



AUTOMATIC FIRE DETECTION SYSTEMS

Small fires too often result in large losses due to delays in detecting the fire and summoning help. This is particularly so when premises are unoccupied **eg:** at night, over weekends and public holidays.

Automatic fire detection systems are designed to give early warning of a fire condition. The response of a detector to fire is transformed into a visual and audible signal to alert building occupants to facilitate evacuation and initial attack on the fire. If the system is directly connected to a fire department control room, the brigade will be automatically summoned.

In addition, detection systems can be used to activate automatic smoke and fire doors, fire dampers and fire extinguishing systems or to shut-off air conditioning systems, pipelines, etc.

System components

Detectors

Detectors are designed to react to one or more of the following characteristics of fire

- Heat
- Smoke
- Flames

Detectors are either capable of being reset or not. The latter type require replacement after activation. Most re-settable types are also fitted with a small indicator light which goes on to indicate which detector was operated.

Heat detectors

There are two types. Fixed temperature detectors only activate when a predetermined temperature is reached, whereas rate of rise detectors response to abnormally rapid temperature increases. These also incorporate an upper fixed temperature limit. Heat detectors can be operated in the following ways.

i ***Fusible alloys***

The melting of an alloy at a predetermined temperature completes an electrical circuit to operate the alarm. Normal operating temperatures vary between 55°C and 180°C.

ii ***Expansion of metals, gases or liquids***

Metals – The expansion due to heat of metal rods, strips, coils or bows in a specific direction completes an electrical circuit and raises the alarm.

Gases – Pneumatic detectors cause the expansion of air in a chamber to distend a flexible diaphragm, completing a circuit and raising the alarm.

Liquids – Comprises a copper tube filled with a fluid and fitted with a metal bellows on each end. The movement of the bellows due to the expansion of the fluid in the tube completes the circuit.

iii **Electrical effect**

Two main types are used. The line detector utilises the effect of heat on heat-sensitive electrical insulation which melts causing contact between two conductors to alarm.

The thermo-couple type activates when a temperature difference between a shielded and unexposed thermocouple produces a voltage difference.

Smoke detectors

i **Ionisation type**

These have a chamber or two chambers incorporating a radioactive source and a positive and negative electrode. Air within the chamber is irradiated and ionised creating positive or negative ions depending on whether electrons are gained or lost. These then move either to the positive or negative electrodes to become neutralised. This movement reduces the resistance of the air causing a small current to flow in the circuit.

When smoke particles enter the chamber charged ions attach themselves to the particles. The charged particles move more slowly enabling them to meet charged particles or ions of opposite polarity and become neutralised. A reduction in the current flowing in the chamber occurs initiating an alarm.

ii **Optical type**

These detectors have a light source and photo-electric cell in a light proof housing which allows free ingress of smoke. They operate on the light scatter principle where light is deflected by the smoke particles which enter the chamber onto the photocell and/or the light obscuration principle where smoke entering the chamber obscures the light beamed onto the photocell. This change in light configuration is sensed, causing the detector to actuate.

Flame detectors

In addition to visible light, flames also emit infra-red and ultra-violet radiation which is detectable.

Infra-red type – An infra-red (IR) sensitive photocell, filter, amplifier, integrator and timer are used to detect IR radiation and will raise the alarm when the radiation detected is in the 4Hz to 15 Hz frequency range. This range is characteristic of the flicker of a flame.

A scanning type which will rotate and monitor through 360° in the horizontal plane is also available. Radiation is reflected by the scanner onto an IR detecting photocell to trigger an alarm. Ultra-violet detectors use either an ultra-violet (UV) sensitive photocell or a UV sensitive gas-filled tube in conjunction with an amplifier to detect UV radiation from flames.

Other detectors

Linear smoke/heat detector (Beam detector)

A light beam is focused directly or indirectly via a reflecting mirror onto a photocell. The turbulent effect caused when smoke or heat waves cross the beam is detected by the photocell and the alarm is raised.

Air sampling type

Sampling tubes connected to an ionisation chamber terminate with the enclosed protected area. Air from the compartment being monitored is passed through an ionisation chamber by sampling tubes and a motor driven fan. Combustion products are monitored and an alarm is raised if these reach a predetermined level.

Wiring

The wiring transmits signals from the detectors to the annunciator panel and to the audible alarms.

It should be protected from accidental damage and the installation thereof should be of the highest quality to facilitate signal transfer. The wiring should be in metal conduit and be kept away from lift and unprotected stair shafts and openings to reduce the possibility of damage by fire.

Note: When evacuation and voice communication systems are interconnected to the detection system all wiring should be of the fire resistant type.

Control/Indicating equipment

The control unit acts as a terminal for the detector and internal and external alarm circuits. It houses the test facilities, alarm silence button, fire or fault signalling and power supply monitoring equipment.

The size of the control unit will depend on the complexity of the detection installation and the total number of zones of which it is comprised. Each zone has a series of detectors off a loop of wiring enabling easy location of a fire within a zoned compartment, usually restricted to about 2 000 m² or less.

An indicator panel, together with a plan of the premises with zone identification should be provided at the main entrance of the building where it will be seen by fire brigade or other personnel responding to an alarm.

Alarms

Alarms, which should be of the highest quality, include sirens, hooters, bells and electronic audible devices.

A rough guide on minimum recommended sound intensities is:

General alarm

65 dBA or 5 dBA more than any background noise likely to last more than 30 seconds.

To wake people

75 dBA at the bed head with all doors closed.

Power Supplies

Power should be available from two reliable sources, each capable of running the system independently.

Usually an AC main supply with a DC back-up supply of continuously charged batteries capable of functioning for 72 hours during a mains power failure.

Maintenance

Regular testing/checking should be carried out as follows:

| | | | | |
|-----------------------------|---|--------------------------|---|--------|
| Battery check | - | Weekly | | |
| Detector circuit check | - | Daily (where applicable) | | |
| Fire Department connections | - | Unmonitored | - | Daily |
| | | Monitored | - | Weekly |

References:

Manual of Firemanship Book 9, HMSO
Fire Safety Data Sheet, FPA UK
Suppression and Detection Systems, Dr. L Bryan
SABS Code of Practice 0139: 1981 –
The Prevention, Automatic Detection and
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