels, dampers, etc. Appropriate glands should be provided where the cable enters the junction box.

9.4 All the cables and wires should be tagged for proper identification. Wires should be identified by ferrules at junction and cables by colour bands at every 3 m distance.

9.5 When connecting different buildings, etc, overhead lines for fire alarm system should not be used. They should be laid underground according to IS 1255.

10 CONTROL CENTRE

10.1 In high rise buildings and special buildings (*see* **7.32.2**), a control centre of an area of 16 m^2 to 20 m^2 should be provided where the control and indicating equipment, power supply units and other fire protection ancillary panels could be installed. This should preferably be on ground floor (floor one).

10.2 The control centre room should have attached WC bath, drinking water facilities and appropriate tables, chairs, record racks, etc.

10.3 The control centre room should have emergency lighting system.

10.4 The control centre room should have intercom and direct telephone facilities. Where possible, a direct hotline or any other means of communication to local fire brigade should be provided.

10.5 The control centre room should have mimic panel of the premises protected and details of all the fire protection systems. Fire orders should be prominently displayed.

be segregated from the rest of the buildings, preferably by an independent A/C system.

11.2 The installer should supply the user with a log book. The log book should be maintained for recording details, including causes of all the alarms (genuine, practice, test or false), faults, service tests and routine inspections, servicing/repairs, etc, as and when done. Periods of disconnection/inoperation should also be shown.

12 INSPECTION, TESTING AND MAINTENANCE

12.1 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 standards 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.

12.2 Initial Installation Inspection Tests

12.2.1 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.

12.2.2 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.

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

12.2.4 Heat detectors with replaceable fusible alloy element should be tested first by removing the element

12.2.5 In periodic testing, heat detectors should be visually examined for damage or other conditions

installation. Drawings should clearly indicate, for maintenance and record purposes, the position of various items of the equipment, junction boxes, sizes and routes of all cables and wires and such other relevant details. If so desired by the user, circuit diagrams of fire alarm system and its components should also be supplied. These drawings and operating instructions should be kept up-to-date and be available for convenient reference and should be located in the control room.

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.

12.2.7 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.

12.2.7.1 Detectors found to have a 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.

12.3 Servicing/Periodical Maintenance

12.3.1 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.

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.

12.3.2 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. 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.

12.4 Maintenance Schedule

12.4.1 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.

12.4.2 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 equipment is 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.

12.4.3 *Daily Attention by the 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.

12.4.4 *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 turn 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; and

b) A visual examination of the battery and connections 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.

12.4.5 *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. All ancillary functions 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.

f) 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.

12.4.6 *Annual Inspection Tests*

The following checks and test sequence should be carried out :

a) The instruction and test routines detailed in **12.4.5** (a) to (f).

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 **12.2.2** to **12.2.5** in respect of heat detectors and, **12.2.6** and **12.2.7** in respect of smoke detectors.

d) Visual inspection should be made to confirm that all cable fittings and equipment are secure, undamaged and 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 rectified, the entries should then again be made.

12.5 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 code so that the correct sensitivity levels/degree is maintained during the entire service span of the installation (*see* **12.2.7**).

12.6 Cleaning and Maintenance

Detectors require periodic cleaning to remove dust or dirt that has accumulated, the frequency of cleaning depending on the type of detector and the 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 manufacturers' 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.

12.7 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 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.

12.8 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.

12.9 Spares

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

ANNEX A

(*Clause* 2.1)

LIST OF REFERRED INDIAN STANDARDS

IS No.	*Title*	*IS No.*	*Title*
5 : 1994	Colours for ready mixed paints and enamels (*fourth revision*)		upto and including 1 100 V (*third revision*)
513 : 1994	Cold rolled low carbon steel sheets and strips (*fourth revision*)	2175 : 1988	Heat sensitive fire detectors for use in automatic fire alarm system (*second revision*)
694 : 1990	PVC insulated cables for working voltages upto and including 1 100 V	8757 : 1978	Glossary of terms associated with fire safety
1255 : 1983	Code of practice for installation and maintenance of power cables upto and including 33kV rating (*second revision*)	9968 (Part 1) : 1988	Elastomer-insulated cables : Part 1 For working voltages up to and including 1 100 V (*first revision*)
1554 (Part 1) : 1988	PVC insulated (heavy duty) electric cables : Part 1 For working voltages	11360 : 1985	Smoke detectors for use in automatic electrical fire alarm system

ANNEX B

(*Clause* 7.1)

PERFORMANCE TESTS/REQUIREMENTS FOR CONTROL AND INDICATING EQUIPMENT

B-1 GENERAL

B-1.1 Control & Indicating (C & I) equipment and sector/zonal panels should be subjected to performance tests. For the purpose of these tests, standard production sample of equipment panel should be taken and tested in minimum configuration arrangement. When the size is large, the tests are to applied to damage prone electronic/electric parts of the unit.

B-1.2 Proper operation of fire alarm sounder being critical and essential, tests/performance criteria specified in **B-3** shall apply to these devices.

NOTE — It is the primary function of C & I equipment to raise an effective alarm in response to the operation of a trigger device by automatically switching on alarm sounder at the protected-premises, by indicating where the trigger device is situated and in certain cases, by transmitting a fire alarm signal to remote location(s). Automatic indication of those faults directly effecting the primary function of the equipment is required. It is necessary to specify routine testing scheme and routine test frequency (time interval between tests). It is understood, however, that testing routine will vary widely with the type of equipment or system. All technical information (instruction manual, operational data, wiring and connection diagrams, provision of special and standard facilities and other relevant information) shall be provided with the C & I equipment. Compatibility with other components/parts of fire alarm system shall be ensured.

The test specified under performance clause are type tests only that neither ensure uniformity of quality in production nor remove the essentiality of regular inspection and maintenance which are essential for reliable operation.

C & I equipment shall be appropriately labelled to include model number or code, number of zone, fixed or modular design and address of manufacturer/ supplier.

B-2 PERFORMANCE

B-2.1 Control and Indicating Equipment

Prior to conducting each of environmental tests given in **B-2.3**, the equipment is preconditioned (*see* **B-2.1.1**) and checked for functional tests (*see* **B-2.2**) and after undergoing each of the environmental tests given in **B-2.3** (after being stabilized), the equipment is tested for functional tests (*see* **B-2.2**).

B-2.1.1 *Preconditioning and Recovery*

Before and after each environmental test, the temperature of the equipment should be allowed to stabilize for at least 3 h to room ambient between 15°C and 37°C and relative humidity lying between 45 to 85 percent. The ambient temperature and humidity should be substantially constant during precondition, during recovery and while a functional test is carried out.

B-2.2 Functional Test

These tests should consist of the following operation in sequence:

a) Operate momentarily a trigger device (automatic detector/mcp) from any zone to ensure correct functioning;

b) Operate alarm silencing switch to ensure correct functioning;

c) Operate another trigger device (detector/mcp) from another zone to ensure correct functioning of C & I equipment and sector/zonal panel, in case of big/sectored equipment;

d) Operate reset control to ensure correct functioning;

e) Check the audible and visible warnings given on disconnection of normal (mains) power; and

f) Restore the equipment to quescent condition.

B-2.3 Test Environments

The equipment should subjected to the following test environments.

B-2.3.1 *Dry Heat Environment*

The equipment/electronic panels should be introduced into the chamber/oven which should be at the ambient temperature of the laboratory (*see* **B-2.1.1**). The chamber should then be adjusted to temperature of 45° to 50°C and 40 to 45 percent relative humidity. The rate of temperature rise should not exceed 1°C/ min. After the temperature equilibrium in the chamber has been reached, the equipment should be exposed to these conditions for 16 h continuously.

B-2.3.2 *Damp Heat Environment*

The equipment/electronic panel(s) should be introduced into a chamber which should be maintained at a temperature of 45 ± 3°C and relative humidity of 90 to 95 percent. The equipment should be exposed to these conditions for 16 h continuously.

B-2.3.3 *Cold Environment*

The equipment/electronic panels while being at the ambient temperature of the laboratory, should be introduced into the chamber, which should also be at

that temperature at the start. The temperature should then be lowered to 0 ± 5°C at the rate not exceeding 1°C/min. The equipment should be exposed to cold environment for a period of 16 h after the temperature stability has been reached. The equipment should remain in the chamber during the recovery period (of 3 h) with cooling off.

B-2.3.4 *Vibrations*

The equipment mounted on vibrating table in its normal operating position and by its normal fastenings should be subjected to vibrations as given in IS 2175.

B-2.4 Inspection and Performance Requirements

After each environmental test, the equipment should be opened and inspected for faults consequential to that test. The equipment/panels shall be considered satisfactory if :

a) no damage is revealed during inspection which is a result of the faulty design or workmanship, and

b) each operation made during the functional tests specified above cause the equipment/ panel to operate normally.

B-2.5 Operational Test

With C & I equipment in its quescent condition for 20 h, the cumulative effect of the operation of trigger device should be applied to each zone in succession, the audible alarm being silenced between each operation where this facility is provided. The equipment shall be considered satisfactory if all fire alarms supposed to be initiated by the operation of a trigger device functions normally and no fault warning is given as a result of this test. In successive zone activation process for a control panels having than three zones, heat detectors, smoke detectors and mcps shall be used unless otherwise specified. The following two conditions shall be observed :

a) At least one zone shall be activated by each type of trigger device, and

b) mcp shall be mounted and operated as intended while heat and smoke detectors shall be mounted (at least once) in hot air tunnel (as per IS 2175) and smoke tunnel (as per IS 11360) respectively and brought into operation by essentially slow build up of temperature and smoke concentration. Rate of rise of temperature shall be 3°C/min and rate of smoke build up shall be less than 0.2dB/m as prescribed in the standard for measuring the response of smoke detectors.

B-3 FIRE ALARM SOUNDER

B-3.1 Continuous Normal Operation

The fire alarm sounder shall be able to operate continuously for a period of at least 50 min without damage or malfunction. The sound output (peak value) shall not vary by more than ± 5dB(A) during this operation.

B-3.2 Sound Level/Characteristics

The sound level (peak value) shall be not less than 65 dB(A) and not more than 120 dB(A) when measured at a distance of 1.5 m (measured in audio-metric chamber).

B-3.3 Environmental Stresses

Construction and housing of sounder shall be such as to afford protection against fouling by dust and damage by other environmental stresses.

Dust — One device shall be exposed to dust test as described in IS 11360.

Corrosion — One device shall be suspended in corrosive atmosphere of SO_2 as described in IS 2175.

Vibrations — One device shall be mounted on vibrating table and shall be subjected to vibrations as per IS 2175.

Climatic Conditions — One device shall be exposed to dry heat, damp heat and cold environment as per **B-2.3.1** to **B-2.3.3** above.

After each environmental stress test, device shall be inspected for fault(s) consequential to that test and its sound output measured. Device shall be considered satisfactory if no damage is revealed and operates normally without output variation greater than ± 5dB(A).

(*Continued from page* 17)

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(Common to all offices)

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