SYSTEM SENSOR EUROPE

guide to conventional fire systems

SYSTEM SENSOR®

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CONTENTS

Note: This document is based on the recommendations of BS5839 Part 1: 2002. It is intended only as a guide to the application of fire detection systems.

Reference must be made to relevant national and local standards.

1. CONVENTIONAL FIRE ALARM SYSTEMS

1.1. PRINCIPLE OF OPERATION

A conventional fire alarm system normally consists of a control panel linked to a number of lines of fire detectors and manual call points, normally called detection zones, and a number of sounder or alarm circuits. A simple system is shown in Figure 1.1.

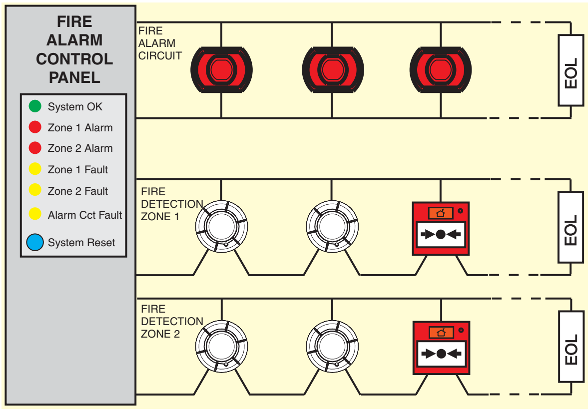

Figure 1.1: Simple Conventional Fire Alarm System

1.2. CONTROL PANEL

The control panel drives the detection zones and sounder circuits, provides LED indications of fire, fault or normal conditions and contains switches to allow the sounders to be activated or silenced and the detectors to reset following an alarm. The control panel is powered from the mains (230VAC) and will contain back-up batteries to allow the system to function for a minimum of 24 hours, dependant on the application, in case of a mains failure.

Note: There are numerous suppliers of fire control equipment and fire detection devices. There is no guarantee that all panels and all detectors are electrically compatible. Therefore, to avoid potential incompatibility issues, it is strongly recommended to purchase both groups of products from the same source, or to obtain confirmation of compatibility from the panel manufacturer.

1.3. FIRE DETECTION AND ALARM ZONES

Most conventional fire alarm panels have several detection zones comprising a mixture of automatic fire detectors and manual call points. In order to limit the effect of faults, and to limit the search area in the case of a fire, the size of a fire detection zone is limited to 2000m², with a maximum travel distance within the zone to locate a fire of 60m. In addition, zones should not cover more than one storey, unless the total floor area of the building is less than 300m². As a result unless the site is very small, the system will comprise several detection zones.

A fire alarm (or sounder) circuit may cover more than one detection zone, but it must follow the boundaries of the relevant detection zones, and the boundaries should be of fire resisting construction.

1.4. CONVENTIONAL SYSTEM OPERATION

1.4.1. Detection Line Operation

Conventional detection systems normally operate on a 24VDC line. In the standby condition, the detectors will draw a low current, typically less than 100µA. When the detector senses a fire, it will switch into the alarm condition with it's LED illuminated, and will collapse the line voltage by drawing a larger current - dependant on the detectors and control panel, but typically 50-80mA. The control panel can sense this, and activate the appropriate alarms. The detector will remain latched in the alarm state with its LEDs illuminated, even if the smoke or heat is removed until it has been reset from the panel by momentarily removing power from the line. This allows the fire to be located even if the signal is intermittent, or to locate possible sources of nuisance alarms.

For some control panel - detector combinations, when a standard base is used, there is an incompatibility between the current specifications of the detector and panel, leading to incorrect reporting by the control panel, for example signalling a fault in place of an alarm, and in some cases damage to the detector due to over current in the alarm state. In these cases it is necessary to use a base fitted with a resistor in series with the detector to limit the current draw in alarm. Resistors fitted into the detector base are also used in some cases to distinguish between a short circuit fault and an alarm. The value of the base resistor is dependant on the control panel, however a typical value is 470 Ohms. If in any doubt, contact the control panel manufacturer who should be able to specify which detector bases should be used with different detector brands.

A manual call-point consists of a simple switch with a resistor in series with it, usually 470 Ohms or 680 Ohms. When the call point is activated, the resistor is switched across the line, and a current of 50-80mA, dependant on the control panel, is drawn.

1.4.2. Detection Line Fault Monitoring

Standard conventional systems are able to monitor the zone for short circuit, open circuit and detector head removal.

When a short circuit occurs on a zone, a high current will be drawn, and the line voltage will be pulled towards zero volts. The panel detects the low voltage / high current and a fault is signalled.

In order to detect an open circuit, or detector head removal, a device is connected across the end of the zone, which can be monitored. This device can take various forms dependant on the control panel.

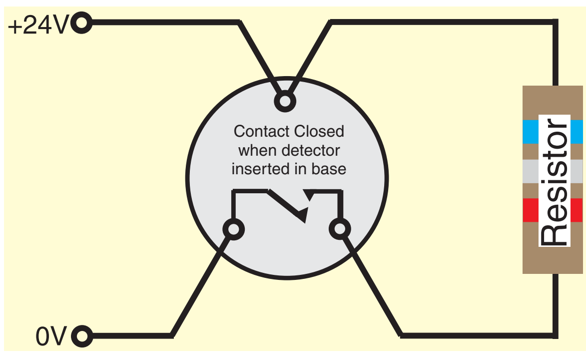

Figure 1.4.1. Resistive End of Line Operation

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The simplest end of line device is a resistor, which will draw a current distinct from the quiescent and alarm currents drawn by the detectors. Installation of detectors into their bases closes a contact in the base supplying the remainder of the zone. Thus if the line is broken, or if a detector head is removed, the current drawn by the zone will fall, and a fault will be signalled (See figure 1.4.1). Example zone current and voltage figures are given in table 1.4.1.

	Monitoring of detection line (example only)	
Condition	Current	Voltage
Open Circuit	<3mA	24V
Normal	5mA (dependant on EOL device)	18V
Fire	50mA (dependant on control panel)	4 – 15V
Short Circuit	High (dependant on control panel)	0V

Table 1.4.1: Example Resistive Conventional System Current and Voltage figures

The problem with a simple resistive end of line is that should a detector head be removed, the remainder of the zone beyond that detector is lost and no alarm can be signalled beyond this point. Should a call point be mounted beyond the removed detector, it will no longer work, which contravenes the requirements of BS5839 part 1. To overcome this either all call points must be mounted at the start of each zone, or in completely separate zones (both of these solutions are often impractical and too costly), or head removal monitoring can be employed.

Active monitoring uses bases fitted with a diode across the contact in the base (fig 1.4.2). Whilst the detector is mounted in the base, the base contact connects directly across the diode, and links it out. There is usually provision for manually linking the diode out to permit continuity testing during commissioning. When the detector head is removed, the diode is connected across the contact, allowing power to continue to be supplied to the remainder of the zone, whilst still permitting the removed detector to be monitored. This is achieved in a number of ways.

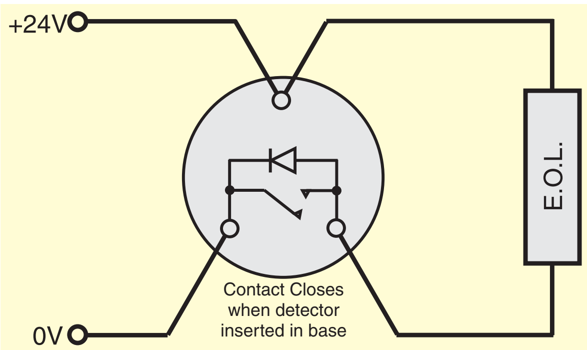

Fig 1.4.2. Active End of Line Monitoring Circuit

An active end of line device uses a switched resistor at the end of line and can thus be used with a standard control panel. It sends a periodic signal back along the detection line, which is normally quenched by the control panel. When a head is removed, the base diode is switched into the line, and pulse can be seen. The Active end of line then switches the resistor out of the line, and a fault is signalled.

If a capacitive end of line is used, the panel periodically drops the line voltage for a few milliseconds, and looks for the line voltage being held up by the capacitor. When a head is removed, the panel will see the line voltage drop immediately as the capacitor's discharge will be inhibited by the diode, and thereby a fault can be signalled.

A third type of end of line device is a diode. With this the panel periodically reverses the line voltage for a few milliseconds: If the line is broken by the diode in the detector base, then no current can flow in the reverse direction.

The type of end of line monitoring used on a system will depend on the control panel. However it is important, particularly when using active end of line monitoring to ensure that the detectors are compatible with the type of monitoring being used. Reference must be made to the panel manufacturer to ensure compatibility.

1.4.3. Remote LEDs

Most system smoke detectors are equipped with a terminal to allow the connection of a remote LED. Remote LEDs are often used outside bedroom doors in hotels so that in case of a fire, it is easy for the fire brigade to identify the location of the fire without needing to enter every room in the building. They may also be used where a detector is located in a hidden position, such as a floor or roof void or cable tunnel, for example, to provide a visual indication that the detector is in an alarm state.

1.4.4. Four-Wire System Operation

In some cases it is necessary that the power to the detectors and the fire detection signal be on separate wires, see figure 1.4.3. In this instance, a base incorporating a change over relay is used. This configuration is known as a four-wire system, and is often seen when a fire zone is integrated into a security panel.

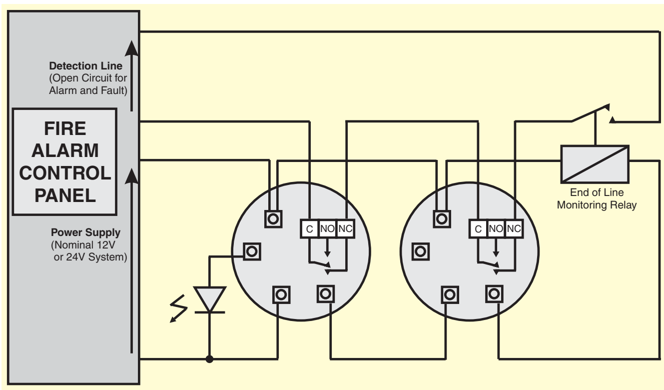

Figure 1.4.3. Typical 4 Wire System Wiring

Figure 1.4.3 shows the simplest form of four-wire system, as used with most security panels. This is used where the monitor line is able only to register an open or closed circuit - there is no distinction between a fault and a fire. By using a normally closed relay at the end of the power line, it is possible to monitor for a power failure to the detectors. The relay contacts are wired in series with the normally closed contacts of the detector relay base(s). Thus in the normal state the detection circuit is closed; in the case of fire or power failure the relevant relay contacts will open.

Normally after an alarm, the detectors are reset by disconnecting the power to the relevant zone for a short period by pressing a central panel reset button. Fire panels have

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this facility built in, however many security panels are unable to do this without turning the entire panel off. Therefore to allow the use of detectors with security panels, non-latching versions of the relay bases are usually made available, which automatically isolate the detector from the supply every few seconds. Thus once the fire condition has passed the detector will automatically reset (note that the alarm condition should be latched at the control panel.)

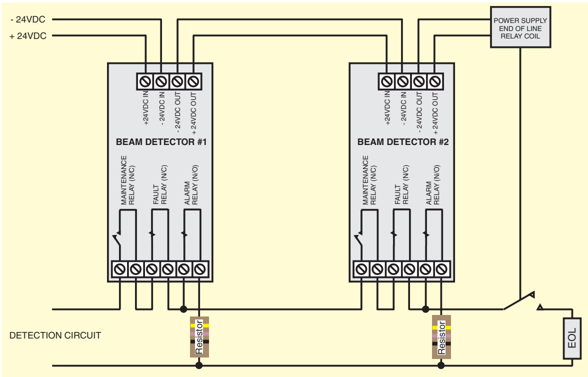


Figure 1.4.4. 4-Wire System with Full Monitoring

Four-wire type systems are also often used with devices such as beam detectors where an auxiliary power supply may be required. In this case if the device is connected to a fire control panel, able to distinguish between different detector states, the circuit can be routed to provide full monitoring for alarm and fault. Figure 1.4.4 shows typical wiring for a beam detector, which includes it's own internal maintenance and fault monitoring. With this layout all fault and maintenance contacts are wired in series, and all alarm contacts in parallel with the end of line device. In the case of a fault or maintenance signal, the end of line will be disconnected, and a fault can be signalled at the panel. To distinguish between an alarm and short circuit, a resistor, typically 470 Ohms is placed in series with each alarm contact as indicated in order to shunt the detector zone. Note that a separate reset signal may be required to reset some beam detectors

1.4.5. Fire Alarm (Sounder) Zone Operation

Similarly to detection lines, it is important to monitor fire alarm zones to ensure that the cable has not been broken, disconnected or shorted. However the operation of alarm zones is different from detection lines.

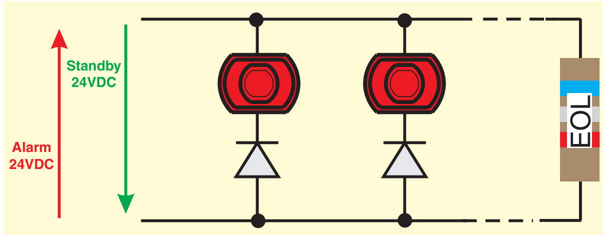


Figure 1.4.5. Conventional Fire Alarm Sounder Circuit

Fire alarm sounders contain a polarising diode, which allows them to operate when a voltage is applied in one direction, but not when the voltage is reversed. When the system is in standby, the panel applies a voltage in the 'wrong' direction, so that the sounders do not operate and do not draw any current. An end-of-line resistor draws a constant monitoring current, which allows the panel to verify that the wiring is intact. Should the panel sense that no current is being drawn, it signals an open circuit fault. In the case of a short circuit, a high current is drawn from the zone, the voltage drops towards zero and a fault condition is shown. To activate the sounders, the control panel reverses the polarity of the voltage to the zone.

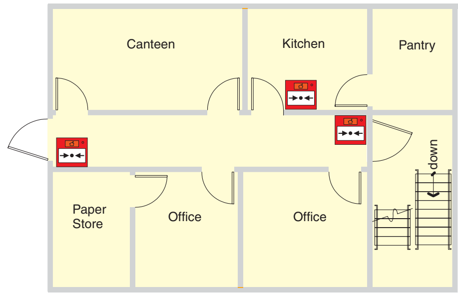
2. DETECTOR APPLICATION GUIDE

2.1. FIRE SYSTEM CATEGORIES.

Before a fire protection system can be designed, it is necessary to define the main objectives of the system. This is normally determined by a fire risk assessment, and should be provided as part of the fire system specification. BS5839 Part 1: 2002 defines three basic categories of fire detection system.

2.1.1. Category M Systems

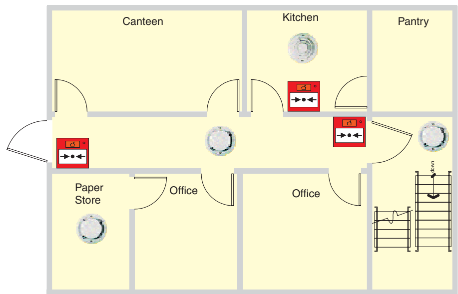
Category M systems rely on human intervention, and use only manually operated fire detection such as break glass call points. A category M system should only be employed if no one will be sleeping in the building, and if a fire is likely to be detected by people before any escape routes are affected. Any alarm signals given in a category M system must be sufficient to ensure that every person within the alarm area is warned of a fire condition.



2.1.2. Category L Systems

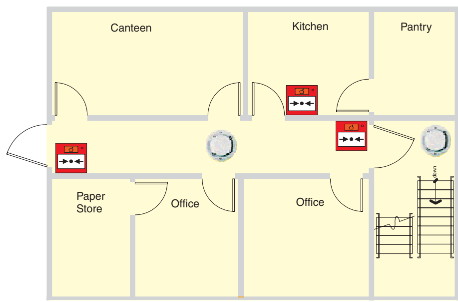
Category L systems are automatic fire detection systems intended to protect life. The category is further subdivided as follows:

Category L5: In a category L5 system certain areas within a building, defined by the fire system specification, are protected by automatic fire detection in order to reduce the risk to life. This category of system may also include manual fire protection.

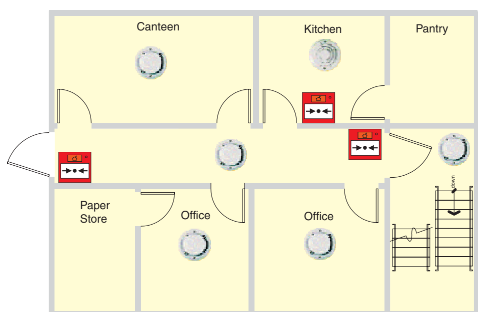


Example L5 System: L4 protection plus areas of high risk

Category L4: Designed to offer protection to the escape routes from a building. The system should comprise Category M plus smoke detectors in corridors and stairways



Category L3: Intended to offer early enough notification of a fire to allow evacuation before escape routes become smoke logged. Protection should be as for category L4 with the addition of smoke or heat detectors in rooms opening onto escape routes.



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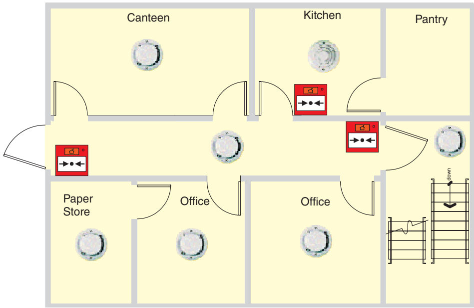
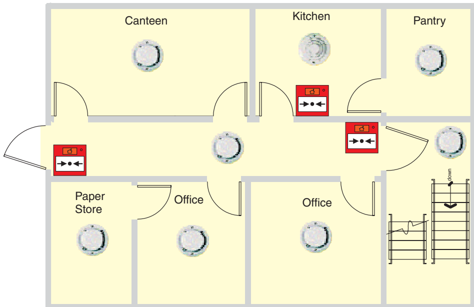


Category L2: Objectives are similar to category L3, however additional protection is provided for rooms at higher risk. Protection should be as for category L3 plus smoke detectors in specified rooms at high risk

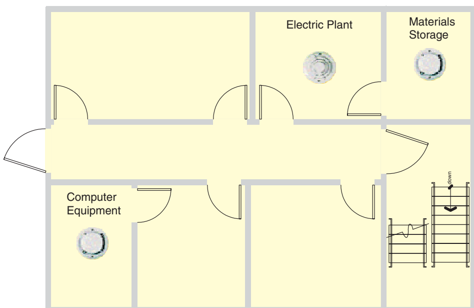


Category L1: The highest category for the protection of life. Intended to give the earliest possible notification of a fire in order to allow maximum time for evacuation. Automatic and manual fire detection installed throughout all areas of the building. Smoke detectors should be employed wherever possible to protect rooms in which people can be expected to be present.

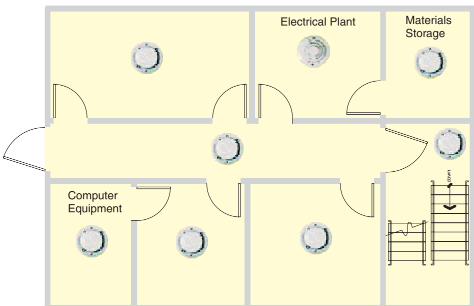
Similarly to class M systems, all alarm signals given in a category L system must be sufficient to warn all those people for whom the alarm is intended to allow for a timely evacuation.

2.1.3. Category P Systems

Category P systems are automatic fire detection systems whose primary objective is to protect property. The category is subdivided as follows:



Category P2: Intended to provide early warning of fire in areas of high hazard, or to protect high-risk property. Automatic fire detection should be installed in defined areas of a building.



Category P1: The objective of a category P1 system is to reduce to a minimum the time from the ignition of a fire to the arrival of the fire brigade. In a P1 system, fire detectors should be installed throughout a building.

In a category P system, unless combined with category M, it may be adequate for alarm signals simply to allow fire fighting action to be taken, for example a signal to alert a responsible person to call the fire brigade.

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2.2. MANUAL CALL POINTS

People can often still detect a fire long before automatic fire detectors; hence manual call points are important components of fire detection systems in occupied buildings to ensure timely evacuation in the case of fire. All call points should be approved to EN54-11, and should be of type A, that is once the frangible element is broken or displaced the alarm condition is automatic.

Manual call points should be mounted on all escape routes, and at all exit points from the floors of a building and to clear air. It should not be possible to leave the floor of a building without passing a manual call point, nor should it be necessary to deviate from any escape route in order to operate a manual call point. Call points mounted at the exits from a floor may be mounted within the accommodation or on the stairwell. In multiple storey buildings where phased evacuation is to be used call points should be mounted within the accommodation to avoid activation of call points on lower levels by people leaving the building.

In order to provide easy access, call points should be mounted between 1.2 and 1.6m from the floor, and should be clearly visible and identifiable. The maximum distance anyone should have to travel in order to activate a manual call point is 45m, unless the building is occupied by people having limited mobility, or a rapid fire development is likely, in which case the maximum travel distance should be reduced to 20m. Call points should also be sited in close proximity to specific hazards, for example kitchens or paint spray booths.

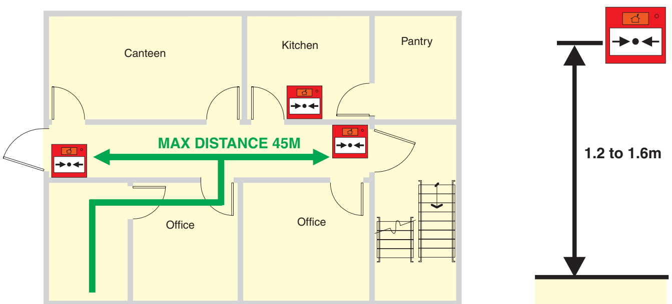

Figure 2.2.1. Manual Call Point Positioning

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2.3. SELECTION OF AUTOMATIC FIRE DETECTORS

Smoke detectors are the most sensitive automatic means of detecting a fire and should be used wherever conditions allow.

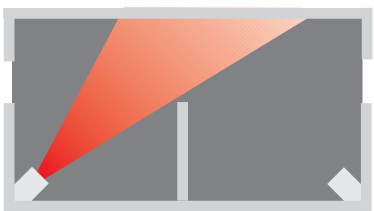
2.3.1. Ionisation smoke detectors

Ionisation smoke detectors use a weak radioactive source to ionise the air between two electrodes, creating positive and negative ions and so allowing a small current to flow across the chamber. Smoke particles attract these ionised particles, and allow positive and negative ions to recombine, thus reducing the number of ions and hence the current flow.

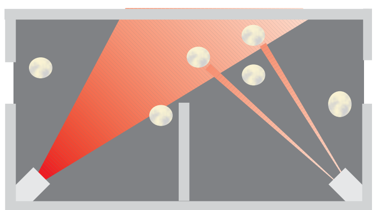
Environmental regulations concerning the radioactive source used in ion detectors means that they are now becoming obsolete, and most major manufacturers are no longer including ionisation detectors in new ranges.

2.3.2. Photoelectric smoke detectors

Photoelectric or optical smoke detectors work by generating pulses of infra red light and measuring any diffracted light. If smoke is present in the sensing chamber, the light is diffracted by the smoke particles onto a photodiode, which senses the presence of the smoke (see figure 2.3.1). They are now largely replacing ionisation detectors as a general purpose detector.



Without Smoke: Chamber is designed so that light from the IR-LED does not reach the receiver



Smoke Present : Light from the IR-LED is reflected off the smoke particles onto the receiver, triggering an alarm signal.

Figure 2.3.1. - Operation of Optical Chamber

Photoelectric smoke detectors are tested across the complete range of EN54 fires, however they are most sensitive to smoke containing large particles from around 0.4 to 10 microns, such as that given off by smouldering fires. A photoelectric detector would therefore be a good choice in an environment where a slow burning fire could be expected, such as a room containing modern fabrics and furnishings.

2.3.3. Multi-criteria Detectors

Multi-criteria detectors comprise two or more sensors within the same housing, integrated by the detector electronics or software to give a faster response, and greater immunity to nuisance alarms. The most common type at present is a combination of optical and rate of rise heat sensors, which can give a response to fast flaming fires similar to that of ionisation detectors. Other sensor combinations are also available.

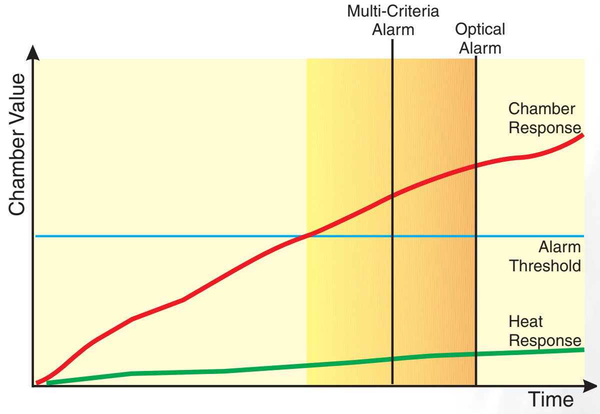


Figure 2.3.2. Photo-Thermal Detector Response

2.3.4. CO Detectors

A recent addition to BS5839 is CO detectors. These use an electro-chemical sensor to detect carbon monoxide given off by incomplete combustion. They provide reliable detection of incipient fires whilst giving good assurance against nuisance alarms. However the chemical cells used in these detectors have a limited life span, and they cannot detect fast burning fires.

2.3.5. Heat Detectors

Heat detectors are normally used in environments where a smoke detector might generate false alarms, for example kitchens or shower rooms.

Rate of Rise heat detectors will alarm if the temperature rises very quickly, or if the temperature reaches a set threshold. This type of detector would be the first choice in an environment where a smoke detector could not be used.

In some environments, such as boiler rooms, fast rates of rise of temperature can be expected normally, meaning that there would be a risk of false alarms when using a rate-of-rise device. In this case a fixed temperature detector would be suitable. As their name implies, fixed temperature detectors give an alarm once the temperature has reached a preset threshold, most commonly 58°C or 78°C for EN54-5 Class AS or BS respectively.

2.3.6. Optical Beam Detectors

Optical beam detectors work on the principle of projecting a beam of light across a room, which is attenuated when smoke is present thus allowing an alarm to be given (Figure 2.3.3). There are two forms of beam detector: emitter and receiver separate (single path), requiring separate wiring both to the emitter and receiver, and reflective in which the emitter and receiver are mounted in the same box, and the beam is shone onto a reflective material at the far side of the room (dual path).

Since an optical beam detector senses smoke across the entire smoke plume, it tends to be less affected by smoke dilution as the ceiling height increases than point type smoke detectors. In addition, a single beam detector can protect a large area; hence they are particularly suitable for protecting large high rooms such as sports arenas, warehouses and shopping malls

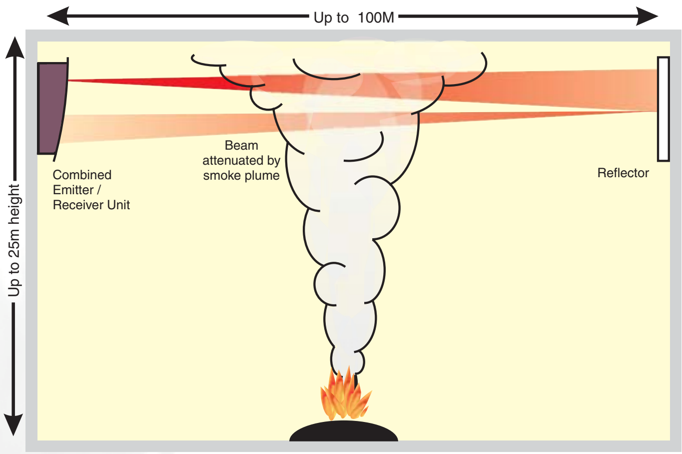


Figure 2.3.3. Operation of Reflective Type Optical Beam Smoke Detector

Beam detectors are more complex to install than ordinary point smoke detectors and it is advisable to consult an application guide for the use of projected beam smoke detectors before considering the use of these detectors.

Detector type	Application	Not suitable for
Ionisation smoke detector	General purpose smoke detector – better for fast flaming fires	Areas subject to smoke, steam, dust or dirt during normal use
Optical smoke detector	General purpose smoke detector – better for smouldering fires	Areas subject to smoke, steam, dust or dirt during normal use
Photo-thermal multi-criteria detector	General purpose detector – good for smouldering and fast flaming fires	Areas subject to smoke, steam, dust or dirt during normal use
Optical beam smoke detector	Large and high rooms	Areas subject to smoke, steam, dust or dirt during normal use
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 detector (58°C)	Areas subject to smoke, steam, dust or dirt and rapid changes of temperature during normal use	Areas subject to temperatures over 43°C
High temperature fixed detector (78°C)	Areas subject to smoke, steam, dust or dirt and temperatures over 43°C during normal use	Areas subject to temperatures over 70°C

Figure 2.3.1. Selection of Fire Detectors

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2.4. LOCATION AND SPACING OF AUTOMATIC FIRE DETECTORS

It is important to consult applicable local and national standards when choosing the spacing and location of fire detectors. The following information is intended only as a guide to the location and spacing of detectors. There is currently no European standard available; hence this guide is based on BS5839 part 1, 2002.

2.4.1. Location and Spacing of Point Fire Detectors on Flat Ceilings

On a flat ceiling with no obstructions, the radius of protection of fire detectors is 7.5m for a smoke detector and 5.3m for a heat detector, and detectors should be mounted a minimum of 0.5m from a wall. Some analogue multi-criteria detectors have a heat sensor only function, switched by the control panel, typically used to reduce the possibility of false alarms during daytime when a building is occupied, reverting to multisensor operation at night time. If this type of operation is employed, the radius of protection for a heat sensor should be used. Figure 2.4.1 gives a simple spacing plan based on these figures, however it should be noted that this might not be the most efficient layout for a given site; for example in larger areas, it is also possible to use a staggered layout, see figure 2.4.2, which may reduce the number of detectors required. In practice, the layout of the room must be considered to obtain the most efficient detector layout.

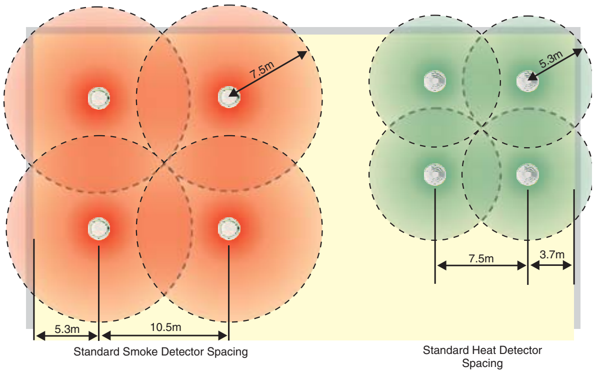


Figure 2.4.1: Simple spacing plans for smoke and heat detectors

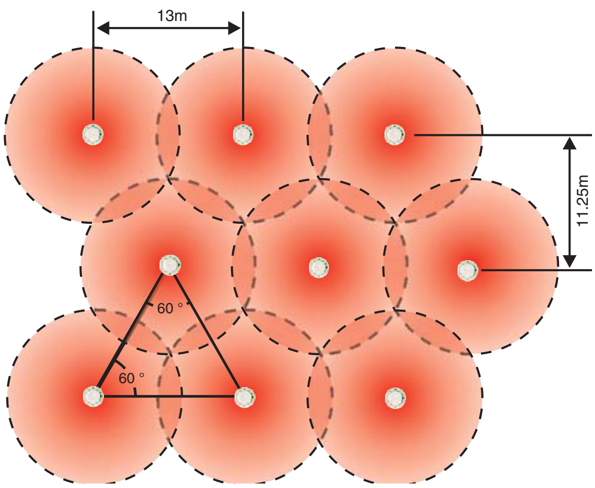


Figure 2.4.2: Alternate smoke detector spacing plan for protecting large areas

2.4.2. Ceiling Height

Smoke or heat detectors can only detect fires once a certain amount of smoke or heat has reached the sensor. As the height of a ceiling increases, the time taken for smoke or heat to reach a sensor will increase, and it will become diluted with clean, cool air. As a result, maximum ceiling heights are limited as indicated in table 2.4.1 below.

Detector type	Maximum ceiling height
Point smoke detector conforming to EN54–7	10.5m
Heat detector conforming to EN54–5 Class A1 (threshold 58°C)	9m
High temperature heat detector conforming to EN54–5 Class B (threshold 78°C)	6m
Optical beam detectors	25m

Table 2.4.1: Maximum ceiling height for different types of detector

Often, a boundary layer can form close to the ceiling, which is free of smoke and remains cool. To avoid this, and maximise the probability of detection, smoke detectors should normally be mounted with their smoke entry 25mm-600mm below the ceiling, and heat detectors should be mounted with their heat element 25mm-150mm below the ceiling. Detector design normally ensures that the minimum requirement is met, but care needs to be taken if the detectors are to be stood away from the roof, for example mounting on an open lattice suspended ceiling.

Another problem that should be considered is the possibility of stratification of the air in a room into hot and cold layers, causing the smoke or heat to stop at the boundaries. This particularly affects high rooms or atria, where beam detectors are often used. Stratification is very difficult to predict, and can vary, even within the same room as environmental conditions change.

2.4.3. Ceiling Obstructions

Ceiling obstructions such as beams greater than 10% of the ceiling height should be treated as a wall, and will thus divide a room. Detectors should not be mounted within 500mm of such an obstruction.

If the depth an obstruction such as a beam is less than 10% of the height of the ceiling, but greater than 250mm deep, then detectors should not be mounted any closer than 500mm to the obstruction.

Where an obstruction such as a beam or a light fitting is less than 250mm in depth, detectors should not be mounted any closer to the obstruction than twice its depth (see figure 2.4.3 below)

Where a ceiling comprises a series of small cells, for example a honeycomb ceiling, or a series of closely spaced beams, for example floor of ceiling joists, the recommended spacing and siting of detectors changes further, dependant on the ceiling height and the depth and spacing of the beams. Reference should be made to relevant standards for details (in the UK BS5839 Part 1: 2002, 22.3.k Tables 1 and 2).

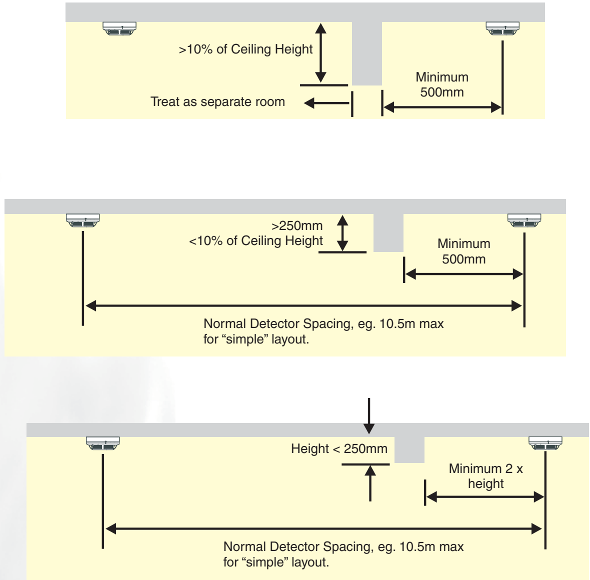


Figure 2.4.3: Detector Spacing around isolated ceiling obstructions

2.4.4. Partitions and Racking

Where the gap between the top of a partition or section of racking and the ceiling is greater than 300mm, it may be ignored. If the gap is less than 300mm it should be treated as a wall.

To maintain a free flow of smoke and heat to the detector, a clear space should be maintained for 500mm in all directions below the detector.

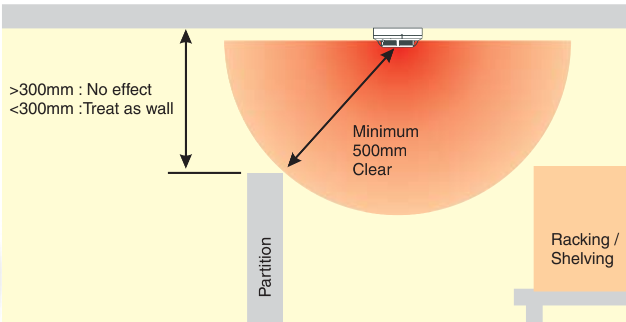


Figure 2.4.4. Partitions

2.4.5. Sloping Ceilings

Where the ceiling is pitched or sloping, the slope of the roof tends to speed the rise of smoke or heat to the apex, hence reducing the delay before the detectors are triggered. For sloped roofs with a pitch height greater than 600mm for smoke detectors, or 150mm for heat detectors, a row of detectors should be placed within a maximum vertical distance of 600mm or 150mm for smoke or heat detectors respectively from the roof apex. Sloped roofs rising less than 600mm for smoke detectors or 150mm for heat detectors may be treated as a flat ceiling.

Since the smoke or heat tends to rise faster up the slope, it is permissible to use a greater spacing for the row of detectors mounted in the apex of the roof: For each degree of slope of the roof, the spacing may be increased by 1% up to a maximum of 25%. Where, as in figure 2.4.5, the roof slopes are unequal the spacing down the slopes can be unequal, however along the roof apex spacing the lesser of the two figures should be used, in this example 10.5m +18%. Where the slope finishes within the adjusted detection radius, the standard distance to the next row of detectors, 10.5m, should be used. Care must be taken when placing the next row that no gaps are left in detection coverage.

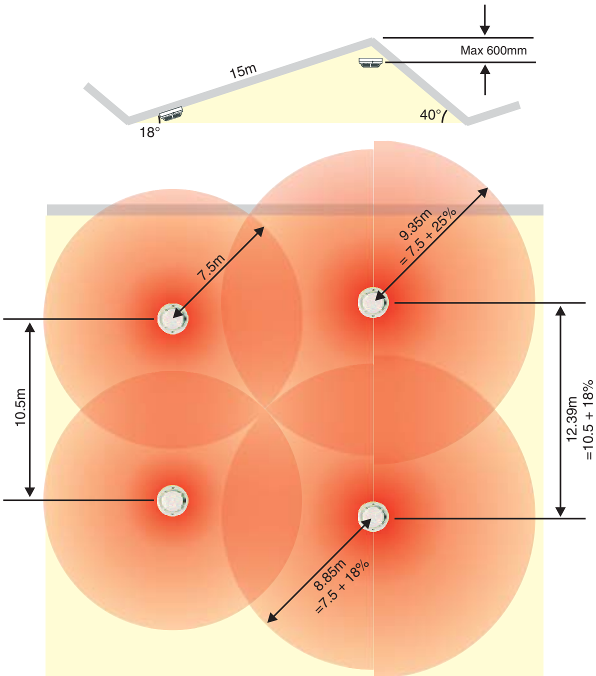
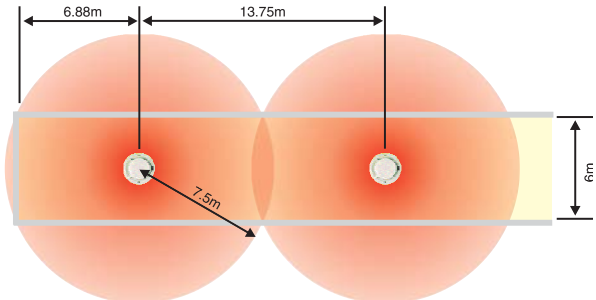


Figure 2.4.5. Spacing of Smoke Detectors under a Pitched Roof

2.4.6. Corridors

In corridors less than 2m wide, detectors should be spaced at a distance of 15m for smoke detectors and 10.6m for heat detectors, with the maximum dimension to a wall at the end of the corridor being 7.5m and 5.3m respectively.

In narrow rooms and corridors greater than 2m wide, due to the way that the coverage radii of detectors intersect with the walls of the corridor, the spacing between detectors will increase. Figure 2.4.6 shows how, for a room 6m wide, the spacing for smoke detectors can be increased from the standard 10.5m.



Note: Detectors are mounted in the centre line of the room

Figure 2.4.6. Smoke detector spacing in corridors greater than 2m wide

Note: This document is based on the recommendations of BS5839 Part 1: 2002. It is intended only as a guide to the application of fire detection systems.

Reference must be made to relevant national and local standards.

2.4.7. Stairwells and Lift Shafts

Internal stairwells and lift shafts and other vertical service ducts through a building provide a clear path for smoke to pass between floors of a building as if they were chimneys. It is therefore important to protect these, preferably using smoke detectors.

All vertical shafts through a building must be protected by a smoke or heat detector at the top of the shaft, and by a detector within 1.5m of each opening onto the shaft.

In internal stairways, a detector should be mounted on each main landing (Figure 2.4.7). In addition, if the detectors on the landings are separated by more than 10.5m, intermediate detectors should be mounted on the underside of the stairs.

Detectors should also be fitted into any room opening directly onto a stairway other than a WC cubicle.

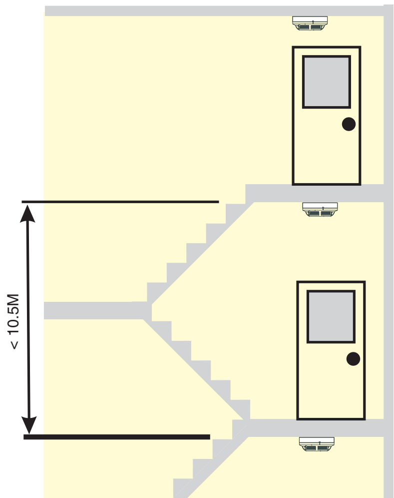


Figure 2.4.7. Detector in Stairwells

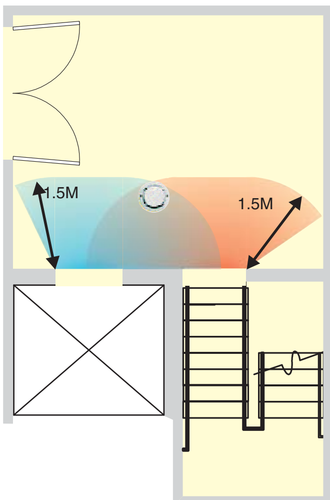


Figure 2.4.8. Protection of Vertical Shafts

2.4.8. Voids and False Ceilings

Detectors need not normally be installed in voids less than 800mm deep, unless on the basis of a fire risk assessment it is thought that fire or smoke could spread extensively through the voids before detection, or unless the fire risk in the void is such as to warrant protection. Use of heat and smoke detectors in voids greater than 800mm high is dependant on the protection category, and fire risk assessment.

Where they are installed into voids, a detector's sensing element should be mounted either in the top 10% or the top 125mm of the void space whichever is greater. Although it can be difficult to install detectors the correct way up in void spaces, care should be taken as incorrect orientation of a detector can lead to increased ingress of dirt and dust, leading to reduced maintenance intervals, and possible nuisance alarms.

Detectors above a false ceiling may be used to protect the area below it, if the false ceiling is perforated uniformly across the complete area of the ceiling, with the holes making up over 40% of the ceiling surface area, having a minimum size of 10mm and the false ceiling having a thickness of less than three times the dimensions of the perforations.

In all other cases, the areas above and below a false ceiling should be treated as separate, and thus should be protected separately with detectors below the ceiling, and if necessary in the void above the ceiling.

2.4.9. Lantern Lights

A detector should be mounted in any lantern light used for ventilation or having a height exceeding 800mm. The temperature in lantern lights can change rapidly owing to heating by sunlight, which means that rate-of-rise heat detectors should not be used and heat detectors should be protected from direct sunlight.

2.4.10. Location and Spacing of Optical Beam Detectors

Generally, for an optical beam detector mounted within 600mm of a ceiling, the fire detection coverage is up to 7.5m either side of the beam (Figure 2.4.9). The beam of the detector should not be closer than 500mm to any obstruction. Similar recommendations to above apply to the application of beam detectors with sloped ceilings, voids, false ceilings, walls and partitions and ceiling obstructions.

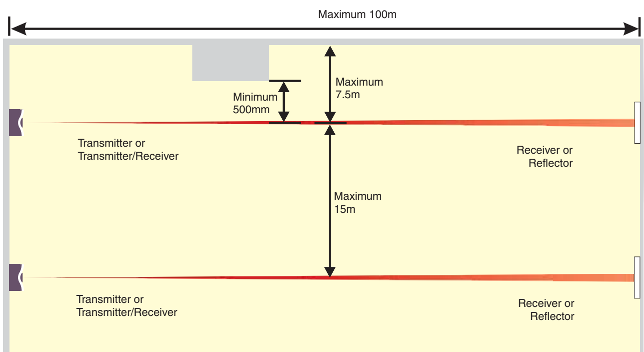


Figure 2.4.9: Standard Beam Detector Layout

Where it is likely that people will be present in an area protected by beam detectors, the detectors must be mounted at a minimum height of 2.7m, and consideration must also be given to the possibility of other temporary obstructions to the beam such as forklift trucks.

For further information on the use and mounting of beam detectors, see System Sensor Europe's Guide to Projected Beam Detectors.

2.5. ALARM SIGNALS

2.5.1. Audible Alarm Signals

Audible fire alarm signals must provide a clear warning of a fire to all those for whom the signal is intended. For category M and L systems this would normally imply all occupants of a building, however in some sites this may not apply, for example in hospitals or rest homes, residents might need assistance to evacuate, in which case it may be sufficient to alert staff.

The general requirement for the volume of audible alarm signals is that they should provide a Sound Pressure Level (SPL) of at least 65dB(A), but not more than 120dB(A) throughout all accessible areas of a building. See figure 2.5.1.

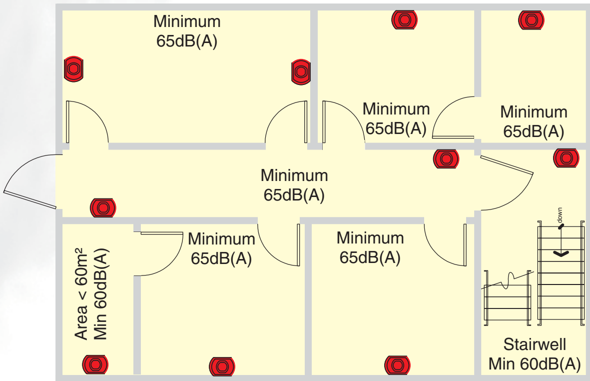
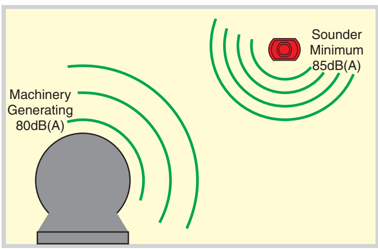


Figure 2.5.1. General Fire Alarm Sound Pressure Levels

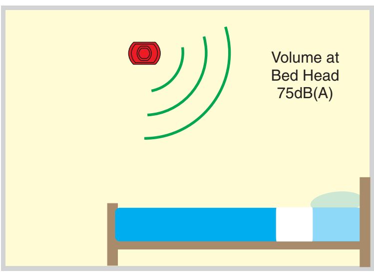
Exceptions to this general rule are as follows:

- In stairways the SPL may be reduced to 60dB(A)
- Enclosures less than $60m^2$ may be reduced to 60dB(A)
- There is no minimum for enclosed areas less than $1m^2$
- At specific points of limited extent the SPL may be reduced to 60dB(A)

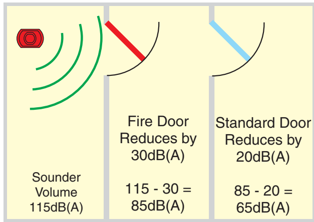
Where a continuous background noise level greater than 60dB(A) is present the fire alarm signal should be 5dB above the ambient, but not greater than 120dB(A).



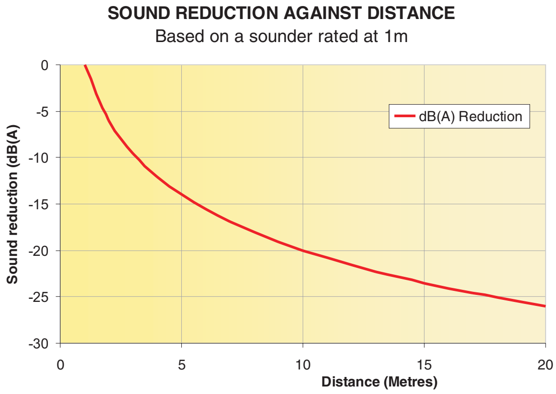
Where the alarm is intended to wake people, an SPL of 75dB(A) is required at the bed head. Generally this will require a sounder to be placed within the room.



Where it is not possible to place a sounder within a room, there will be a loss of approximately 20dB(A) through a standard door, and 30dB(A) through a fire door.



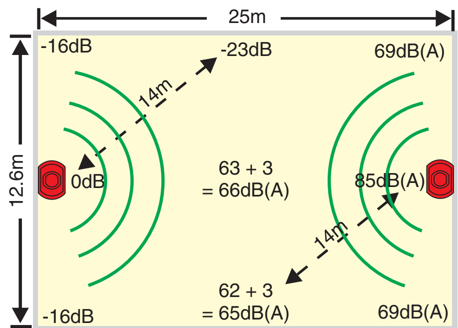
Warning: Volumes greater than 120dB(A) will cause damage to hearing.



In open space, as the distance from a sounder doubles, the sound level will be reduced by 6dB(A), as shown.

It is preferable to use multiple quieter sounders to achieve the required sound level, rather than a smaller number of loud devices. This is to prevent points of excessive volume, which may lead to disorientation or damage to hearing. Two sounders providing equal sound levels will combine to add 3dB(A) to the SPL.

2.5.2. Visual Alarm Signals



Note: dB(A) figures are for example only.
Left side represents attenuation; right side indicates typical sound pressure level

Visual alarms are normally used only as a supplement to audible alarms where they are likely to be ineffective, for example in areas of high background noise levels where hearing protection is likely to be worn. They can however be used alone where audible warnings are undesirable for example operating theatres and recording studios.

Visual alarms should be clearly distinguishable from other warning lights, preferably red and should flash at a rate of 30 to 130 flashes per minute. The recommended mounting height is above 2.1m, however they should not be mounted closer than 150mm from the ceiling. They should be positioned so that any alarm is clearly visible from all locations within the area protected.

2.6 MAINTENANCE OF FIRE DETECTORS

Caution: Prior to carrying out any maintenance or testing on a fire alarm system, the relevant authorities and staff should be notified.

Over time, the sensitivity of a smoke detector can change owing to a build-up of dirt in the detector chamber. In most modern detectors this effect is slowed by the inclusion of drift compensation functions, however the build up can still lead to a risk of false alarms or change in the detector sensitivity.

The frequency of maintenance requirements on a detector will depend on site conditions, obviously the dirtier the site the more frequent maintenance will be required. The optimum frequency for a given site should be determined over a period of time after the commissioning of the fire system.

All System Sensor detectors (smoke, heat, or multi-criteria) are designed such that they can be easily dismantled for maintenance. Instructions are given for maintenance in the instruction manual supplied with each detector. Normally it is sufficient to use compressed air or a vacuum cleaner to remove dust from the detector chamber.

Once maintenance on a fire detection system has been completed, it should be re-tested.

2.7 ROUTINE FUNCTIONAL TESTING OF FIRE DETECTORS

BS5839 Part 1: 2002 gives a range of recommendations regarding routine testing of a fire detection system.

A weekly test should be carried out on a fire detection system by activating a manual call point to ensure that all fire alarm signals operate correctly, and that the appropriate alarm signals are clearly received. This test should be carried out at approximately the same time each week, using a different call point in rotation.

In order to comply with BS5839 Part 1: 2002, periodic inspections, servicing and functional tests of the fire alarm system should be carried out at intervals determined by an assessment of the site and type of system installed, not normally greater than six months.

It is recommended to perform regular functional tests on all fire detectors annually. These annual tests may be carried out over the course of two or more service visits during the twelve-month period.

System Sensor detectors include various means of testing the system without using smoke, dependent on the detector range being tested, including magnet switches and laser test tools.

Codes and standards (in the UK BS5839Part 1:2002, Section 6) now require functional tests to introduce smoke through the smoke detector vents and into the sensing chamber. It also calls for heat detectors to be tested by means of a suitable heat source, and not by a live flame. CO fire detectors now also need to be functionally tested by a method that confirms that carbon monoxide can enter the chamber.

Many installers use a set of equipment that consists of a complete range of test tools that locate on the end of the pole such as those available from No Climb Products Ltd (www.noclimb.com) in order to aid compliance with codes. Tools exist for testing smoke, heat, and CO fire detectors, whilst also enabling them to be accessed and removed at heights up to 9 meters from the ground.

Using functional test equipment, along with those maintenance tools available from System Sensor, should ensure that the system remains at its optimum operation for many years.

3. 300 SERIES CONVENTIONAL FIRE DETECTOR RANGE

The 300 Series range of detectors is produced using the latest in manufacturing and design techniques, pushing out the boundaries of existing conventional detector technology. With a multitude of innovative features, Series 300 detectors 'act conventionally, think intelligently'.

300 Series detectors can be used in conjunction with the S300RPTU remote hand-held programming unit to gain access to many advanced features including: read/write last maintenance date; read chamber contamination level; read value of the smoke or thermal element and perform an alarm test. Each unit can be programmed with a unique address. When used in conjunction with the S300ZDU and a compatible control this address will be displayed on the S300ZDU whenever the detector is in alarm.

All the features via the hand-held programming unit are achieved effectively and effortlessly without the need to remove the detector or having to gain direct physical access (other than by the use of 'No Climb Products' or similar servicing tool), saving valuable commissioning / maintenance time. They provide an end user with the confidence to know that the fire system is being regularly serviced and that it is operating at it's optimum level, with minimum disruption to business activities.

300 SERIES FEATURES

- **Low profile design**
- **Low current draw**
- **Backward compatible with 100 Series detector range of bases**
- **Wide operating voltage 8 to 30V**
- **Bi-colour LED detector status indicator (Red - Alarm; Amber - Fault; Optional Green Flashing - Standby)**
- **Automatic drift compensation (2351E and 2351TEM only)**
- **Programmable sensitivity (2351E and 2351TEM only)**
- **Addressable feature**
- **Advanced maintenance features via remote hand-held test unit**
- **Range of detector bases available**
- **ASIC (Application Specific Integrated Circuit) Controlled**

SERIES 300 SPECIFICATIONS

Electrical

Operating Voltage Range	8 to 30VDC (Nominal 12/24VDC)
Standby Current	See Individual Devices
Maximum Alarm Current	80mA (Limited by control panel and detector base)
Operating Temperature Range	-30°C to +70°C
Humidity	5 to 95% Relative Humidity (Non-condensing)
Height	See Individual Devices
Diameter	102mm
Weight	See Individual Devices
Max Wire Gauge for Terminals	1.5mm^2

Note: This document is based on the recommendations of BS5839 Part 1: 2002. It is intended only as a guide to the application of fire detection systems.

Reference must be made to relevant national and local standards.

2351E PHOTOELECTRIC SMOKE DETECTOR

The 2351E photoelectric detector includes a state of the art optical chamber, which, combined with ASIC control, provides efficient and accurate detection of fires with a high level of resilience to non-fire environmental influences.

Tested and Approved to EN54-7 (2000)

Standby Current:	50μA at 24VDC
Height:	38mm (plus 9mm for B401 base)
Weight:	105g (plus 60g for B401 base)

2351TEM PHOTO-THERMAL FIRE DETECTOR

The 2351TEM photoelectric smoke/thermal detector incorporates an optical chamber and a thermal element, which in turn are continually monitored by the ASIC using algorithms developed specifically for the unit. An alarm signal is only enabled in the detector once the processor is satisfied that an incipient fire has been detected. By using a combination of inputs, the incidence of nuisance alarms is reduced whilst the response time to an actual fire is improved.

Tested and Approved to EN54-7 (Optical Smoke Sensor); EN54-5 (2000) Class A1R (Rate of Rise Thermal Sensor) and CEA 4021 (Requirements for Multi-Criteria Detectors)

Standby Current:	65μA at 24VDC
Height:	48mm (plus 9mm for B401 base)
Weight:	105g (plus 60g for B401 base)

5351E RATE OF RISE HEAT DETECTOR

The 5351E thermal detector incorporates the latest in thermal element technology the detector to provide efficient and accurate detection of fires, especially in environments such as bars or kitchens where smoke detectors are inappropriate due to the high level of airborne contamination.

Approved to EN54-5:2000 Class A1R

Standby Current:	60μA @ 24VDC (LED no blink)
Height:	48mm (plus 9mm for B401 base)
Weight:	105g (plus 60g for B401 base)

Note: To avoid unwanted alarm conditions being triggered by class A1S and A1R detectors maximum ambient operating temperature should not exceed 45°C.

4351E FIXED HIGH TEMPERATURE HEAT DETECTOR

The 4351E thermal detector incorporates the latest in thermal element technology, which combines with the ASIC to provide efficient and accurate detection of fires, especially in environments such as boiler houses or kitchens where smoke detectors are inappropriate due to the high level of airborne contamination.

Tested and approved to EN54 part 5 (2000) Class BS

Standby Current:	65μA at 24VDC
Height:	48mm (plus 9mm for B401 base)
Weight:	105g (plus 60g for B401 base)

Note: To avoid unwanted alarm conditions being triggered by class BS detectors maximum ambient operating temperature should not exceed 68°C.

Note: This document is based on the recommendations of BS5839 Part 1: 2002. It is intended only as a guide to the application of fire detection systems.

Reference must be made to relevant national and local standards.

4. VISION CONVENTIONAL FIRE DETECTOR RANGE

System Sensor's Vision range of detectors is a range of conventional detectors, which have been produced using the latest in manufacturing technology and supplied with an array of advanced features, making them 'better by design'.

A laser-based hand held Remote Test Unit can be used in conjunction with Vision detectors for alarm test purposes. The unit transmits a coded message, preventing spurious alarms being generated by other laser-based devices. With a range of several metres, the hand held test unit provides an effortless way of remotely alarm testing the range of Vision detectors and removes the need for any direct physical access to the detector by the user.

VISION FEATURES

- **Low profile design**
- **Low current draw**
- **Automatic drift compensation**
- **Remote alarm test feature**
- **Easy maintenance**
- **Range of detector bases available**
- **Remote LED Option**
- **Extended warranty**
- **ASIC (Application Specific Integrated Circuit) Controlled**

VISION RANGE SPECIFICATIONS

Operating Voltage Range	14 to 28VDC (Nominal 24VDC)
Standby Current	See Individual Devices
Maximum Alarm Current	80mA (current limited by control panel)
Operating Temperature Range	-30°C to +70°C
Humidity	5 to 95% Relative Humidity (non-condensing)
Height (excluding base)	See Individual Devices
Diameter	102mm
Weight	See individual devices
Max Wire Gauge for Terminals	1.5mm^2

VISION
Focus on the future

2020P PHOTOELECTRIC SMOKE DETECTOR

The 2020P photoelectric smoke detector uses a state of the art optical chamber combined with ASIC control to provide quick and accurate detection of fires. A combination of the unique chamber design and other technically advanced features significantly extends service intervals before cleaning of the detector becomes necessary.

Approved to EN54-7:2000

Standby Current: 45µA @ 24VDC
Height: 32.5mm (plus 9.5mm for standard base)
Weight: 75g (plus 45g for standard base)

2020PT PHOTO-THERMAL FIRE DETECTOR

The 2020PT multi-criteria detector uses a state of the art optical chamber and a thermal element combined with an ASIC, running sophisticated algorithms to provide quick and accurate detection of fires. The combination of photoelectric and thermal characteristics provides a faster response to 'real fire' situations, while at the same time reducing the risk of unwanted environmentally generated alarms.

Approved to EN54-7:2000 (Optical Smoke Sensor)
EN54-5:2000 Class A1R (Rate of Rise Heat Sensor)
CEA 4021 (Multicriteria Detector)

Standby Current: 60µA @ 24VDC
Height: 40.5mm (plus 9.5mm for standard base)
Weight: 78g (plus 45g for standard base)

Note: To avoid unwanted alarm conditions being triggered by class A1S and A1R detectors maximum ambient operating temperature should not exceed 45°C.

2020R RATE OF RISE HEAT DETECTOR

The 2020R thermal detector uses a state of the art thermal element to provide quick and accurate detection of fires. The detector incorporates both rate of rise and static elements and is suitable for all areas where the ambient conditions do not normally exhibit rapid changes in temperature.

Approved to EN54-5:2000 Class A1R

Standby Current: 55µA @ 24VDC
Height: 40.5mm (plus 9.5mm for standard base)
Weight: 70g (plus 45g for standard base)

Note: To avoid unwanted alarm conditions being triggered by class A1R and A1S detectors the maximum ambient operating temperature should not exceed 45°C.

2020F AND 2020HF FIXED TEMPERATURE HEAT DETECTOR

The 2020F (58°C) and 2020HF (78°C) thermal detector uses a state of the art thermal element to provide quick and accurate detection of fires. The detector incorporates a static element and is suitable where ambient conditions do normally exhibit rapid changes in temperature e.g. kitchens.

2020F approved to EN54-5:2000 Class A2
2020HF approved to EN54-5:2000 Class BS

Standby Current: 55µA @ 24VDC
Height: 40.5mm (plus 9.5mm for standard base)
Weight: 70g (plus 45g for standard base)

Note: To avoid unwanted alarm conditions being triggered by class A2 detectors the maximum ambient operating

5. CALL POINTS

KAC's range of Call Points comprise indoor, outdoor and special environment products suitable for all applications. They are available in a variety of colour and marking options for a wide range of applications, including red for use in fire systems.

An extensive range of adaptor trays is available, allowing easy installation anywhere in the world.

The majority of the KAC product range is certified to EN54 Part 11, and other approvals are available.

INDOOR

KAC Indoor Call Points are available to satisfy all system types from conventional switch only manual systems, through to intelligent addressable systems.

Products are surface mounted using the fixings in the rear enclosure. The back-box is supplied punched with centres to assist drilling of cable entries.

Indoor products are generally rated at IP24D.

OUTDOOR

KAC Outdoor Call Points are available to satisfy all system types from conventional switch only manual systems, through to intelligent addressable systems.

Products are surface mounted using the fixings in the rear enclosure. The back-box is supplied punched with centres to assist drilling of cable entries.

Outdoor products are generally rated at IP55.

WATERPROOF

KAC Waterproof Call Points are available to satisfy all system types from conventional switch only manual systems, through to intelligent addressable systems. Waterproof products are rated at IP67.

Waterproof products for Marine Applications are certified with Lloyds Register.

Products of this type are available which are certified for use in Hazardous Areas.

SWITCHES

KAC Call Point Switching Devices provide alternative methods of manual activation of systems, rather than the traditional break glass principle. There are both indoor and outdoor models available in the familiar KAC housings.

A variety of different colours and switch types can be chosen, key-switches and push buttons being the most popular. There is also a large choice of text markings to identify the purpose of the device.

ACCESSORIES

An extensive range of accessories supports KAC calls points, including a number of mounting accessories, allowing easy installation throughout the world.

More information about call points and their accessories is available on the KAC website.

Note: This document is based on the recommendations of BS5839 Part 1: 2002. It is intended only as a guide to the application of fire detection systems.

Reference must be made to relevant national and local standards.

6. AUDIO VISUAL PRODUCTS

KAC Sounders and Strobes from simple tone set conventional products to fully featured fourteen-tone intelligent units, a range of sounders, strobes and combined sounder-strobe products suitable for all applications.

The range meets the requirements of EN54 Part 3; key products are LPCB and VdS Approved. All are fully tested under simulated climatic conditions to ensure “real-world” conformance to the published specifications.

SOUNDERS

KAC Sounders are available in four or fourteen-tone versions. They operate at 9-33VDC, optimised for use at 12 and 24 volts. Four tone sounders have a high, medium and low volume selection, whilst the fourteen tone sounder has a volume control.

The sounders have a distinctive, acoustically efficient low profile shape, producing high sound output at low current levels. The shape provides a wide-angle uniform sound distribution providing good audibility in all directions.

The sounders are of rugged construction with solid-state electronics providing high reliability and stable performance. Three bases are available: low profile IP44, IP55 or IP66.

DETECTOR BASE SOUNDERS

KAC Detector Base Sounders are for use either underneath smoke detectors or fitted with a red or white lid as a low profile wall mounted sounder. They are available in four or fourteen tone versions. They operate at 9-33VDC (nominally 12 and 24 volt). Four tone sounders have a high, medium and low volume selection, whilst the fourteen tone sounder has a volume control.

The package is acoustically very efficient, producing omni-directional high sound output with low current levels. The detector base sounder can be used under any smoke detector with 60mm mounting centres and an external diameter of up to 102mm.

STROBES

The KAC Range of stand-alone Strobes is designed to provide visual signalling for use in a wide range of applications. There are both standard and high intensity output strobes available. A variety of different coloured strobe lenses are available. This variety of colours provides a range of products for different applications.

SOUNDER STROBES

The KAC Sounder Strobe combines a full feature fourteen-tone sounder with an integral strobe mounted on the horn. The design provides an efficient combination of audible and visual warning, in a package taking up no more surface area than a standard sounder.

A variety of different coloured strobe lenses are available and the product housing is available in either red or white.

BASES

Three bases are available for KAC Sounders and Sounder Strobes. The standard base is an IP44 rated low profile unit. The base has rear and side cable access suitable for use with standard trunking and has mounting holes suitable for the majority of back box formats.

A deeper profile base with knockouts and marked drilling positions for rear and side entry allows for an IP55 rating, when used with appropriate glands.

The IP66 base has the same features as the IP55, but includes a sealing kit to increase the protection rating.

7. OTHER INFORMATION

7.1. STANDARDS

To ensure that a fire alarm system provides adequate protection, it is advisable to ensure that it meets all relevant standards. The system should be designed in accordance with relevant national and local standards. Useful standards and references include:

British Standard Code of Practice for fire detection systems BS 5839 part 1: 2002

European Standard for Fire Detection and Alarm Systems:

Control and Indicating Equipment
BS EN54 part 2: 1998

Sounders
BS EN54 part 3: 2001

Point Heat Detectors
BS EN54 part 5: 2001

Point Smoke Detectors
BS EN54 part 7: 2001

Manual Call Points
BS EN54 part 11: 2001

Optical Beam Detectors

BS EN54 part 12: 2002

These are all available from:

British Standards Institution
389 Chiswick High Road
London
W4 4AL

7.2. APPROVAL BODIES FOR FIRE DETECTION PRODUCTS

All components of the fire alarm system should be certified to a European standard by an independent certification body that specialise in the certification of fire and security systems. These include:

BRE - LPCB
Building 3,
Bucknalls Lane,
Garston,
Watford,
WD25 9XX,
England
Tel: (+44) (0) 1923 66400

VdS
Amsterdamerstrasse 174,
50732 Köln,
Germany
Tel: +49 221 77 66 00

ANPI
Parc Scientific Fleming,
1348 Louvain-la Neuve Sud,
Belgium
Tel: +32 10 47 52 73

CNMIS
16 Avenue Hoch,
75008 Paris, France
Tel: +33 1 53 89 00 40

DIFT
Jernholmen 12,
DK-2650 Hvidovre,
Denmark
Tel: +45 36 349 000

Pittway Technologica SpA

Via Caboto 19/3
34147 Trieste
Italy

Tel: +39 040 9490 111

Fax: +39 040 382 137

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