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Pocket guide to Linear Heat Detection

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Contents

Foreword

The purpose of this guide is to provide information on the correct installation of Linear Heat Detectors in life-safety and property protection applications. This guide briefly summarizes the principles of operation of Linear Heat Detectors, their design requirements and practical applications for their use as a component of a fire alarm system.

Linear Heat Detectors can be important components of a well-designed fire alarm system. Their unique capabilities enable Linear Heat Detectors to overcome many limitations of other detection types in open applications and in harsher environments. This guide has been developed to help give you an understanding of the Linear Heat Detector's capabilities and its benefits compared to other detection methods.

Please note: This document is intended only as a general guide to the application of Linear Heat Detectors. Reference should always be made to the detector manufacturer's installation requirements and instructions, and local standards.

LHD applications:
Underground tunnels

Glossary of terms

Linear Heat Detector
Uses a heat-sensitive cable to detect changes in temperature along its length. Linear Heat Detectors provide continuous coverage and are ideal for monitoring large or complex areas, such as warehouses, tunnels and industrial facilities.

Aspirating Smoke Detectors
Air is drawn through a network of pipes to detect smoke. Smoke flows into the sampling chamber which detects the presence of smoke particles suspended in air by detecting the light scattered by them in the chamber.

Optical Beam Smoke Detector
A fire detector which uses a beam of light (usually infrared) projected across an open area to monitor for smoke emitted by an incipient fire. There are two types of Beam Detector:

- **End-to-End:** Transmitter and receiver are mounted at either end of the protected area.
- **Reflective:** Transmitter and receiver are mounted in the same housing and the beam is directed at a specially designed reflector, mounted at the opposite end of the protected area.

Glossary of terms

Point Detector
A device, which senses an incipient fire at a single location, most commonly using optical or ionisation smoke detection or heat detection. The area of coverage of a Point Detector is defined in local or national standards.

Controller
Controllers interpret changes in the detection cable, triggering alarms when heat thresholds are exceeded. They may also display system status, manage fault indications, and interface with external fire safety equipment.

Detection cable
The core component of a Linear Heat Detection system, designed to sense heat at specific activation temperatures. Detection cables can be fixed (reacting at a set temperature) or programmable (allowing temperature thresholds to be adjusted for specific applications).

Detector coverage
Detector coverage is the area, is simply the coverage from the detector in which a fire detector is considered to effectively sense an emerging fire. This area is defined by local and international standards.

End-of-Line Unit
A device installed at the end of a detection cable loop in a Linear Heat Detection system. It monitors the integrity of the circuit, ensuring proper operation by identifying faults such as open circuits or short circuits. The EOL unit is essential for maintaining system reliability and signalling any issues to the controller.

Distance locating
Shows which zone and the trigger point in m of a fire or fault event.

Interlock mode
Utilize two or more zones to cover an area, all zones must be triggered to indicate a fire event, otherwise shows fault.

Rate of rise
Triggers a fire event if activated. Typical activation occurs when a proportion of the sensor cable is heated at a specified rate for a certain amount of time.

Spacing
The recommended maximum distance between adjacent detection cables or between a detection cable and surrounding structures. Proper spacing ensures comprehensive heat detection coverage while avoiding gaps or areas of reduced sensitivity.

Who should read this guide?

You should read this guide if:

- You specify or design fire detection systems
- You are responsible for your building's fire protection system
- You are the Fire Marshall for your workplace
- You are planning to install a Linear Heat Detector or other smoke detection system
- You are in a risk assessment role for fire protection
- Your role is to support or sell fire detection systems
- You work in the fire and rescue service

The guide offers general guidance; you should also consult local and national regulations and the manufacturer's technical specifications for particular detectors.

LHD applications:
Underground car parks

What is Linear Heat Detection (LHD)?

Linear Heat Detector: 'sensing chamber' up to 40 kilometres in length

Linear Heat Detection (LHD) operates by continuously monitoring temperature changes along the whole length of sensing cable. The cable is designed with heat-sensitive materials that react to temperature changes. When the ambient temperature exceeds a pre-defined threshold, the material within the cable undergoes a change, triggering the detection system. This system alerts individuals to potential fire conditions based on the temperature rise along the cable.

Unlike traditional point heat detectors, which only monitor the temperature at a single point, LHD provides continuous monitoring across a large area or specific path, such as along pipelines, cables, or the perimeter of a room. This makes it particularly useful in environments where uniform temperature changes need to be detected over a large surface or in confined spaces where traditional point detectors may not be effective.

How does LHD work?

Linear Heat Detection (LHD) systems monitor the temperature along the entire length of a sensing cable. The cable contains heat-sensitive materials that react to temperature changes. When the temperature exceeds a set threshold, the properties of the materials change, triggering the detection system to signal a potential fire.

The system functions similarly to an array of point detectors placed continuously along the cable, allowing it to detect temperature variations wherever they occur along its path. LHD is particularly effective for monitoring large or complex areas, such as long corridors, tunnels, or areas with distributed equipment, where detecting localized temperature increases quickly is crucial.

LHD systems can be classed as 'simple apparatus' under ATEX and IECEx regulations. This means that, with the controller placed in the safe area and appropriate barrier use, standard LHD cables can be used to detect heat events in hazardous environments.

Did you know?
Linear Heat Detection is ideal for protecting large or complex areas like tunnels, storage facilities, and conveyor systems. Unlike traditional point detectors, LHD continuously senses temperature variations along the entire length of the cable, providing early warning across extensive spaces without the need for multiple sensors.

Types of LHD

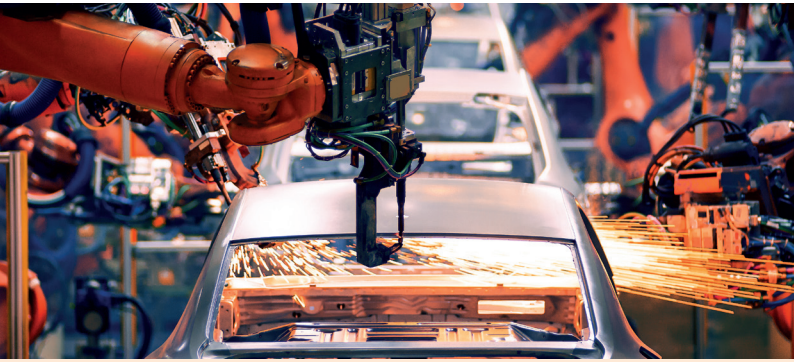
Fixed Activation Temperature Cables

- Activate an alarm or trigger a fire suppression system when the temperature at any point along the cable reaches a pre-set, fixed threshold.
- Contains heat-sensitive materials that change their properties when exposed to a certain temperature.
- Once the temperature is exceeded, the system activates, providing early detection of a potential fire.
- Often used in environments where a specific temperature threshold is a reliable indicator of a fire hazard.

Programmable Activation Temperature Cables

- Activation temperature can be adjusted to suit different environments or specific applications.
- The heat-sensitive system is programmed to respond to a temperature in a range, depending on the needs of the area being monitored.
- The cable reacts linearly to heat and, when the temperature exceeds the programmed value, an alarm or fire suppression system is triggered.
- These cables are ideal for applications where varying temperature thresholds are required.

Types of LHD



Thermistor-based Cables

- Similar to point detectors with thermistors placed at regular intervals along the cable. Each 'point' can detect heat events in a radius around the thermistor.
- These thermistors are semiconductor devices whose electrical resistance varies predictably with temperature.
- The system continuously monitors resistance changes, triggering an alarm when a predefined temperature threshold is reached.
- Lower detection resolution compared to Fixed or Programmable products, ideal for simpler environments where it is easier to obtain full coverage of a space.

Fibre Optic Cables

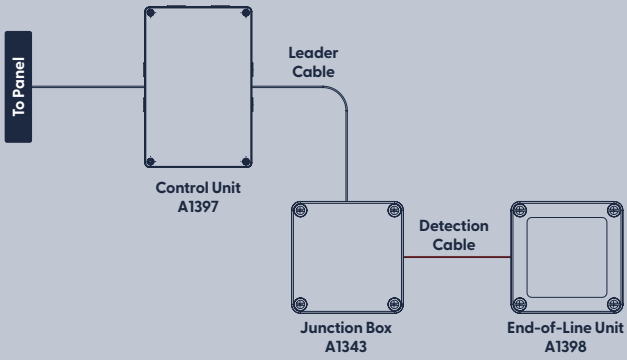
- Detect heat along their entire length.
- They continuously sense temperature changes across vast areas by transmitting laser light through the fibre, with backscattered signals analysed by a powerful fibre optic controller to detect temperature variations.
- This allows for precise detection of hotspots, overheating equipment or fire hazards in real-time.
- Fibre Optic Cables are highly durable, immune to electromagnetic interference, and suitable for harsh environments such as tunnels, industrial plants and power facilities, where early and reliable fire detection is critical.

Types of LHD

Feature	Programmable
Temperature range	54°C to 100°C
Maximum cable length	500m
Number of zones	1
Installation complexity	Simple
Detection resolution	Continuous
Maintenance needs	Low
Application flexibility	High
Repairability	Simple
Cost	Low

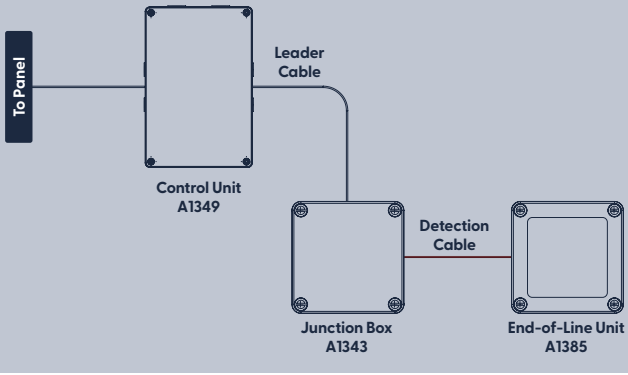
Fixed	Thermistor-based	Fibre Optic
68°C to 88°C (EN) 68°C to 230°C (UL)	Up to 200°C	Up to 120°C
1,000m - 3,000m	~3,000m	<10,000m
2	1	255
Simple	Moderate	High
Continuous	Point Specific	Continuous Data
Low	Low	High (calibration)
Medium	High	High
Simple	Moderate (calibration)	Complex
Low	Medium	High

Fixed Activation Temperature EN



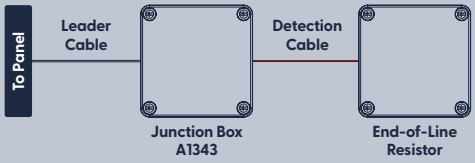
- For fixed activation temperatures a Control Unit and End-of-Line unit are required as well as the correct Fixed Temperature Detection Cable.
- The controller enables the Distance Locating and Interlock Mode features of the cable.
- Typically the Activation Temperature of the cable selected will be 30°C above the maximum ambient temperature of the environment the detection cable will be placed in.
- Leader Cable can be used to bridge the gap between the controller and the detection cable. This way the controller can be placed in a non-sensing, or safe area.

Fixed Activation Temperature UL (Option 1)



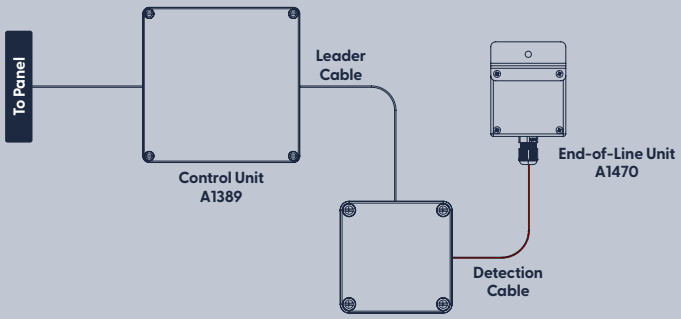
- For fixed activation temperatures, a Control Unit and End-of-Line unit can be used as well as the correct Fixed Temperature Detection Cable.
- The controller enables the Distance Locating and Interlock Mode features of the cable.
- Typically the Activation Temperature of the cable selected will be 30°C above the maximum ambient temperature of the environment the detection cable will be placed in.
- Leader Cable can be used to bridge the gap between the controller and the detection cable. This way the controller can be placed in a non-sensing, or safe area.

Fixed Activation Temperature UL (Option 2)



- For shorter distances, the correct Fixed Temperature Detection Cable can be wired directly to the fire panel and an End-of-Line Resistor is used to correctly terminate the cable.
- Without the controller the Distance Locating and Interlock Mode features of the cable are disabled.

Programmable Activation Temperature



- For Programmable Activation Temperatures, a Control Unit and End-of-Line unit are required. The Activation Temperature is programmed into the Control Unit.
- The Control Unit enables the Rate of Rise detection feature of the cable.
- Typically the Activation Temperature of the cable will be programmed at 30°C above the maximum ambient temperature of the environment the detection cable will be placed in.
- Leader Cable can be used to bridge the gap between the controller and the detection cable. This way the controller can be placed in a non-sensing, or safe area.

LHD applications: Storage facilities

How do LHD systems differ from others?

LHD systems differ from traditional point heat detectors in the way they monitor temperature changes across an area. Point heat detectors are typically installed at specific locations and only detect temperature changes at the point where they are installed. These detectors respond when the temperature at that specific point exceeds a set threshold.

In contrast, LHD systems use a continuous cable that runs along a specific path or area. The cable contains heat-sensitive materials that trigger an alarm when the temperature exceeds a preset threshold at any point along its length. This allows LHD systems to provide continuous, real-time temperature monitoring over long distances, offering broader coverage and more precise detection of temperature changes across larger or more complex areas.

The key difference lies in how the protected area is monitored. Point detectors focus on isolated points, while LHD systems provide continuous temperature monitoring along the entire length of the cable, offering early detection across larger spaces.

How should LHD systems be installed?

Following the guidelines below will maximize the performance of Linear Heat Detectors and minimize the occurrence of faults and false alarms:

1. When used to protect specific items such as machinery or cabling, the detector should be mounted as close as possible to the potential fire source. It can be mounted either directly above the item or in thermal contact with it.

2. Ensure the Linear Heat Detectors are not installed in areas where the flow of hot gases could be obstructed. This can impact the detector's efficiency in identifying potential fires.

3. Detectors should be sited with appropriate consideration for environmental factors, such as airflows from ventilation systems, which might dilute or redirect heat away from the Detectors.

4. Avoid over-tensioning the detector cable during installation to prevent damage to its sensing elements.

5 Ensure smooth bends in the cable to avoid kinking or crushing.

6 Sharp bends can affect the sensitivity and integrity of the detector.

7 Use appropriate brackets or clips to secure the detector cable at intervals recommended by the manufacturer. Loose or unsupported cables can lead to additional hazards to firefighters or hinder evacuation attempts in the event of a fire.

8 Account for ambient temperature fluctuations and ensure the detector is rated for the environmental conditions of the installation site. Special precautions may be required for extreme heat, cold, or humidity.

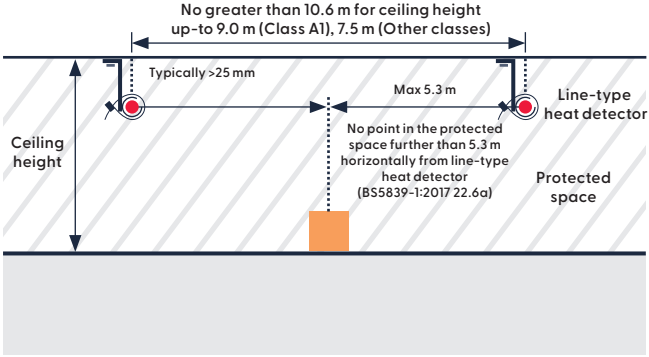
9 Verify compatibility with the control panel and other elements in the fire detection system to ensure proper integration.

10 Keep the detector cable from crossing over heat sources, lighting fixtures, or other equipment that could cause localized overheating.

BS 5839 guidance

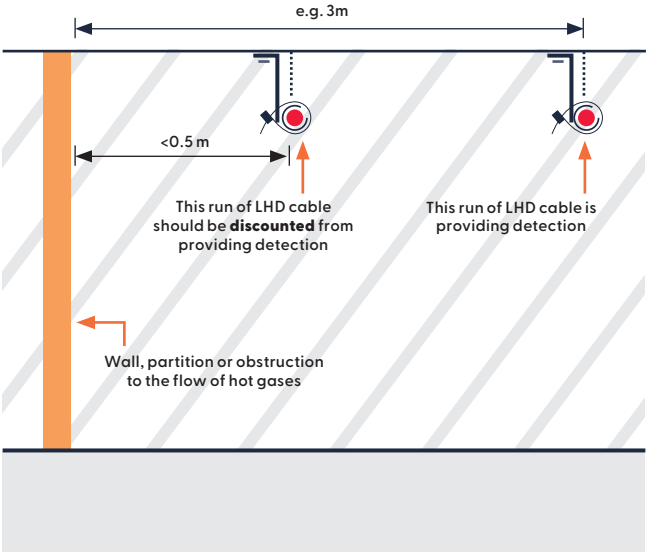
Standard recommendations (BS 5839 Part 1)
BS 5839 Part 1 gives a code of practice for the design, installation, commissioning and maintenance of automatic fire detection systems in non-domestic buildings. Some of the key recommendations for Linear Heat Detectors are summarized here. This is provided for general guidance only; refer to the standard for detailed information.

Installation of cabling
The maximum horizontal distance between any point in the protected area and the nearest point on a line heat detector should not exceed 5.3 m.



Distance from vertical surfaces

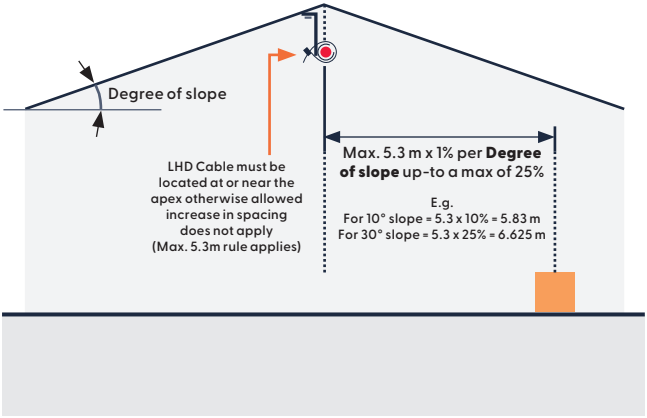
Detection cable within 0.5 m of walls, partitions, structural beams, ductwork should not be considered for detection purposes. Similarly, sections within 500 mm of the control equipment should also be disregarded.



BS 5839 guidance

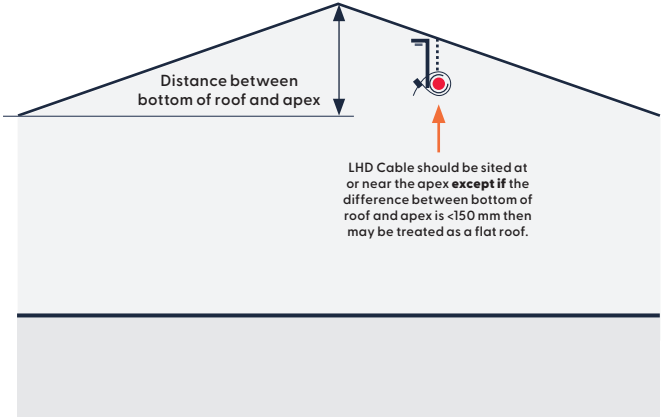
Distance adjustment for sloped ceilings

For line heat detectors installed at or near the apex of a pitched ceiling, the maximum horizontal distance (5.3 m) can be increased by 1% for each degree of slope, up to a maximum of 25%. However, for detectors not at or near the apex, the standard horizontal distance applies.



Positioning near the apex

Fire detectors should be positioned at or near each apex of a pitched roof unless the height difference between the apex and the roof base is minimal (less than 150 mm for heat detectors). In such cases, the roof can be treated as flat for installation purposes. Supplementary detection is recommended for buildings with very high ceilings, >9 -m for Class A1 or >7.5 m for other heat detectors.



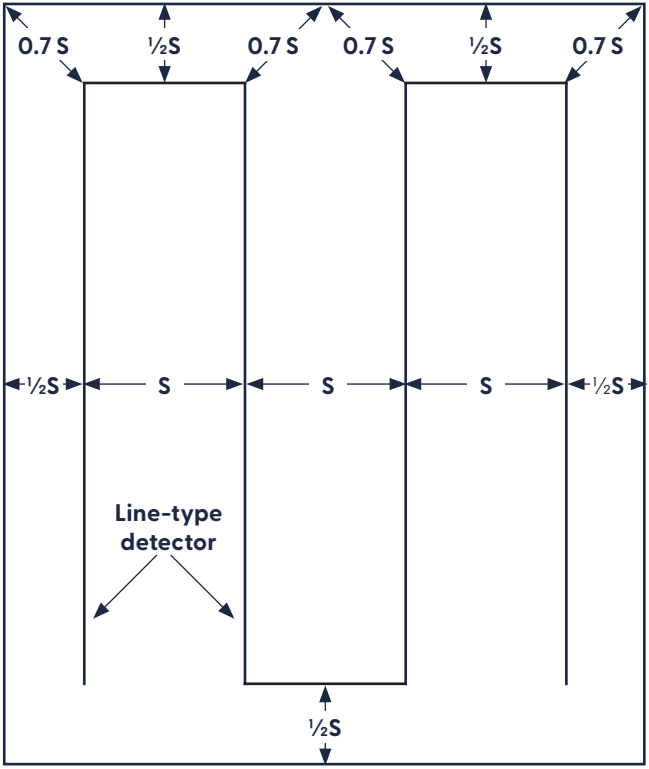
NFPA 72 guidance (2022 edition)

Standard recommendations (NFPA 72 Section 17.6.3)
NFPA 72 Section 17.6.3 gives a code of practice for the design of automatic initiating devices. Some of the key recommendations for Linear Heat Detectors (or line-type detectors, as the standard describes) are summarized here. This is provided for general guidance only; refer to the standard for detailed information.

Location and spacing: smooth ceilings
Detectors should be located no more than 20 inches from the ceiling. Detectors must be installed so that the distance between any two detectors does not exceed their listed spacing. Additionally, detectors must be located within one-half of the listed spacing from all walls or partitions that extend to within the top 15% of the ceiling height, measured at right angles. Every point on the ceiling must have a detector within a distance that is no greater than 0.7 times the listed spacing.

Irregular areas
In areas with irregular shapes, detectors may be spaced farther apart than the listed spacing, as long as no point within the detector's coverage zone is more than 0.7 times the listed spacing from the detector, measured to the farthest wall or corner.

Line-type Detectors – spacing, layouts, smooth ceiling



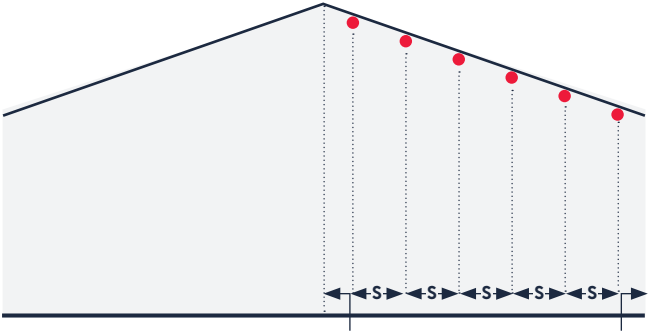
S = space between Detectors

NFPA 72 guidance (2022 edition)

High Ceilings
(NFPA 72 Section 17.6.3.5.2)
NFPA 72 Section 17.6.3.5.2 removes the requirement to adhere to the derating requirement by Table 17.6.3.5.1 for line-type electrical conductivity detectors and advises that the manufacturer's published instructions shall be follower for appropriate alarm point and spacing.

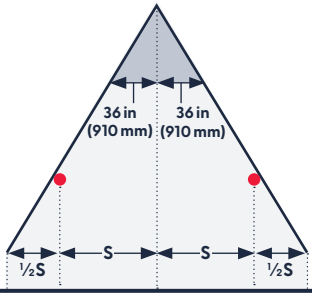
Sloped Ceilings
(NFPA 72 Section 17.6.3.4.2.1)
NFPA 72 Section 17.6.3.4.2.1 A row of detectors shall first be located at or within 36 in (910 mm) of the peak of the ceiling.

- Detectors must be installed so that the distance between any two detectors does not exceed their listed spacing.
- For ceiling heights up to 30 ft, the product's listed spacing value should be used.
- For ceiling heights over 30 ft, FFE's general recommendation is to use half the product's listed spacing value.



S = Space between Detectors
● = Smoke Detector or Heat Detector

36 in (910 mm) maximum



S = Space between Detectors
● = Smoke Detector or Heat Detector

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FM guidance

FM Global Data Sheet 5-48 (Automatic Fire Detection) provides high-level guidance on the use of linear heat detection but refers users to application-specific data sheets for detailed requirements. Key points include:

- **Section 2.2.1.6** recommends the use of linear heat detection on conveyor belts, cable trays, and rack storage areas, or as otherwise specified in occupancy-specific guidelines.

- **Section 2.2.1.14.6** addresses detector placement in pre-action systems, stating that spacing under smooth ceilings must not exceed the FM Approved spacing for the specific detector. For non-smooth ceilings, the maximum allowable spacing is the lesser of either:
  – Half the FM Approved spacing of the linear heat detector, **or**
  – The full allowable sprinkler spacing.

For example, if the FM Approved spacing is 30 ft x 30 ft and the sprinkler spacing allows for 130 ft^2, the maximum permitted LHD spacing under irregular ceilings would be 15 ft x 15 ft.

It is important to note that FM Global's listed spacing criteria often differ from UL standards, even for the same detector models. FM's requirements prioritize property protection—making them particularly relevant for applications such as aircraft hangars, industrial facilities, and other high-asset environments. In practice, LHD project deployment is often evenly divided between property protection (FM) and life safety (NFPA) use cases.

What tools do you need for installation?

The instructions for installing, aligning and testing Linear Heat Detectors vary depending on the model and manufacturer and so you should follow the guidance provided with your system. However, the following tools and equipment are useful to have available when installing any type of detection system:

Tools for mounting detectors to building structure: drill, cross-head and flat-head screwdrivers, etc.

Multimeter and test leads: to check incoming power supply when fault-finding.

Scissor lift or other high-level access equipment: for use when mounting detection cable. Testing detectors after installation is done from ground level through end-of-line tests, saving time and avoiding the need to work at height.

LHD applications:
Industrial manufacturing

How should LHD systems be maintained?

Follow the steps below periodically to maintain the performance of the detectors (the frequency will depend on the cleanliness of the operating environment):

1. Inspect the entire length of the detector periodically for physical damage, corrosion, or signs of wear, especially at mounting points.

2. Perform regular functional tests by simulating heat conditions, following the manufacturer's instructions. This ensures the detector's response remains accurate.

3. Clean the detector cable and its surroundings to remove dust, grease, or debris that might interfere with heat sensing.

4. Examine electrical connections at junctions, splices, or terminations to ensure they remain secure and corrosion-free.

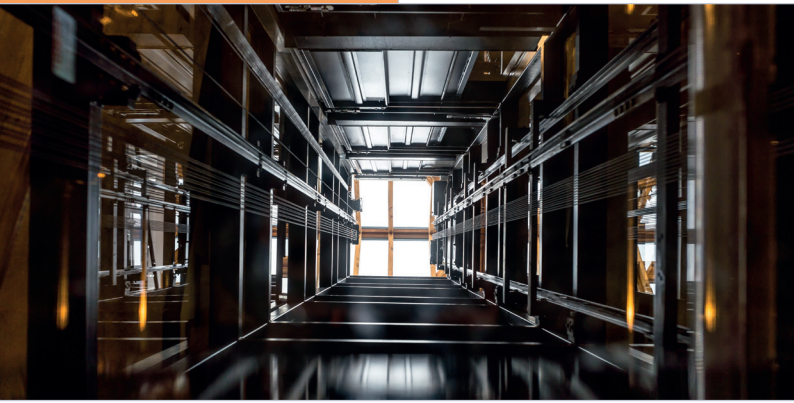
5. If applicable, recalibrate the system or replace components as recommended by the manufacturer. Over time, sensitivity can degrade, affecting the system's reliability.

6 Keep a detailed log of inspections, tests, and maintenance activities, including any repairs or replacements made.

7 Reassess the installation if the environment changes, such as the addition of new machinery or alterations in airflow that could affect the system's performance.

Where can you install them?

Did you know?
Linear Heat Cables are not only able to protect spaces horizontally. They are also used to protect vertical installations such as lift shafts, instead of a more complicated installation of Point Detectors.



Applications

Long unobstructed distances
- Warehouses
- Aircraft hangers
- Agricultural facilities
- Lift shafts

Industrial buildings
- Manufacturing facilities
- Marine
- Mining operations
- Aircraft hangers
- Electrical rooms

Restricted access
- Mass transit terminals
- Manufacturing sites

Explosive atmospheres
- Linear Heat is classed as a 'simple apparatus' under ATEX and IECEx classification.

- Controller and End-of-Line units located remotely in safe area for system monitoring with appropriate use of barriers.

When are other Detectors more suitable?

Application	Reason	Preferred Detector
Highly cluttered areas of restricted space (e.g. roof voids)	Need long unobstructed pathway for beam	**Point Smoke Detectors**
Risk of beam blockage (e.g. warehouse racking)	May cause faults/false alarms	**Point/ Aspirating Smoke Detectors**
Lack of structural surfaces for mounting (only cladding/ plasterboard/ wood available)	Beam quickly becomes misaligned and cannot be corrected by automatic re-alignment routines	**Point/ Aspirating Smoke Detectors**
Very dusty environments	Detector optics become coated beyond compensation limits	**Flame/Heat Detectors**
Outdoors or in areas with high air flows	Smoke will not predictably accumulate around detectors	**Flame Detectors**

Notes

Further information

FFE provides training to support continuous professional development for those interested in Linear Heat Detection network design, configuration and maintenance to ensure peak sensitivity and accurate fire detection.

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