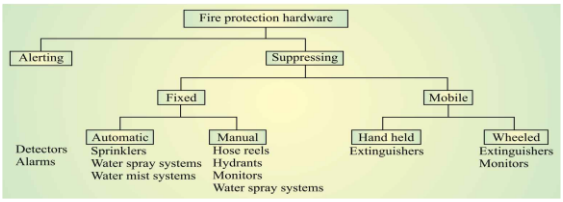
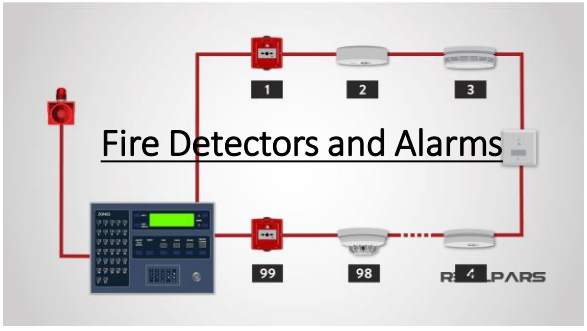
Fire Protection





Fire Detection and Alarm Systems

What are you expecting from it?

- to identify a developing fire emergency in a timely manner, and
- to alert the building's occupants and fire emergency organizations.

This is the role of fire detection and alarm systems.

Fire Detection and Alarm Systems

What are you expecting from it?

Depending on the anticipated fire scenario, building and use type, number and type of occupants and criticality of contents and mission, these systems can provide several main functions:

- provide a means to identify a developing fire through either manual or automatic methods.
- alert building occupants to a fire condition and the need to evacuate.

Fire Detection and Alarm Systems

Another common function is the transmission of an alarm notification signal to the fire department or other emergency response organization.

- Fire detection and alarm systems
- Fire-aid fire fighting equipment
- Water-based fixed fire protection systems
- Fixed systems based on media like carbon dioxide and vaporizing liquids.
- Mobile fire fighting appliances
- Communication systems.

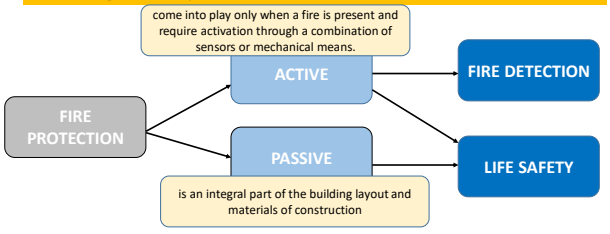
Fire alarm systems are installed to….

- To provide for the safety of occupants in buildings, and to make provision for their evacuation or refuge during a fire or other emergency,
- To provide fire department with early notification of a fire in a building and to direct them to the area of risk,
- To reduce loss of property; the property may have considerable intrinsic value and the insurers either require a fire detection system or may incentives its use,
- To reduce building damage; the building may be unoccupied for periods where equipment is still powered and the owner wishes to ensure that if anything goes wrong the fire department is called to the scene in a timely manner. Sometimes fire detection and alarm systems are used to compensate for structural fire protection shortcomings or to give special cover for items of high value,

- To reduce the amount of business lost, and
- Minimize risk to the public who attend unfamiliar properties. It is often a mandatory requirement by the Building Codes

Fire Detection and Alarm System is electronic equipment which detects fire and raises alarm as warning of fire.

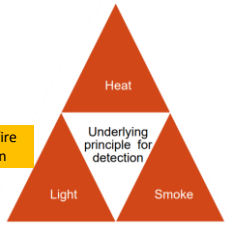
A fire alarm system is number of devices working together to detect and warn people through visual and audio appliances when smoke, fire, carbon monoxide or other emergencies are present.



Basics of Detectors and Alarms

- When people are present v/s people are not present or not alert…
- Detectors make you alert by sensing one or more effects or products of fire, it may be thermal or non-thermal.

FIRE DETECTION

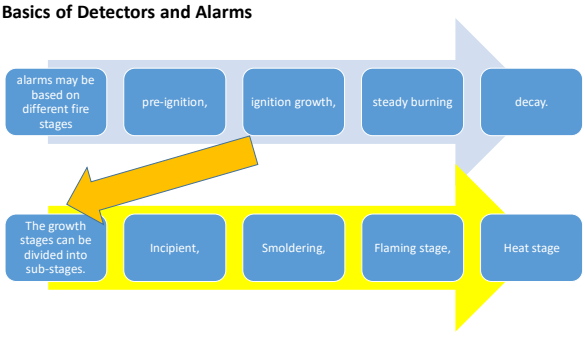


Three things produced by fire forms the basis of detection

It protects by:

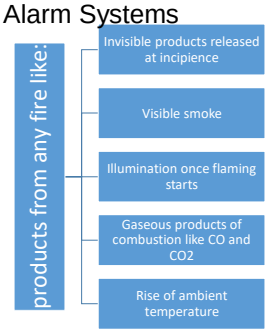
- Detecting a fire at an early stage
- To alert occupants, so that they escape the building safely.
- Notifying the relevant personnel
- To initiate automatic fire control and suppression system.
- Identifying and guiding fire fighters

Basics of Detectors and Alarms



Fire Detection and Alarm Systems

a detector is primarily intended to detect the changes beyond some threshold value in it immediate environment due to either the effect or products of fire.



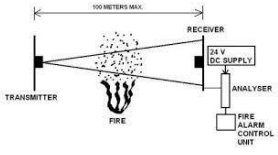
Fire Detection and Alarm Systems

Heat	Fixed temperature (expansion, melting/fusion, resistance thermistor)
	Rate of rise of temperature
	Combination
	Rate compensation
Smoke	Ionisation
	Photoelectric
	Aspirating
Gases	Carbon monoxide
Light	Visible light – light obscuration
	Visible light – light scattering
	IR radiation
	UV radiation

Classification of Sensors

Detectors Types Based on Effects

Spot Fire Detector



Line Fire Detector

- Remember it is the duty of a **Civil Engineer** and **Architect** to design such type of safe and protected buildings when they are at the stage of designing of any new site.

Fire Detection and Alarm Systems

- The area may be covered by the **spot detectors** will depend on…
  - the type of detectors,
  - compartment configuration,
  - ambient conditions etc.
- In large spaces, **Line detectors** are preferred.

Fire Detection and Alarm Systems

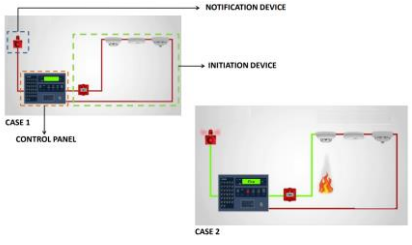
Choice of selecting a detector depends on ….

- The speed of response required
- Need to minimize false alarms
- The nature of the fire hazard
- Cost, suitability for environment, maintenance requirement, etc.

Fire Alarm System Components

System Components

- Control Panel
- Initiation Device
- Alarm Notification device



Control Panel

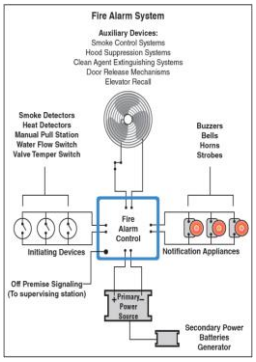
1. Control panel serves as the “brain” of the system.
2. Manages and monitors the proper operation of the system
3. It can indicate the source of an alarm so that responding fire personnel will know what activated the alarm and where the initial activation occurred.
4. Also manages the primary power supply and provides a backup power supply for the system.
5. It may perform additional functions, such as notifying the fire department when the alarm system is activated, and may interface with other systems and facilities.
6. Control panels vary greatly, depending on the age of the system and the manufacturer.

Control Panel

7. Fire alarm control panels are used to silence the alarm and reset the system.
8. Many buildings have an additional display panel, called a remote annunciator, in a separate location.
9. The fire alarm control panel should also monitor the condition of the entire alarm system to detect any faults.
10. A fire alarm system is usually powered by a 110-volt line, even though the system’s appliances may use a lower voltage.
11. In some systems, a battery in the fire alarm control panel will automatically activate when the external power is interrupted.
12. The control panel in a large building may be programmed to perform several additional functions

Fire alarm control unit (FACU)

- The fire alarm control unit (FACU), formerly called the fire alarm control panel (FACP), contains the electronics that supervise and monitor the integrity of the wiring and components of the fire alarm system.
- The FACU --- the brain for the alarm system.
- It receives signals from alarm-initiating devices--- processes the signals,& produces output signals that activate audible and visual appliances.
- The FACU also transmits signals to an off-site monitoring station .
- Power and fire alarm circuits are connected directly into this panel



FACU can also perform other functions, such as:

- Providing two-way firefighter communication
- Controlling elevators, HVAC, fire doors, dampers, locks, or other fire protection features
- The FACU can also provide public address messages and mass notifications alerts through prerecorded evacuation messages or independent voice communications.

PRIMARY POWER SUPPLY

- The primary electrical power supply usually comes from the building's main power connection to the local utility provider.
- The FACU must supervise the primary power supply and signal an alarm if the power supply is interrupted

SECONDARY POWER SUPPLY

- All fire alarm systems must have a secondary power supply.
- This requirement is designed so that the system will be operational even if the main power supply fails.
- Secondary power sources can consist of batteries with chargers, engine-driven generators with a storage battery, or multiple engine-driven generators, of which one must be set for automatic starting.
- The system shall be capable of powering the required load for a duration of not less than 24 hours,

2. INITIATING DEVICES

- A fire detection system consists of manual and automatic alarm-initiating devices that are activated by the presence of fire, smoke, flame, or heat.
- MANUAL ALARM-INITIATING DEVICES
  - Manual pull stations
- AUTOMATIC ALARM-INITIATING DEVICES
  - Smoke detectors
  - Flame detectors
  - Heat detectors

A ceiling-mounted re alarm speaker and strobe light combination unit.

Different types of smoke detectors.

Smoke and carbon mono-oxide combination detector

NOTIFICATION APPLIANCES

- Audible notification signaling appliances are the most common types of alarm-signaling systems used for signaling a fire alarm in a structure.
- Once an alarm-initiating device is activated, it sends a signal to the FACU, which then processes the signal and initiates actions.
- The primary action initiated is usually local notification, which can take the form of:
  - Bells
  - Buzzers
  - Horns
  - Speakers
  - Strobe lights
  - Other warning appliances

Notification appliances fall under the following categories :

- Audible — Approved sounding devices, such as horns, bells, or speakers, that indicate a fire or emergency condition.
- Visual — Approved lighting devices, such as strobes or flashing lights, that indicate a fire or emergency condition.
- Textual — Visual text or symbols indicating a fire or emergency condition.
- Tactile — Indication of a fire or emergency condition through sense of touch or vibration.

ADDITIONAL ALARM SYSTEM FUNCTIONS

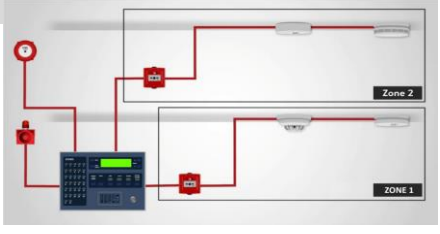
Building codes have special requirements for some types of occupancies in case of fire.

In these cases, the fire detection and alarm system can be designed to initiate the following actions:

- Turn off the heating, ventilating, and air-conditioning (HVAC) system
- Close smoke dampers and/or fire doors .
- Pressurize stairwells and/or operate smoke control systems for evacuation purposes
- Unlock doors along the path of egress
- Provide elevator recall to the designated floor and prevent normal operations .
- Operate heat and smoke vents
- Activate special fire suppression systems, such as preaction and deluge sprinkler systems or a variety of special-agent fire extinguishing systems

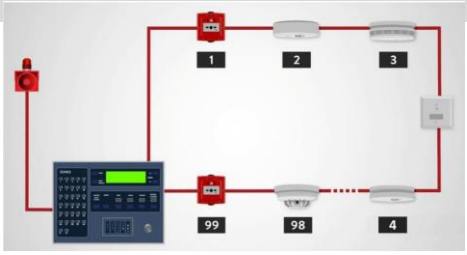
CONVENTIONAL ALARM SYSTEMS

A conventional alarm system is the simplest type of protected premises alarm system. When an alarm-initiating device, such as a smoke detector, sends a signal to the FACU, all of the alarm-signaling devices operate simultaneously.



ADDRESSABLE ALARM SYSTEMS

Addressable alarm systems display the location of each initiating device on the FACU and an annunciator panel if provided. This connection enables emergency responders to pinpoint the specific device that has been activated.



ZONED CONVENTIONAL ALARM SYSTEMS

- Fire-alarm system annunciation enables emergency responders to identify the general location, or zone, of alarm device activation.
- In this type of system, an annunciator panel, FACU, or a printout visibly indicates the building, floor, fire zone, or other area that coincides with the location of an operating alarm-initiating device

EMERGENCY COMMUNICATIONS SYSTEMS

- An emergency communications system is a supplementary system that may be provided in facilities in conjunction with detection and alarm signaling systems.
- The purpose of emergency communications systems is to provide a reliable communication system for occupants and firefighters.

1. Voice Notification Systems

- A one-way voice notification system warns building occupants that action is needed and tells them what action to take.
- This type is most commonly used in high-rise buildings, places of assembly, and educational occupancies

2. Two-Way Communication Systems

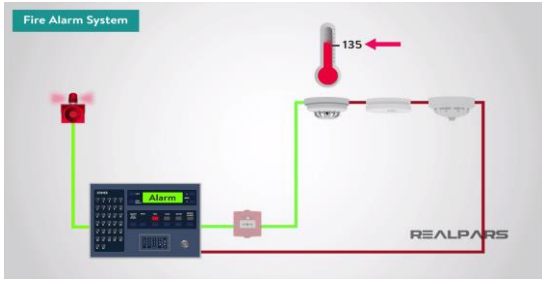
- This system is most helpful to fire suppression personnel who are operating in a building, particularly in high-rise structures that interfere with portable radio transmissions.

3. Mass Notification System (MNS)

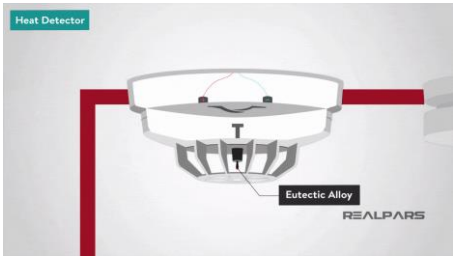
- MN System that notifies occupants of a dangerous situation and provides information and instructions.
- The purpose of a mass notification system (MNS) is to provide emergency communications to a large number of people on a wide-scale basis.
- This communication can be directed to the occupants of a building or even an entire community.

Heat Detector

Heat detector can either work on a fixed temperature basis, where it will trigger an alarm if the temperature exceeds a pre-set value or they can work on the rate of change in temperature.



Commonly Heat detectors work in a similar way to an electrical fuse, the detectors contain a eutectic alloy which is heat sensitive when a certain temperature is reached the alloy turns from a solid to a liquid which in turn triggers the alarm.



Heat Detector

Fires have two types of thermal effects:

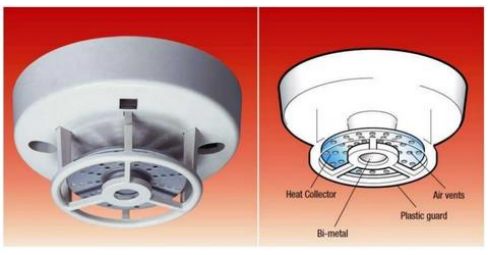
- Rise of temperature in the immediate surroundings
- Faster rise of ambient temperature than that due to normal atmospheric changes.

- Both of these effects are utilized as principles of actuation of heat detectors.

Fixed-Temperature Heat Detector

- The detecting element in these detectors must be fully heated to its set temperature for the alarm to be actuated, which makes suited for slow-growing fires.
- For fast-growing fires, the detector element may not be fully heated but just getting even small heated, it will get activated.

Fixed-Temperature Heat Detector



Fixed-Temperature Heat Detector

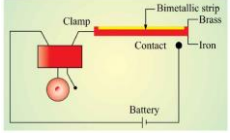
- Fusible elements
- Expanding metal or a gas
- Quartzoid bulb type sprinklers
- Bimetallic elements
- Line detectors

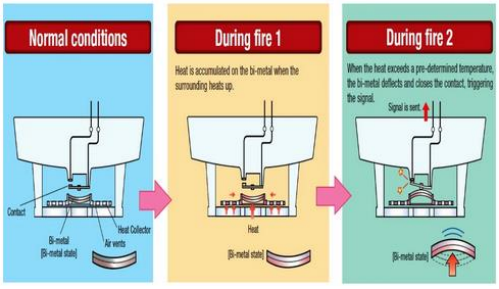
Fusible Elements

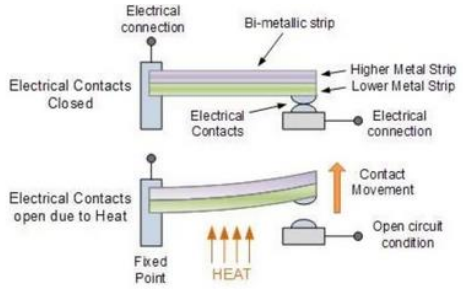
- Some alloys and eutectic metals such as Bi, Pb, Sn or Cd melt at relatively low temperatures (55-180 °C).
- The fusible element can be a solder to hold a spring under tension.
- When the element fuses due to fire, the spring is released to complete a circuit and initiate an alarm.
- These are not reusable detectors.

Bimetallic Elements

- When a bimetallic strip made of two metals with different thermal expansion coefficients such as Fe and Cu is heated, one expands more than the other.
- Ni-Fe alloy (Invar) which are generally used for low expansion components.
- While Mn-Cu-Ni, Ni-Cr-Fe or stainless steel alloys are used for high expansion components.







Break-line Cable

- A length of flexible PVC insulated cable is cut at intervals and the bared conductors are rejoined with a low-melting fusible alloy.
- Under the normal conditions, there is a steady flow of current through the conductor but during a fire, the fusible joint melts and this break in circuit acutates an alarm.
- This is a simple form of a line detector.

Expansion of Gases

- Gases have high expansion coefficient which can be used in pneumatic heat detectors.
- Air is filled into chamber with a flexible diaphragm.
- Rise in air temperature expands the air in the chamber and exerts pressures on the diaphragm.
- Sustained expansion pushes up the diaphragm until it completes an electrical circuit and raises the alarm.

Expansion of Liquids

- The best example of heat detector based on thermal expansion of liquids is the Quartzoid bulb sprinkler.
- Both liquid and the air bubble contained within the liquid expand when there is a rise in temperature of surrounding air.
- In the case of a fire, the temperature rises and the glass bulb shatters and water is sprayed over the designed area.

Rate-of-Rise (ROR) of Temperature Heat Detector

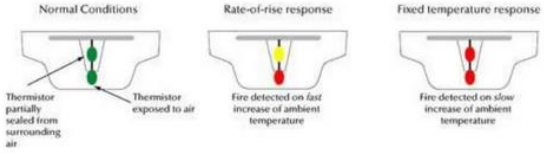
- This is designed for the fast growing fires as there will be rapid temperature rise.
- The internal components constantly compare the temperature of the surroundings to a baseline temperature programmed into the detector.
- It will compensate for any normal variations in ambient temperature.
- Once the temperature reaches at a predetermined criteria of temperature, alarm is actuated.
- ROR responds in the range of 7-8 ˚C/min or higher range and is best suited for the inaccessible areas.

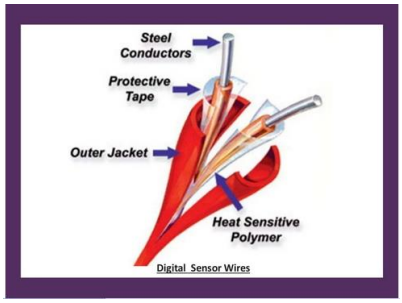
Combination Heat Detector

- This can give the advantage of both fixed temperature and ROR detectors i.e. for slow as well as rapid fire.
- In case of slow fire, it will compensate any temperature rise in chamber but if there is a rapid rise in temperature, the air in the chamber expands faster and it will push the diaphragm against the electrical contact to complete the circuit and raise the alarm.
- This combination heat detectors are good for the areas with unstable, high average temperatures such as an area where the several ovens are opened and closed routinely.

Line Detector

- There is a pair twisted wires of different metals or alloys to give them right strength, conductivity and corrosion resistance.
- Each wire is insulated with material that loses its insulating property at higher temperatures.
- The wire pairs have outer jacket to protect against damaging environmental conditions.
- When the fixe temperature is reached at any point along the line detector, the wires will come into the contact of each other to create a short circuit and actuate an alarm.





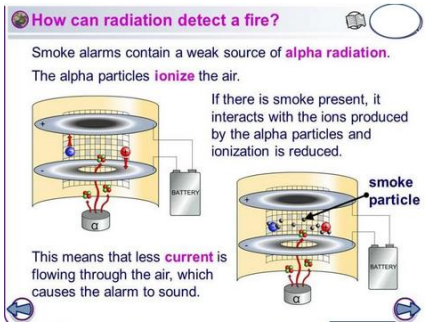
Smoke Detector

SMOKE DETECTION SYSTEMS

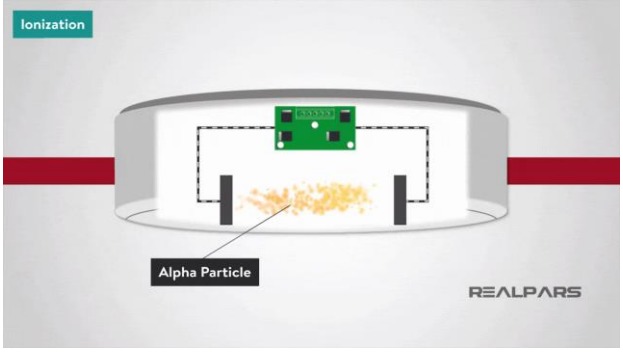
- IDENTIFY PARTICLES OF COMBUSTION

There are three basic types of smoke detectors including:
- ❑ Ionization
- ❑ Light Scattering
- ❑ Light Obscuring

- MOST COMMON TYPES ARE **PHOTOELECTRIC** AND **IONIZATION**



- Ionization Smoke detector generally contains two chambers.
- The first is used as a reference to compensate for changes in ambient temperature, humidity or pressure.
- The second chamber contains a radioactive source, usually alpha particle, which ionizes the air passing through the chamber where a current flows between two electrodes.
- When smoke enters the chamber the current flow decreases.
- This drop in current flow is used to initiate an alarm.



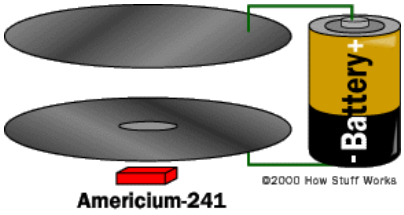
IONIZATION DETECTORS

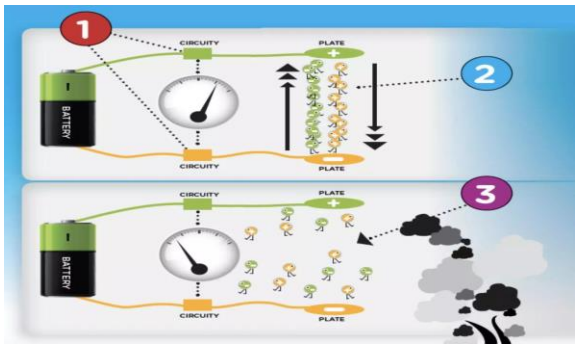
- USE A PIECE OF OF RADIOACTIVE MATERIAL (ALPHA RADIATION)
- The alpha particles generated by the americium ionize the oxygen and nitrogen atoms of the air in the chamber.
- When you knock an electron off of an atom, you end up with a free electron (with a negative charge) and an atom missing one electron (with a positive charge).

Ionization Detectors

- The electronic sensor in the smoke detector sense the small amount of electrical current that these electrons and ions moving toward the plates represent.
- When smoke enters the ionization chamber, it disrupts this current -- the smoke particles attach to the ions and neutralize them.
- The detector senses the drop in current between the plates and sets off the horn.

IONIZATION DETECTORS





IONIZATION DETECTORS

PHOTOELECTRIC DETECTORS

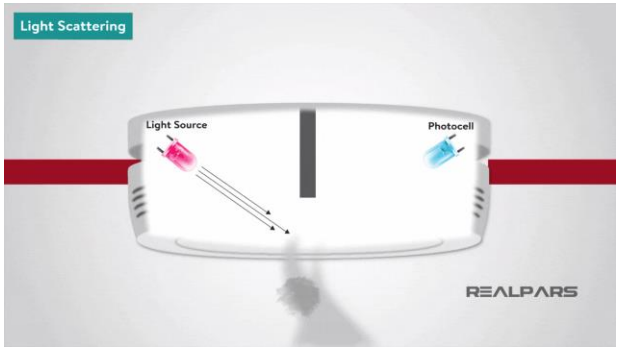
- Particles of combustion distort a light beam
- Distorted light beam activates signal
- work on the principles of the amount of light reaching a photoelectric cell.
- two types of photoelectric detectors: **Light Obscuration Type** and **Light Scattering type**.

PHOTOELECTRIC DETECTORS

- These are installed under non-fire conditions when the detector chamber is free from any smoke particles, light emitted from the source does not reach the sensor.

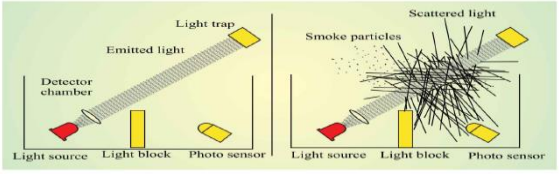
Light Scattering Smoke Detector

- The light scattering smoke detector operates on the **Tyndall effect**; a photocell and light source are separated from each other by a darkened chamber such that the light source does not fall on the photocell.
- The passage of smoke into the chamber causes the light from the source to be scattered and fall on the photocell.
- The photocell output is being used to initiate an alarm.



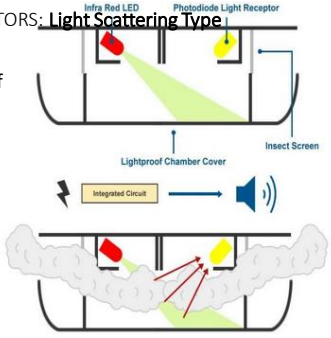
PHOTOELECTRIC DETECTORS: **Light Scattering Type**

- When smoke enters the chamber, some of light is scattered toward the sensor and reaching to the cell will either create current or allow more current to flow through it and alarm will give sound.

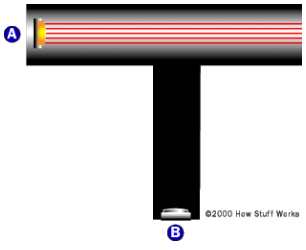


PHOTOELECTRIC DETECTORS: **Light Scattering Type**

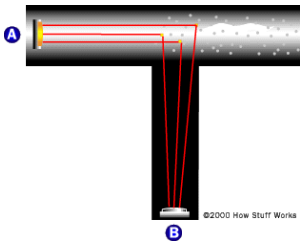
- This is spot type of detector.



PHOTOELECTRIC DETECTORS: **Light Scattering Type**



PHOTOELECTRIC DETECTORS: **Light Scattering Type**



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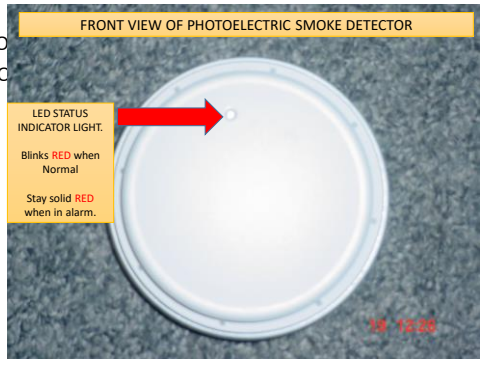
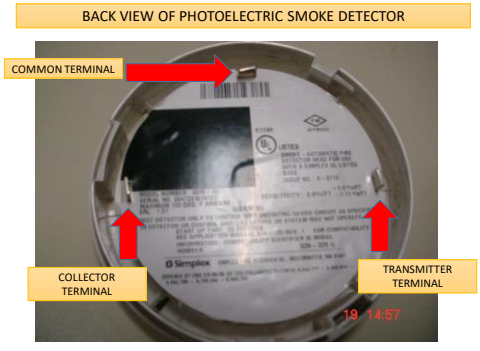
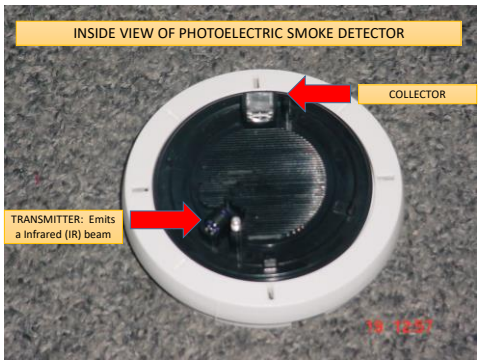
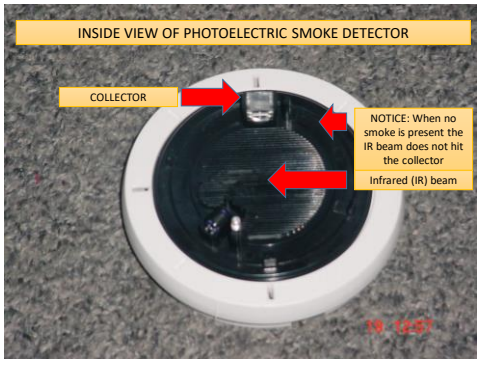





INSIDE VIEW OF PHOTOELECTRIC SMOKE DETECTOR
COLLECTOR
TRANSMITTER: Emits a Infrared (IR) beam


INSIDE VIEW OF PHOTOELECTRIC SMOKE DETECTOR
COLLECTOR
NOTICE: When no smoke is present the IR beam does not hit the collector
Infrared (IR) beam

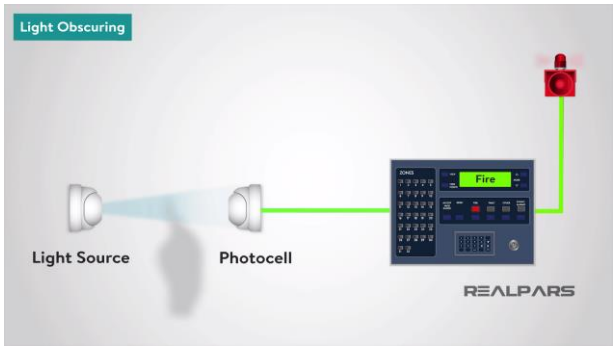

Once the IR beam hits the smoke the beam disperses. When the IR beam is displaced enough it will be picked up by the collector. This will cause the smoke detector to go into alarm.
COLLECTOR

Light Obscuring Smoke Detector

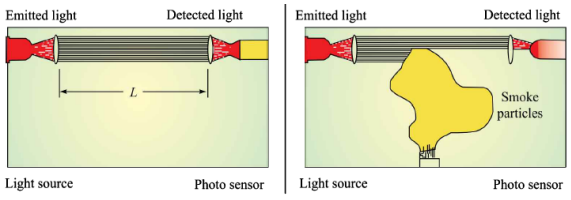
Photoelectric Type

- These detectors work on the principles of the amount of light reaching a photoelectric cell.
- There are two types of these detectors: First is **Light Obscuration Type** and **Light Scattering type**.

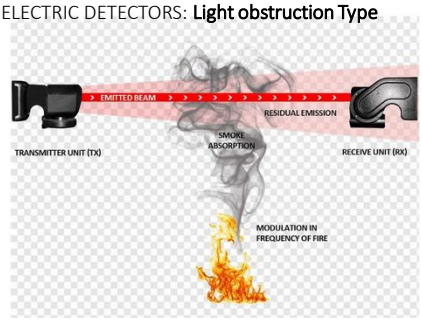
- In the Light obscuring smoke detector, smoke interferes with a light beam between a light source and photocell.
- The photocell measures the amount of light it receives.
- The variation in photocell output, is being used to initiate an alarm.
- This type of fire detection equipment can be used to protect large areas with the light source and photocell positioned some distance apart.



PHOTOELECTRIC DETECTORS: **Light obstruction Type**



PHOTOELECTRIC DETECTORS: **Light obstruction Type**



Aspirating Detectors

- Comprise of detector with a small air pump attached to piping manifold with perforations used to draw air samples from surroundings and send to sensing element
- Sampled air passed through filter before sensing element
- Very sensitive elements used due to dilution of smoke in air

Duct detector

- Used to monitor quality of air passing through HVAC duct
- Can sample large volume air with single detector

- Special type detectors developed:
- duct prob units for use in ventilation system
- Video smoke detection based on sophisticated computer analysis.

Optical Flame Detectors

Optical Flame Detectors

- Fire produces both **visible (IR) and invisible (UV) radiation** and these detectors are designed for that only.
- In the case of smoky fires, IR detectors may be preferred to UV because IR radiation can penetrate smoke better than UV.
- respond rapidly in the case of clean burning such as alcohol or methane that would not be detected by smoke detectors.
- The place where long fire is possible, this type of detectors are installed.

UV Flame Detectors

- respond to flaming fires emitting light in the ultraviolet portion of the spectrum.
- can respond to a fire condition in less than 10 milliseconds.

UV Flame Detector Uses

- extremely fast
- used in high-hazard applications, such as aircraft maintenance areas, munitions production, and other areas where flammable or explosive liquids or solids are handled or stored.
- should not be used around arc welding, as they will respond to the ultraviolet light produced by the welding process.

UV Detectors: limitations

- Keep UV detector lenses totally clean.
- A gradual buildup of contaminants frequently found in high-hazard spaces (oil, gasoline, petrochemicals, salt, and dust) block UV radiation.
- A layer thin enough to be undetectable to the human eye can cause a UV detector to be completely blind.
- Clean lenses according to the manufacturer's instructions.

Testing UV Detectors

- Test feature designed into some detectors allows for checking the device.
- A small UV source inside the detector housing is shielded from directly illuminating the sensor.
- A test switch deactivates alarm circuits and illuminates the test lamp.
- The test lamp rays pass through the front window to the sensor.
- Detector response to the test indicates that the window is clean and that the sensor and electronic circuits are operational.

IR Flame Detectors

- respond to flaming fires emitting light in the infrared portion of the spectrum.
- can respond to a fire condition in less than 50 milliseconds.
- designed to alarm to hydrocarbon fires, while ignoring things like arc welding, nuclear radiation and x-rays.

Testing IR Detectors

- The dark spot or dome at the bottom center of each IR device is the lens.
- Detector lenses must be kept clean to ensure the earliest possible detection of a fire.
- A 250-watt IR heat lamp several feet from the detector can serve as a flame substitute in testing an IR flame detector.

IR Flame Detectors

- ineffective for smoldering or beginning fires.
- used where possible fires would develop quickly (fuels, such as combustible gases and liquids, or loose cotton fiber),
- capable of protecting a large area if it is mounted high on a ceiling or wall (30 to 50 feet).

TESTING FLAME-ACTUATED DETECTORS

- should be inspected frequently (monthly) for physical damage, accumulation of lens deposits, and paint.
- Be sure that auxiliary functions of the flame detection system are deactivated
- Inform the fire department and persons who would hear the alarm.

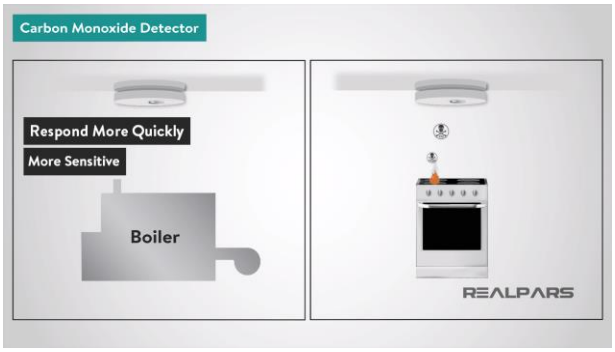
Gas-sensing Detectors

- Fire gas detectors use either **semiconductor** or **catalytic element** technology.
- Both oxidizing and reducing gases create electrical changes in the semiconductor.
- This catalyst accelerates the oxidation of combustible and raises the temperature of the element to actuate an alarm.

Gas-sensing Detectors

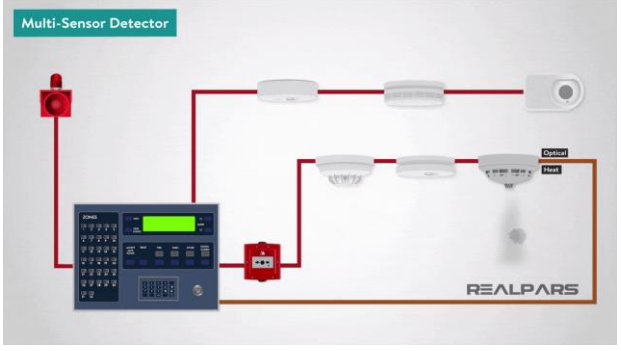
- Generally CO detectors are sensitive to the gas produced in the early smoldering stages of a fire.
- not affected by ambient dust and steam
- recommended for sleeping areas.

- Carbon monoxide detectors are known also as CO fire detectors are electronic detectors used to indicate the outbreak of fire by sensing the level of carbon monoxide in the air.
- Carbon monoxide is a poisonous gas produced by combustion.
- In this instance, these detectors are not the same as Carbon monoxide detectors used in the home for protecting residents against carbon monoxide produced by incomplete combustion in appliances such as gas fires or boilers.
- Carbon Monoxide fire detectors use the same **type of sensor** as those in the home but are more sensitive and respond more quickly.
- Carbon monoxide detectors have an electrochemical cell, which senses carbon monoxide, but not smoke or any other combustion products



Multi-Sensor Detectors

- The Multi-sensor detectors combine inputs from both optical and heat sensors and process them using a sophisticated algorithm built into the detector circuitry.
- When polled by the control panel the detector returns a value based on the combined responses from both the optical and heat sensors.
- They are designed to be sensitive to a wide range of fires.



Application-specific Detectors

- Nowadays it is in practice to design different types of detectors to be installed to address the limitation of each type and releasing the extinguishing in built agents.
- This led to the development of multisensory, multi-criteria capability type detectors know as Application-specific Detector (ASD).
- These type of detectors can reduce the false alarm.
- These detectors are used in computer rooms, HVAC ducts, welding shops, parking garages, high-bay warehouses etc.

Application-specific Detectors

- The use of microprocessors in the fire alarm systems has helped to overcome some limitations of smoke detectors.
- Analogue technology are used to monitor conditions in a protected area and transmit it to a computer based alarm control unit.
- This permits the designers to adjust sensor sensitivity to suit ambient conditions where it is really necessary.
- Analogue sensors can be photoelectric or ionization or combination of thermal, photoelectric and ionization units.

Selection of Detectors

- The detector has to be selected on the basis of the risk to be protected and the individual circumstances.
- Size of room, height of the ceiling, composition of combustible materials, activities that may cause false alarms and the air handling system have to be considered in the selection process of detectors.
- Whatever detector is employed, it should be reliable, robust and economical.
- Thus the selection of detector is the most important task of the fire safely system implementation.

- It is very important to select and install right kind of fire detectors and that must be properly understood by the owners and occupants and also know the alternatives.
- Smoke detectors are the most preferred one as due to the thumb rule for life safety and early detection is the most important part of fire fighting.
- Generally heat detectors are important where property protection is a major concern.
- Both optical flame and heat detectors can't detect the smoke but they can only react to a flaming fire and not an incipient one.

- When a person is sleeping or not present at the site, the selection of detector becomes very important and there generally audio detectors are preferred.
- Finally, the role civil engineer and architect becomes crucial for selection of the correct type of detector in a building or any premises.

EXAMPLE FIRE RISKS

Fire risk detection key: very good = ★★★★★ good = ★★★★ moderate = ★★★ poor = ★★ very poor = ★

Fire risk	Example fire(s)	Ionisation detection	Optical (scatter) detection	CO detection	Heat detection	Flame detection	Typical multisensor detection, eg optical-heat*	Typical multisensor detection, eg optical-heat-CO*
Smouldering white smoke	Electrical fire	★★	★★★★★	★	★	★	★★★★★	★★★★★
	Smouldering wood	★★★	★★★★★	★★★★	★	★	★★★★★	★★★★★
Smouldering dark smoke	Smouldering furnishings	★★	★★★★	★★★★★	★	★	★★★★	★★★★★
Smouldering changing to flaming	Waste paper bin fire	★★★★	★★★★	★★	★★	★★★	★★★★	★★★★
Flaming (clean burn)	Burning solvents	★	★	★	★★★	★★★★★	★★★	★★★★
Flaming (dirty)	Burning oils	★★	★★★	★★	★★★	★★★★★	★★★★	★★★★

Choosing a Fire Alarm System

Property Type and Size:
The nature of your property, whether it's a commercial building, industrial facility, or residential complex, will influence the type of fire alarm system needed.
Additionally, consider the property's size and layout for effective coverage.

Detection Technology:
Fire alarm systems employ various detection technologies, including smoke, heat, and flame detectors.
Select a system that aligns with the specific fire hazards present in your environment.

Code Compliance:
Ensure that the chosen system complies with local fire codes, regulations, and industry standards.
Meeting these requirements is essential for the safety of your property and occupants

Zoning and Notifications:
Different areas of your property may require different response levels.
Look for a system that allows zoning options and the ability to send notifications to relevant personnel or emergency services.

Integration Capability:
Consider a fire alarm system that can integrate with other security systems, such as access control and CCTV.
This integration enhances overall safety and coordination in emergency situations.

Monitoring and Maintenance:
Opt for a system that offers continuous 24/7 monitoring, promptly alerting you to potential issues.
Regular maintenance is crucial to ensure the system's reliability.

Expandability:
As your property evolves, your fire alarm system should accommodate changes.
Choose a system that can be easily expanded or upgraded without major disruptions.

Budget:
While prioritizing safety, it's important to consider your budget.
Look for a system that strikes the right balance between features and cost-effectiveness.

False Alarms and Failure to Detect

- False alarms or failure to detect during a test may be caused by environmental factors or the aiming of the detector.
- Check that detectors are not blocked and lenses are shielded from direct rays of the sun and other sources of IR, such as welding equipment, in the case of UV detectors.

EXAMPLE FALSE ALARM RISKS
False alarm risk rejection key: very good = ★★★★★ good = ★★★★ moderate = ★★★ poor = ★★ very poor = ★

False alarm risk	Example false alarm cause	Ionisation	Optical (scatter) rejection	CO rejection	Heat rejection	Flame rejection	Typical multisensor rejection, eg optical-heat**	Typical multisensor rejection eg optical-heat-CO**
Steam	Shower or bathroom	★★★★	★★	★★★★★	★★★★	★★★★★	★★★	★★★
Smoke	Smoking, kitchen/ cooking fumes	★	★★★	★★★★	★★★★★	★★★★★	★★★	★★★★
Dust	Warehouse	★★★	★★	★★★★★	★★★★★	★★★★★	★★★	★★★
Other particulate	Aerosol canister products, artificial smoke	★	★	★★★★★	★★★★★	★★★★★	★★★	★★★★
Sparks/naked flames	Welding	★★	★★	★★★	★★★	★	★★★★	★★★★★
Substance ingress	Insects	★★★	★★★	★★★★★	★★★★★	★★★★★	★★★★	★★★★★
High ambient airflow	Air-conditioning, open doors/ windows	★★	★★★★★	★★★★★	★★★★★	★★★★★	★★★★★	★★★★★
Rapid thermal change	Opening of ovens	★★	★★★★★	★★★★★	★	★★★★★	★★★★	★★★★

Alarm Systems

- The simplest and oldest fire alarm is the fire bell.
- Public address (PA) systems are also widely used in industries and large buildings to alert the occupants about the fire and to evacuate the building.
- Generally sprinkler system is inbuilt with the alarms.
- The breaking glass fire alarm system is also common manually actuated device that may have complex electronics.
- A fire detection and alarm systems may include the following points:
  - Alarm initiators (manual or automatic: break glass alarms, sprinkler system flow devices etc.)
  - Alarm indicators (audible or visible)
  - Auxiliary control such as ventilation, smoke control etc.
  - System control unit
  - Primary electrical power supply as well as a stand-by power supply (battery or generator)
  - Signal to a central 24 x 7 manned station or an external response location, lika a fire station.

ALARM SYSTEMS

- TYPES
  - CENTRAL STATION
  - LOCAL SYSTEM
  - PROPRIETARY SYSTEM
  - VOICE SYSTEMS
- INSPECT AND TEST AT LEAST ANNUALLY

Fire Alarm Panels

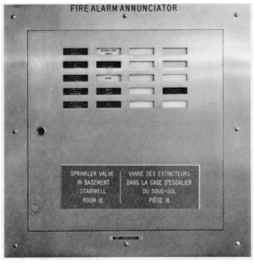
Fire Alarm Panels

- Zone Indicators
- Alarm Indicators
  - Fire
  - Trouble Alarm
  - Loss of Signal/Connection
- Test and Alarm Resets

Annunciator Panels

- Located near main entrance of buildings
- Identify zones for alarms

Annunciator Panel



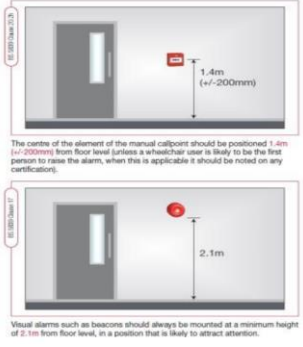
Pull Stations

- Manually actuated fire alarm boxes, commonly called manual pull stations, allow occupants to manually initiate the fire alarm signaling system.
- Manual pull stations may be connected to systems that sound local alarms, off-premise alarm signals, or both.

- According to NFPA® 72, the pull station should be mounted on walls or columns so that the operable part is not less than 42 inches and not more than 48 inches above the floor.

POSITIONING

1. Manual call points shall be located that, no person has to travel distances of more than **30 m** to reach them.
2. Manual call points shall be located preferably near entry to **staircases** at every level.
3. When manual call points are also installed external to the building, the travel distance shall be **45 m.**
4. Where necessary, the travel distance may require to be reduced to less than 30 m, where there is difficulty in free access or potentially dangerous risks.
5. Call points shall be fixed at a height of **1.4 m** above the surrounding floor level.



Pull Stations

- Activate fire alarm in building
- Single action or dual action
- Most types these days have method for determining activation
  - Break glass bar
  - Require key to reset

INSPECTION AND TESTING

- The employer shall assure that fire detectors and fire detection systems are tested and adjusted as often as needed to maintain proper reliability and operating condition.
- Local Fire Codes stipulate testing requirements

Fire Alarm Systems and Control Panel

- Francis Upton patented the first electric fire alarm in 1890 in USA but major improvements came later in 1960s.
- Fire alarm control panel is a core component of a fire alarm system and called the CPU of the whole fire detection and alarm system.
- The primary purpose of this panel is to monitor each circuit, zone or detector for the condition of alarm or other abnormality can be detected and can be operated in a right direction to reduce the harmful effects and intend to warn the occupants for the condition.
- It may be linked to the public fire brigade station.
- Generally it may be located to the security post of a building or an industrial fire station.
- Conventional or collective and Intelligent or addressable panels are in use today.

Principle of Operation

- There are two principles of operation: Collective and Addressable.

Collective

- In collective fire alarm systems, there are one or more circuits, with detectors connected in parallel.
- An alarm signal is received at the fire panel as the current on a circuit changes beyond set limits when one of the detectors on that circuit activates an alarm.
- The control panel of a collective system can display the alarm of fault status of circuit but it can't identify the status of individual detectors of the circuit which is the biggest drawback of this principle.

Addressable

- In addressable fire alarm systems, there are one or more circuits, with detectors connected in parallel wherein each detector has a unique ID address.
- Hence we can identify each and every detector when the alarm is raised.
- For large complex premises, a single panel may not be adequate but several alarms connected in a network will give good result in case of any emergency which will reduce the possibility of false alarms and sometimes combination of both is used.

Thank You

Thank You