# Detection

- Explain the operation of different detectors
- Distinguish between the different activation methods of detectors
- Describe the difference between spot and linear detectors

# Early detection leads to greater chance of survival and less property loss

Heavily dependent on the fuel burning and the rate that it burns

# Fire Detection

- Human detection
- Mimic human senses
  - Less accurate
  - Longer to activate
- Known fire signatures
  - Different from background
  - Heat, smoke, light, gases
- Transport lag

# Manual Alarm Initiating Devices

- General alarm
- Coded
  - Older pull stations
  - Sends a specific alarm “code” to identify it’s location
  - Rare due to increased us in addressable alarm systems
- Non-coded
  - Most common

# Single Action

# Single Action - Break Glass

# Double Action

# Double Action - Break Glass

# Manual Alarm Initiating Devices

- Must be red and mounted on a contrasting background
- Conspicuous, unobstructed, and accessible
- Should be mounted between 42” and 48” off the floor and within 5’ of every exit on every floor
- Maximum travel distance of 200’

# Fixed Detectors

- Spot
  - Single location for each detector or port
- Linear
  - Any signal across a space
  - Within 20 in of ceiling

- Non-restorable
  - Sensing element destroyed detecting fire
- Restorable
  - Sensing element used multiple times

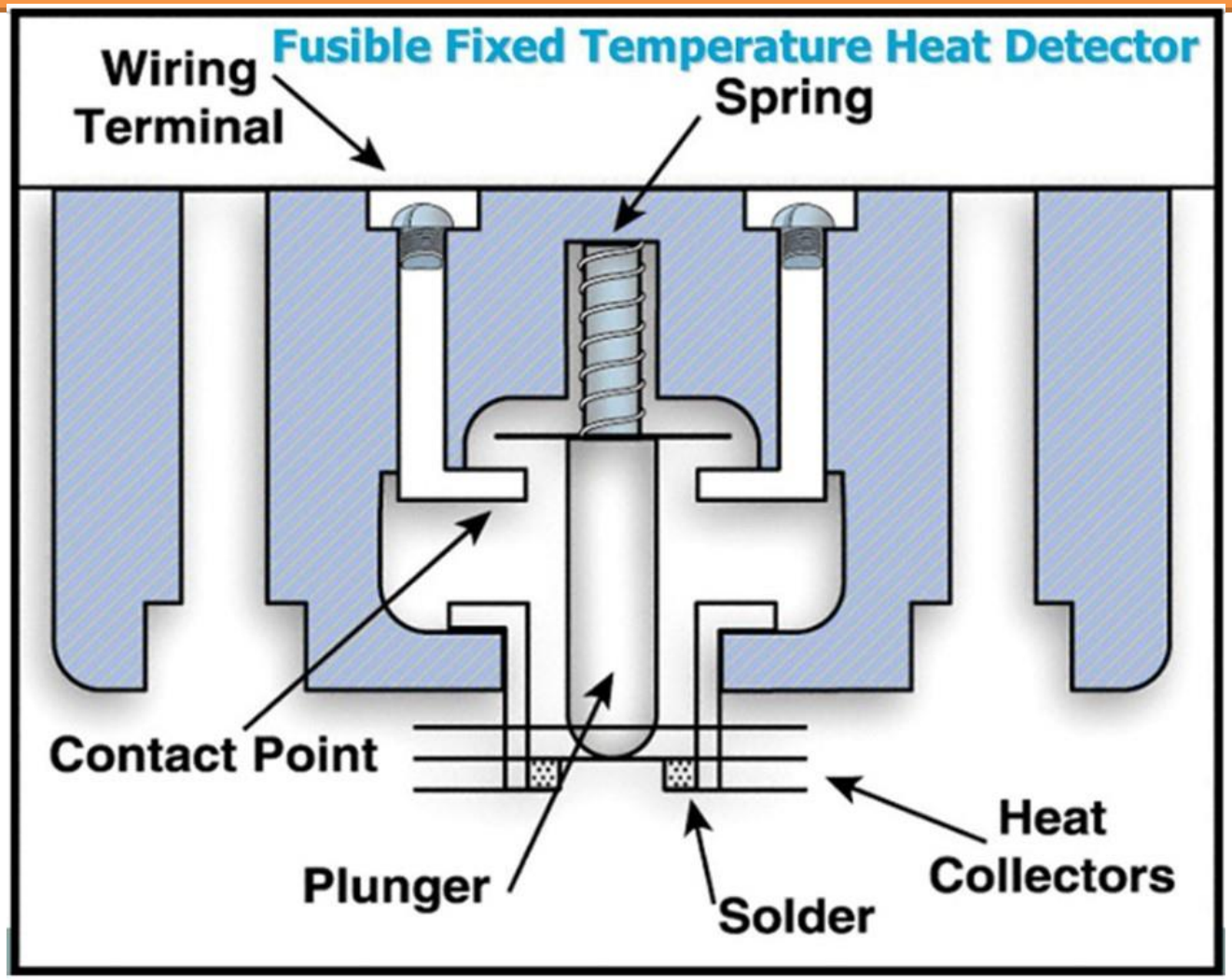
# Heat Detectors

- Oldest type of detector
  - Sprinklers
- Lowest nuisance alarm rate
- Typically ceiling mounted in small confined areas

# Heat Detectors

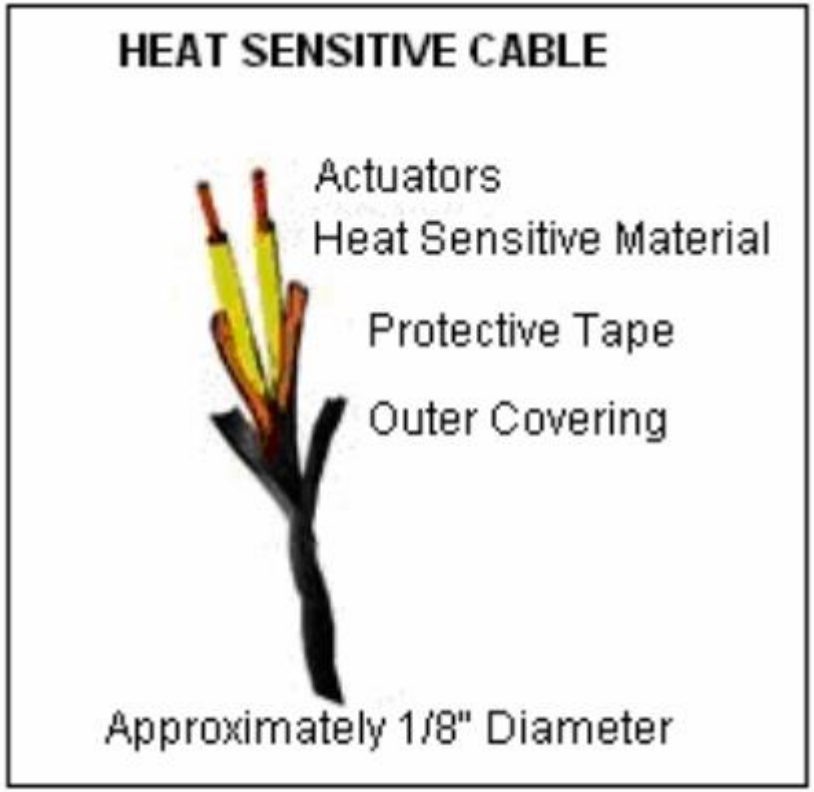
- Fixed temperature
  - Detect a rise in the surrounding air temperature to the set point
    - When a fixed temperature device operates, the temperature of the surrounding air will always be higher than the operating temperature of the device itself. This difference between the operating temperature of the device and the actual air temperature is “thermal lag”
  - Fusible element

# Fixed Temperature – Fusible Element


Fusible Fixed Temperature Heat Detector
Wiring Terminal
Spring
Contact Point
Plunger
Solder
Heat Collectors

# Heat Detectors

- Continuous line
  - Electrical conductors are held apart by heat sensitive insulation
  - Insulation has set melting point
  - Wires contact sending signal
  - Wires fuse and must be replaced

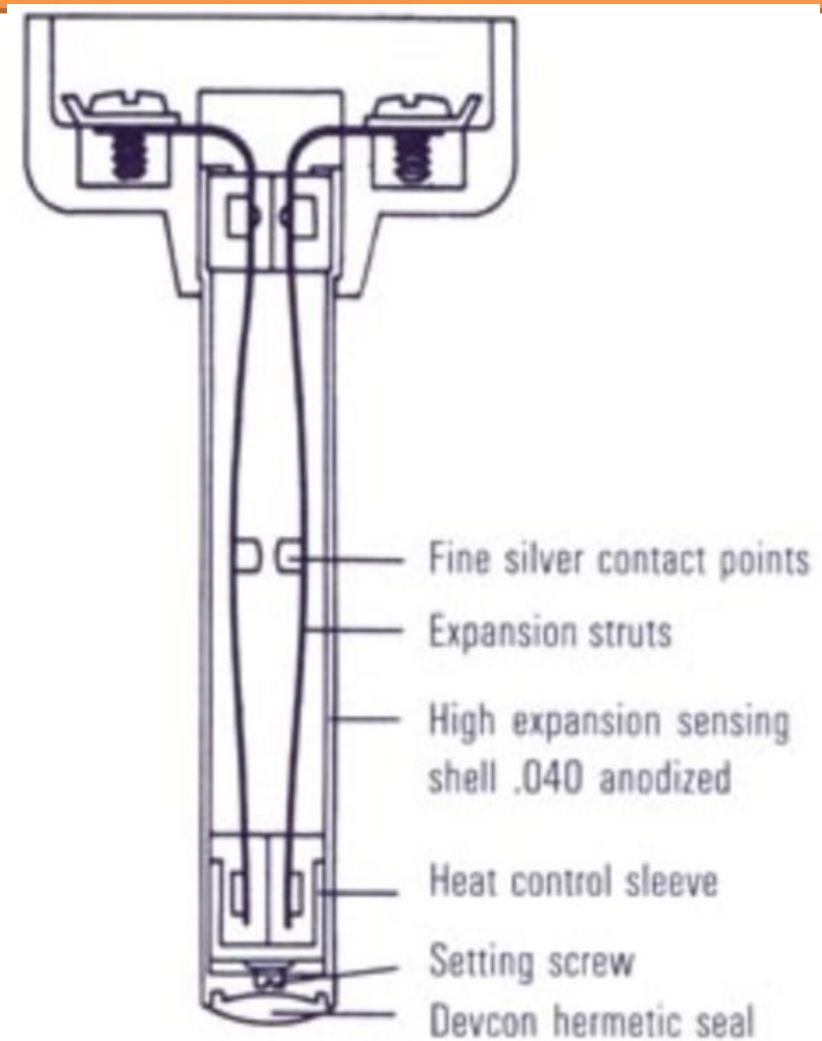


# Heat Detectors

- Rate of rise
  - Spot type
  - Line type
  - NFPA HB 14-18

# Rate Compensating

- Surrounding air temperature reaches a specific temperature threshold
- Sealed tube with two sensing elements, an outer metal tube and an internal pair of bi-metallic struts which are connected to both ends of the tube
- As the temperature rises, the outer shell expands faster than the struts, pulling them closer together, allowing the contacts to close
- Thermal lag is eliminated


Fine silver contact points
Expansion struts
High expansion sensing shell .040 anodized
Heat control sleeve
Setting screw
Devcon hermetic seal

# Smoke Detectors

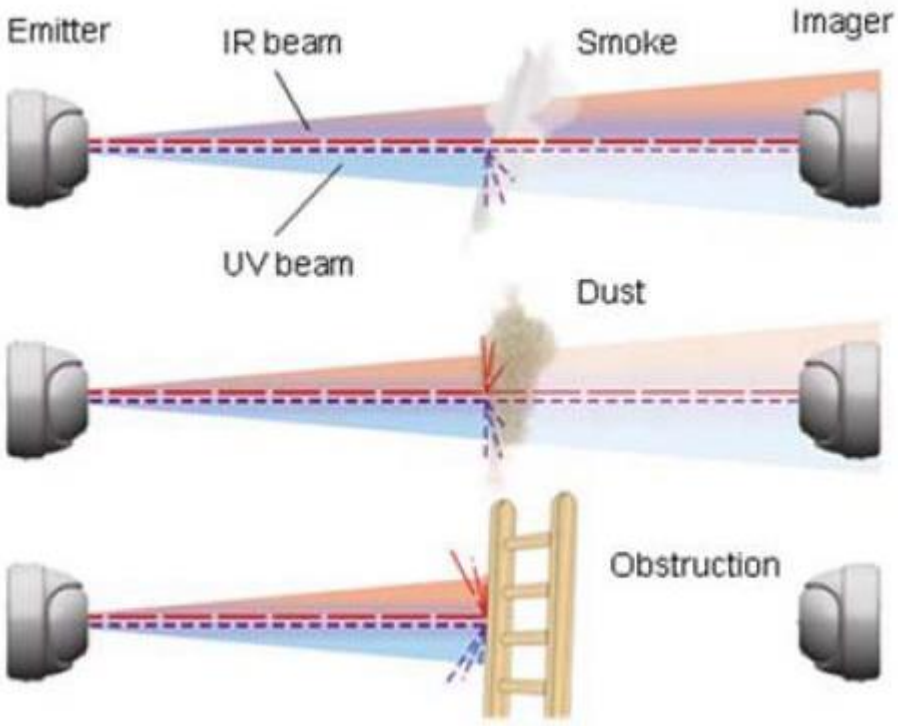
- Detect most fires much more rapidly than a heat detector
- Ionization
  - Somewhat faster in response to high energy flaming fire
- Photoelectric
  - Have superior response to low energy smoldering fires because they respond to smoke density
  - Photoelectric may equal or surpass ionization detectors response to a flaming fire
    - have been increasing in market share
- Video
  - Cameras and computer analyze changes in captured images

# Smoke Detector Function

- Ionization
  - Contain a very small amount of radioactive material
  - Air is ionized in a sensing chamber
  - Result is the air being conductive allowing current to flow between two charged electrodes
  - Smoke particles enter the sensing chamber
  - Decreases the conductivity of the air by attaching to the ionized
  - When the conductance is below the permitted level, the detector alarms
  - NFPA HB 14-20

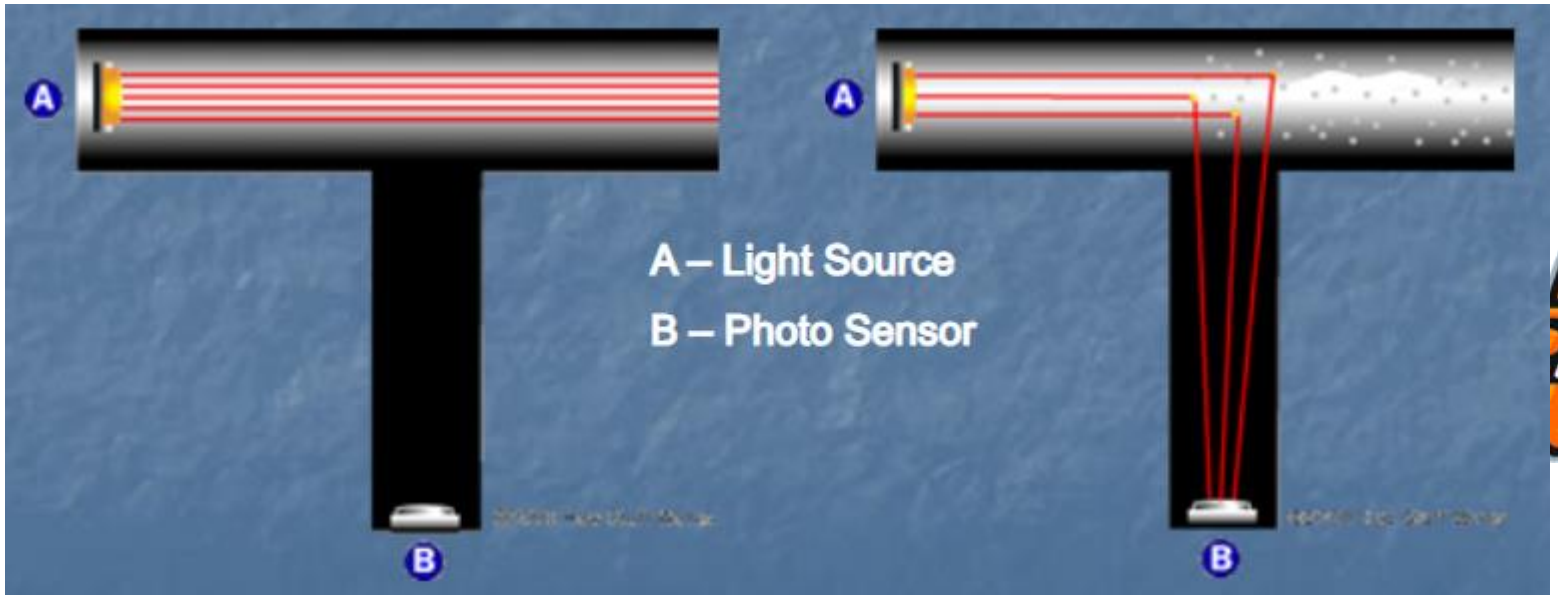
# Smoke Detector Function

- Photoelectric
  - Smoke affects a light been passing through the air
  - Two methods
    - Decrease of light beam intensity (linear)
    - Scattering of a light beam (spot)
  - Intensity decrease (obscuration)
    - Light source, Transmitter, Receiver
    - Light reaching the receiver is reduced and initiates an alarm
    - One projected beam smoke detector is equivalent to a row of spot type smoke detectors along the same path
    - Must have a completely unobstructed view
    - Some models may be sensitive to flashing lights such as on large machinery or vehicles


Emitter
IR beam
Smoke
Imager
UV beam
Dust
Obstruction

# Smoke Detector Function

- Light scattering
  - Light source and reviver
  - Arranged so the light rays do not hit the receiver
  - When smoke enters the light strikes the particles allowing light to be redirected onto the receiver causing the detector to alarm



# Smoke Detector Function

- Video
  - Analyze changes in digitized video image
  - Must have an illuminated space
  - Significant advantages in a large open facilities like aircraft hangers

# Air Sampling Smoke Detector

- Air sampling
  - Almost all operate on photo electric light scattering principal
- Continuous air sampling
  - Network of tubes to pull air into the detector
  - Limitations
    - Transport time of air two sensor limits size of area covered
    - Smoke dilution
    - Must supervise piping network
    - Limited ability to be zoned

# Smoke Detectors

- Nuisance alarms
  - Near cooking
  - Dusty areas
  - Steam areas
  - Maintenance on beam detectors (alignment)
- Not directly in air stream from a wall mounted supply diffuser
- At least 3’ from ceiling mounted supply diffuser
- Should be mounted to detect smoke drawn to return air diffuser

# Flame Detectors

- Ultraviolet
  - Photo diode allows a burst of current to flow for each UV photon that contacts the sensor.
  - When the number of current bursts per second reaches a certain level, the detector alarms
  - Sensitive to most fires except petroleum distillates due to the large amount of smoke they produce

# Flame Detectors

- Infrared
  - Contain a filter to screen out unwanted wavelengths.
  - Responded just to the resulting infrared component
  - Almost all carbon-containing fuels emit significant infrared radiation.
  - However carbon-free fuel’s such as hydrogen and sulfur are not detectable by infrared detectors

# Flame Detectors

- Combination ultraviolet and infrared
  - Typically require both the UV and IR or sensors to respond to cause an alarm resulting in better false alarm rejection

# Wet Pipe Water Flow Alarms

- Electrical contact, physically connected to the fire alarm system, is closed when water flow is detected
- Supplementary devices installed allowing a more precise determination of the location of water flow
- Alarm check valves
  - Clapper lifts allowing water to flow into an alarm port connected to electrical or mechanical alarm initiating devices
  - Retard chambers are required to prevent false alarms
- Vane-type water flow alarm devices
  - Most common
  - Inserted into the riser just above the point at which water enters the system
    - Two typical problems with vane-type alarm devices
      - Leaks around the point of entrance into the riser
      - Detached vanes

# Dry Pipe, Pre-action and Deluge System Waterflow Alarms

- Passageway that is uncovered when the clapper trips into the open position
- Systems are not generally affected by surges
- Outlet from alarm passageway may be attached to water motor gong or a pressure operated switch
- Vane-type waterflow alarm devices not permitted with dry pipe, pre-action or deluge systems
  - Hydraulic shock occurs when the clapper trips increasing the possibility that the vane might become detached

# Detector Options

- Single sensing element
- Combination
  - Fixed temperature and rate of rise
  - Photoelectric and ion
  - UV and IR
  - Others

# Initiating Devices

- Signal sent
  - Analog or digital
  - Wires
  - Fiber-optic
  - Wireless
- Addressable or not
  - Able to communicate their location in a circuit on the alarm panel
  - Allows for quicker response to fire and quicker repair if needed

# Addressable Detectors

- Each detector has own address
  - Control panel can display unique identifyer
- Control panel surveys
  - Can check in any order
  - Normal or alarm
  - Nothing=trouble