LINEAR HEAT DETECTOR

Installation Instructions

2020 REV. 1

Catalogue

I. Linear heat detection cable selection and module wiring instructions

1. Digital Type LHD NMS1001 Series

1.1 Operation principle of Digital LHD

The NTC heat sensitive material out of the two metal conductors will break down at specific fixed temperature allowing the conductors contact, the shot circuit will initiate the alarm. NMS1001 is Digital Type LHD, the alarm temperature is fixed, as mentioned above, the same as "Detector Temperature Rating". When the temperature rises up to the rating, no matter a point or a part of the protected device, the detector will initiate the alarm. And this type is unrecoverable type, the detector should be replaced after the alarm.

1.2 How to choose the Digital Type LHD

Multiple detector temperature ratings listed below are available for different environments:

Regular	68°C
Intermediate	88°C
	105°C
High	138°C
Extra High	180°C

How to choose the suitable alarm temperature level, similar to choose the spot type detectors. Taking the factors below into consideration:

a. What is the maximum environmental temperature, where the detector is used?

Normally, the maximum environmental temperature should be less than the parameters listed below.

Alarm temperature	68°C	88°C	105°C	138°C	180°C
Environmental temperature (Max.)	45°C	60°C	75°C	93°C	121°C

We can not only take the environmental temperature into consideration, but also the protected device itself temperature. Otherwise, the detector will initiate a false alarm.

b. Choosing the correct type of LHD according to the application environments

E.g. When we use LHD to protect the power cable, the max. environmental temperature is 40°C, but the temperature of the power cable is not lower than 40°C, if we choose LHD of 68°C alarm temperature rating, the false alarm will perhaps happen.

As mentioned before, there are multiple types of LHD, Conventional Type, Outdoor Type, High performance of Chemical Impedance Type and Explosion Proof Type. Each type has its own features and applications. Please choose the right type according to the actual situation.

2. The Structure and Wiring of Interfaces and EOL Box

2.1. NMS1001-I and NMS1001-P

NMS1001 is Digital Type LHD with comparatively simple output signal.

Technical Parameters

NMS1001-I Control Unit 	●Interface for NMS1001, NMS1001-CR/OD and NMS1001-EP digital Linear heat detection cable ●With local fire and fault indication ●Fire and fault relay output available ●Low-power design ●Metal case
	Technical Specifications ●Operating Voltage: DC 24V Operating Voltage Range: DC 16V-DC 28V ●Operating Current: Standby Current: ≤20mA Fire Current: ≤30mA Fault Current: ≤25mA ●Operating environment: Temperature: -55°C-+60°C Relative humidity:95% ●IP Rating: Ip66 ●Dimensions:90mm × 85mm × 52mm(L×W×H)
NMS1001-P Terminal Unit (EOL Box) 	●End of Line Unit for NMS1001, NMS1001-CR/OD and NMS1001-EP Digital Type Linear heat detection cable ●The functions are balancing the signal status ●For Digital Type Linear heat detection cable monitoring and alarm/fault simulating
	Technical Specifications ●Operating Voltage: No Electronics ●Operating environment: Temperature: -55°C-+60°C Relative humidity:95% ●IP Rating: IP66 ●Dimensions:90mm×85mm×52mm(L×W×H)

Cable connecting instruction

2) Connecting Drawing of NMS1001-P (Diagram 2)

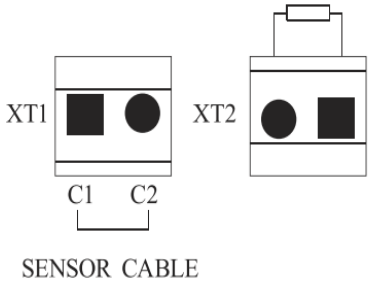


Diagram 2

- C1 C2: with sensor cable, non-polarized connection
- XT: connected with 4.7kΩ terminal resistance

Cable connecting instruction

1) Connecting Drawing of NMS1001-I (Diagram 1)

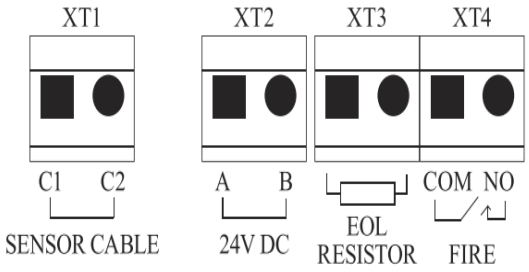


Diagram 1

- C1 C2: with sensor cable, non-polarized connection
- A,B: with DC24V power, non-polarized connection
- EOL RESISTOR: EOL RESISTOR (conforming to input module)
- COM NO: fire alarm output (resistance value in fire alarm<50Ω)

2.2. NMS1001-L Control Unit and Locator

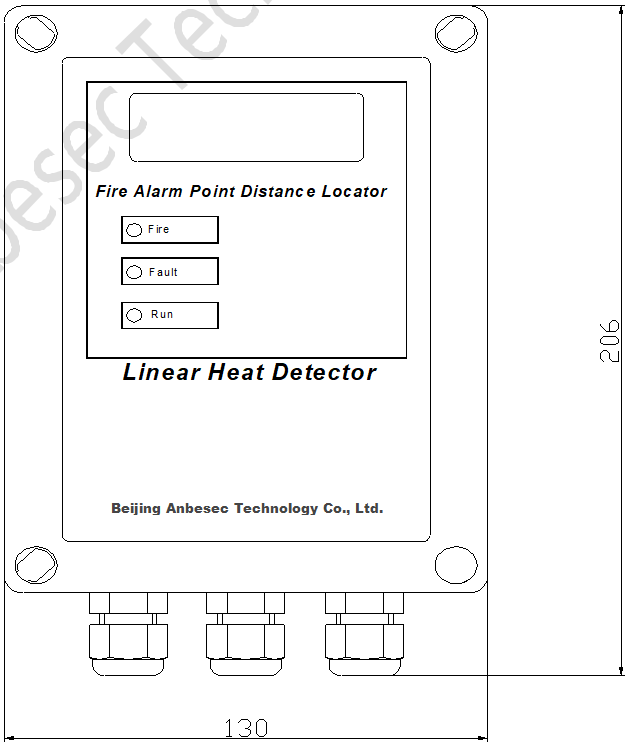


Diagram 1 Outline Schematic Diagram of Linear Detector Interface

2.2.1. Wiring Introduction

(1) Schematic Diagram for Wiring Terminal of Linear Detector Interface is as shown in Diagram 2:

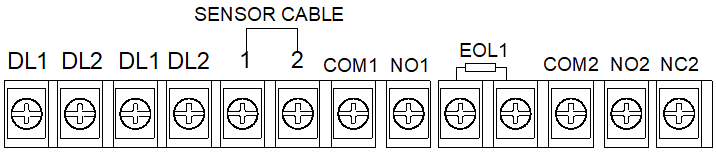


Diagram 2 Schematic Diagram for Wiring Terminal of Linear Detector Interface

Among which:

DL1 and DL2: connect to DC 24V power without polar connection.

1.2: connect to Linear heat detection cable. Wiring method is as follows:

Terminal label	Linear heat detection cable wiring
1	Non-polarity
2	Non-polarity

Diagram 3 Wiring Introduction for Linear Heat Detection Cable of Linear Detector Interface

COM1 NO1: pre-alarm/fault/normal compound output of terminal contacting point

EOL1: access point 1 of terminal impedance (matched with input module and corresponds with COM1 NO1)

COM2 NO2 NC2: fault output

2.2.2 Application and Operation of NMS1001-L Control Unit and Locator

Switch on for Control Unit after finishing system wiring and installation. Green indicator of Control Unit flashes. Control Unit enters supply initialization status. When the green indicator constantly lights, Control Unit enters normal monitoring status.

(1) Normal monitoring screen

The indicator display of linear detector interface under normal operation is as following screen:

NMS1001-L Anbesec Technology

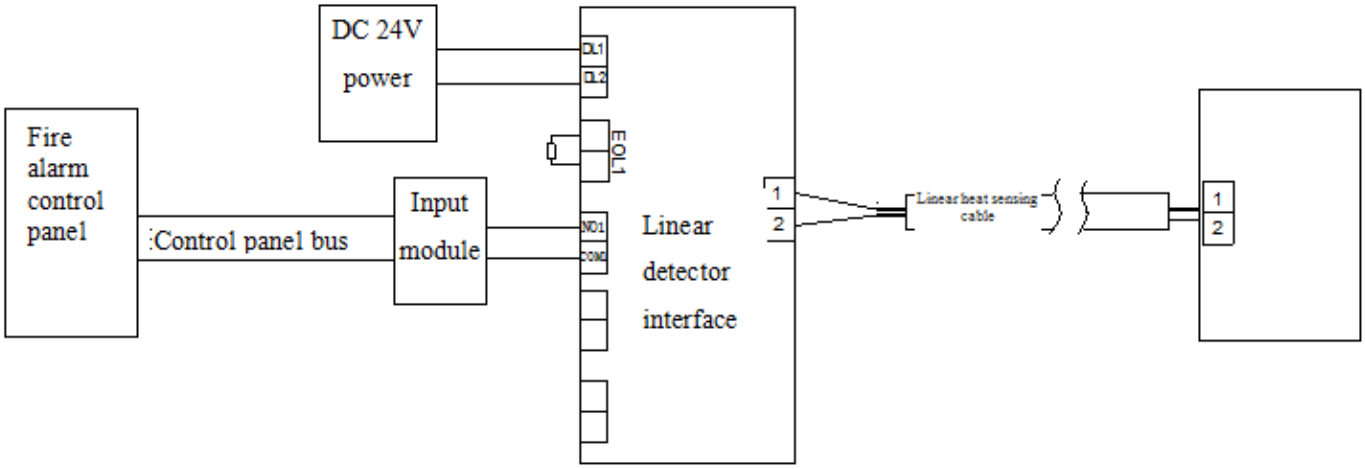
Fire alarm interface

The indicator display of Control Unit under fire alarm is as following screen:

Fire Alarm! Location:0540m

The indication "Location: XXXXm" under fire alarm status is the distance from fire location to Control Unit

2.2.3 Matching and connecting for NMS1001-L system:



Precautions:

a.) Detector interface and matched fire alarm control panel are suggested to be grounded reliably.

b.) While installing, forbid rigidly bend and twist Linear heat detection cable. The bending radius of Linear heat detection cable shall exceed 150mm and the Linear heat detection cable shall be protected from damage,

c.) During delivery, it is necessary to well pack the cable and avoid overstock impact.

d.) Perform impedance value test annually over double open ends of fixed temperature linear heat detector, the normal impedance between the cores of which shall not be lower than 100MΩ

e.) Or replace it. Measuring equipment shall adopt 500V tramegger.

f.) Forbid privately maintain detector. Should any fault occur to detector, please contact our company timely.

The consumers can choose other electrical equipment to connect with NMS1001, making good preparation as followed:

1. Analyzing the protection capability of the equipment (input terminal). For during the operating, the LHD may couple the signal of the protected device (power cable) causing voltage surge or current impact to the input terminal of the connecting equipment.

2. Analyzing the anti-EMI capability of the equipment (input terminal). Because long-length use of LHD during the operation, there may be power frequency or radio frequency from LHD itself interfering the signal.

3. Analyzing what is the maximum length of LHD the equipment can connect. This analysis should depend on the technical parameters of NMS1001, which will be introduced in detail later in this manual.

If any other queries relating, please contact us for more information. Our engineers will provide technical support.

3. Analog Type LHD NMS2001 Series

3.1. Analog Type Linear heat detection cable

Description

Analog Linear Heat Detector --NMS2001 is a kind of four-core high-performance analog linear heat detector, with high adaptability and high performance-price ratio, which could be widely applied in places of industry, commerce and superheat dangerous area.

Structure and principle of the Linear heat detection cable:

NMS2001 Linear heat detection cable is a kind of flexible cable, containing four strands red and white stranded conductors. Its outer jacket is made of high temperature impedance PVC and can reinforce the durability and reliability of the cable. If necessary, chemical impedance material and flame impedance outdoor material could be selected for the jacket, to satisfy the requirements on different environmental occasions. The schematic diagram of the structure of NMS2001 Linear heat detection cable is shown as follows:

NMS2001 Linear heat detection cable has high impedance and the insulating layers of its four core conductors are made of a kind of special NTC (negative temperature coefficient) material and its electrical control unit could reflect the fluctuation of system temperature by monitoring the fluctuation of material impedance.

While wiring, the two red wires and two white wires are respectively connected to NMS2001 linear detector Control Unit and are strand-connected at the terminal, which comes a detecting loop .

The system detects the impedance fluctuation of Linear heat detection cable resulted from the fluctuation of circuit temperature---i.e. when temperature rises, impedance drops. This fluctuation is monitored through linear detector Control Unit of Linear heat detection cable. When it reaches preset

alarm threshold value, output alarming signal. This feature allows the system to have the ability to detect fire in point or in line of whole circuit, which is that the system could detect the temperature fluctuation in certain point as well as certain area. After alarming, it could automatically restore to working condition.

Because the signal of Linear heat detection cable is analog signal, the application length shall not be overlong. Normally we regulate that the length for one tape is 200m. About the application issues, see detailed introduction in following part of the article.

3.2. NMS2001-I Control Unit

The Linear heat detector Control Unit is the controlling equipment used for monitoring temperature fluctuation of Linear heat detection cable and being connected to mainframe of intelligent fire alarm control panel.

NMS2001-I performs continuous monitoring over fire alarm, open circuit/short circuit in monitored area. These alarming signals are shown on the LCD and indicators of NMS2001-I.

Since fire alarm has locking function, NMS2001-I must be disconnected to power and reset after alarming. While the fault function could automatically reset, it means that after clearing fault, fault signal of NMS2001-I is automatically cleared.

NMS2001-I requires DC 24V power supply. While installation, please refer to the power capacity and wire selection.

Features

- Plastic shell: chemical impedance, aging impedance and impact impedance;
- IP rating: IP66
- Linear detector interface has liquid crystal display which could show various alarming information on LCD for the convenience of user's operation.
- Fire alarm simulation and fault simulation could be performed through linear detector interface. Systematical commissioning is easy and convenient.
- The detector has high ability of interruption impedance adopting fine grounding measurement, isolation test and software interruption impedance technique. It is able to apply in places with high electromagnetic field interruption.

Technical parameters

- Working voltage: DC24V Allowed range: DC 20V-DC 28V
- Standby current≤60mA
- Alarm current ≤80mA
- Alarming reset: disconnection reset
- Status indication: Stable power supply: green indicator flashes (frequency at about 1Hz)
  - Normal operation: green indicator constantly lights.
  - Fixed temperature fire alarm: red indicator constantly lights
  - Fault: yellow indicator constantly lights
- Operating Environment: Temperature: -10°C-+50°C
  - Relative humidity ≤95%, no condensation
- Outer shell protection class: IP66

Face Plate

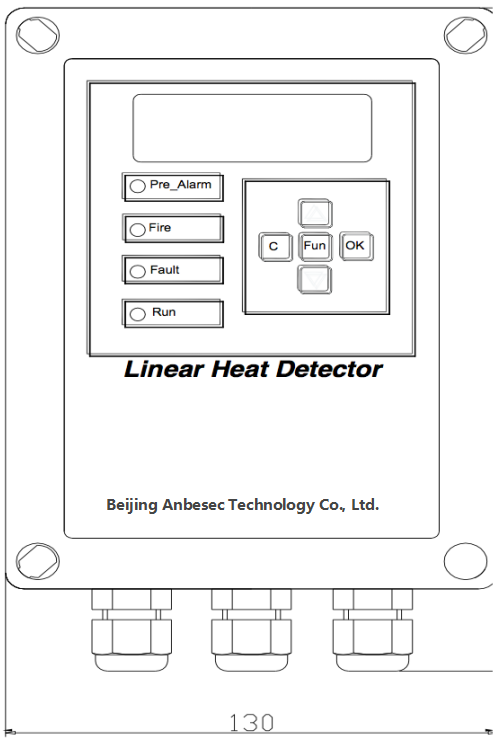


Diagram 1 Outline Schematic Diagram of Linear Detector Interface

Wiring introduction

Schematic Diagram for Wiring Terminal of Linear Detector Interface is as shown in Diagram 2:

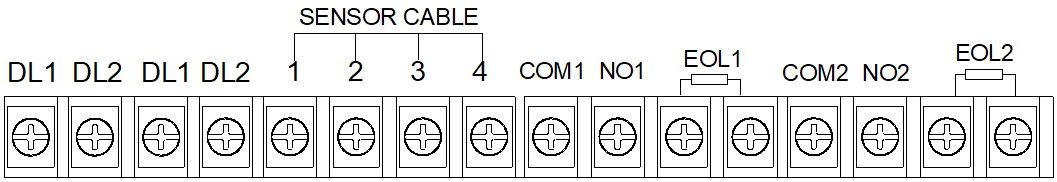


Diagram 2 Schematic Diagram for Wiring Terminal of Linear Detector Interface

Among which:

DL1 and DL2: connect to DC 24V power without polar connection.

1, 2, 3, and 4: connected to linear heat sensing cable. Wiring method is as follows:

Terminal label	Linear heat sensing cable wiring
1	Red
2	Red
3	White
4	White

Diagram 3 Wiring Introduction for Linear Heat Sensing Cable of Linear Detector Interface

COM1 NO1: pre-alarm/fault/normal compound output of terminal contacting point

EOL1: access point 1 of terminal impedance (matched with input module and corresponds with COM1 NO1)

COM2 NO2: fire alarm/ fault/normal relay contact multiple output

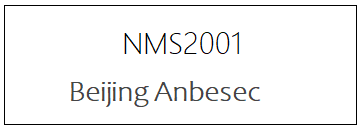
EOL2: access point of terminal impedance (matched with input module and corresponds to COM2 NO2)

(2) Wiring method for Linear heat detection cable end

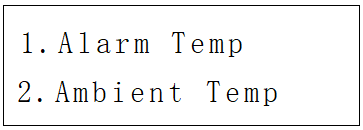
Two red wires at the end of Linear heat detection cable are connected. Two white wires are processed for water-proof seal after connected.

Application and operation of NMS2001 Linear detector interface

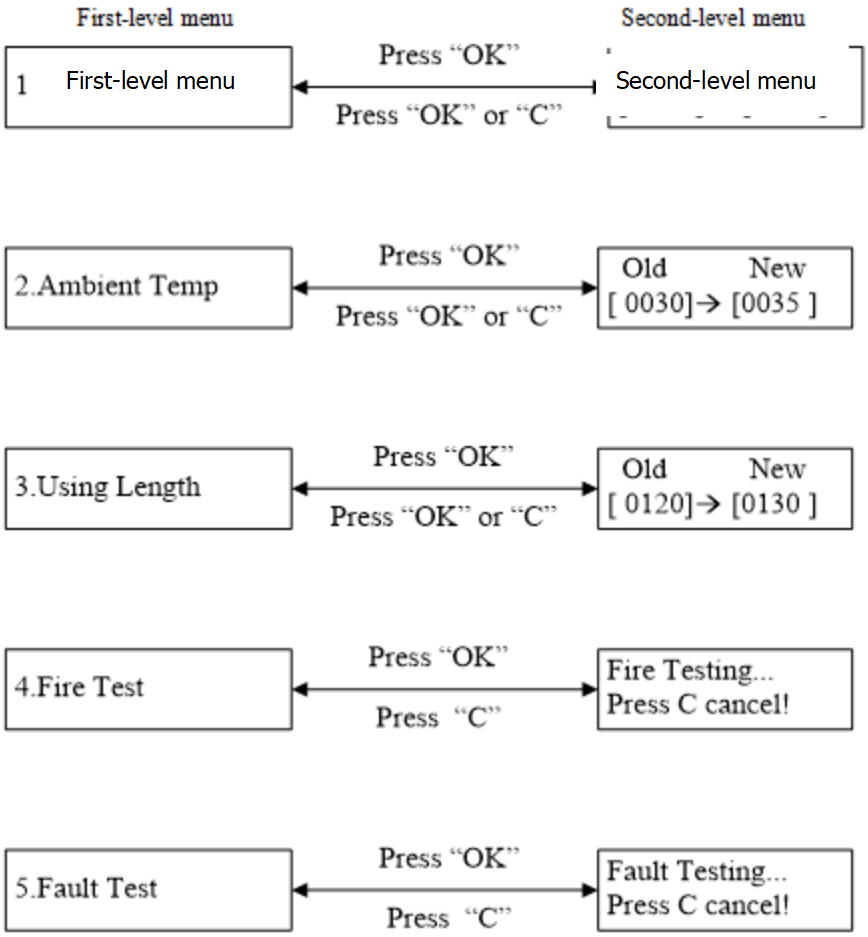
Open power for linear detector interface after finishing system wiring and installation. Green indicator of linear detector interface flashes. Linear detector interface enters supply initialization status. When the green indicator constantly lights, linear detector interface enters normal monitoring status. The linear detector interface could be processed and set through liquid crystal and buttons.
(2) Entrance screen for operating and setting
The indicator display of linear detector interface under normal operation is as following screen:



Press "Fun" and linear detector interface shows as following:



Select between menus through "△" and "▽". "OK" is used for entering selected menu. "C" is used for exiting current menu and returning to previous menu.
General structure for menus of NMS2001 linear detector interface is as follows:



In second-level menus of "1. Alarm Temp", "2. Ambient Temp" and "3. Using Length", the current numeric phrase could be changed through pressing "△" and "▽"; press "C" to jump to last numeric phrase and press "OK" to jump to next numeric phrase; when pressing "OK" at the end of numeric phrase, the current setting is finished and it returns to last menu. When pressing "C" at the first numeric phrase of number, the current setting is cancelled and it returns to previous menu.

Alarming temperature setting

(1) Alarming temperature value could be set between 70℃-140℃, default pre-alarm temperature = alarming temperature -10℃

(2) Environment temperature setting

Set max environment temperature for operation environment of detector. By setting this parameter, the environmental applicability of detector could be adjusted.

(3) Applied length setting

Set application length of detector

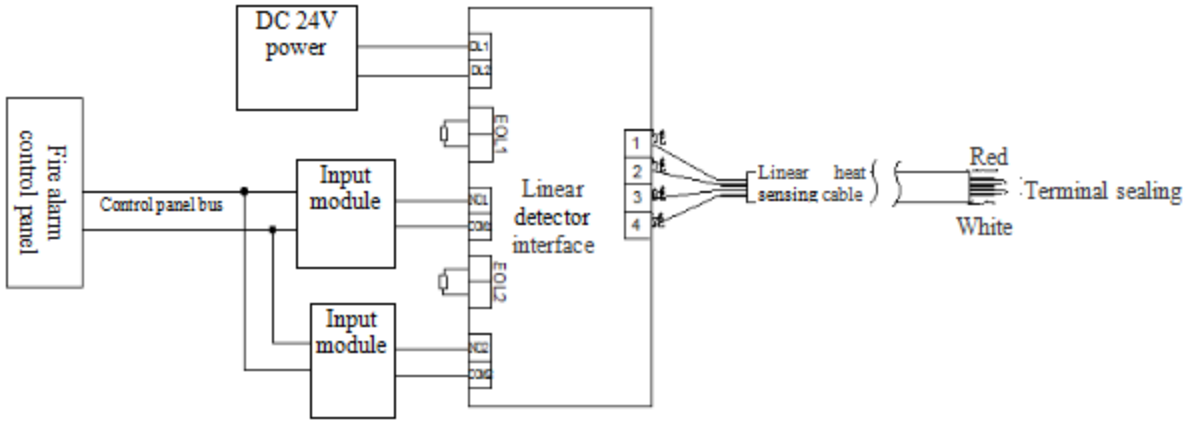
(4) Fire alarm test, fault test

Through the fire alarm test and fault test in menu, the connectivity of system could be conveniently tested.

(5) AD check

The menu is used for equipment commissioning.

NMS2001 system matching and connecting:



Performance parameters of detecting temperatures and spaces

Model / Items	NMS2001 NMS2001-OD NMS2001-CR
Levels	Ordinary
Alarming Temperature	70°C-140°C
Storage Temperature	≤50°C
Working Temperature (Min)	Sensor cable: ordinary type -40°C（custom type lowest: -63°C ） Interface: -10°C
Working Temperature(Max)	Subtract 30°C from alarming temperature
Responding time（s）	（Max）≤15s
Max. Listed Spacing	FM 7.7m UL/cUL 15.2m
Max. height of installation	9m

Parameters of electrical & physical related performance

Model / Items	NMS2001 NMS2001-CR/OD
Material of core conductor	Copper
Diameter of core conductor	0.52mm
Insulation strength between cores and outer jacket	**1000MΩ hms / 2KV**
Electrical performance	Max. 1A 110VDC

Precautions:

- Detector interface and matched fire alarm control panel are suggested to be grounded reliably.
- While installing, forbid rigidly bend and twist linear heat sensing cable. The bending radius of linear heat sensing cable shall exceed 150mm and the linear heat detection cable shall be protected from damage,
- During delivery, it is necessary to well pack the cable and avoid overstock impact.
- Perform impedance value test annually over double open ends of fixed temperature
- linear heat detector, the normal impedance between the cores of which shall not be lower than 100MΩ
- Or replace it. Measuring equipment shall adopt 500V tramegger.
- Forbid privately maintain detector. Should any fault occur to detector, please contact our company timely.

II. Design and Applications of LHDs in typical places

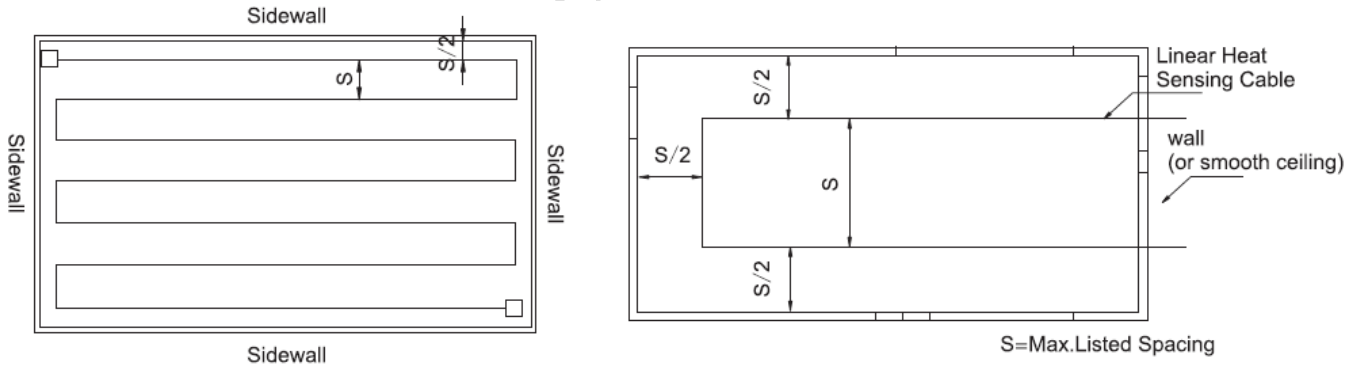
1. Installation Instruction of Linear Heat Detection Cable

The linear heat detector is a type of fire detector with advanced functions, which meet all kinds of fire protection requirements in any inflammable sites. Though the detector has strong protective outer jacket to prevent damage, more attention should be paid during the installation due to the partial and internal damage that cannot be found immediately. The damaged cable may cause the alarm of system malfunction or alarm during the future use. As a result, the followings should be paid attention to:

- Forbid heavy objects overwhelming the Linear heat detection cable;
- Forbid bending or turning the Linear heat detection cable with an acute angle;
- Prevent corrosion;
- Forbid using nonstandard accessories on the Linear heat detection cable.

It comes to different fire detecting results due to different methods of installation, so we need take all the following factors into consideration, including the height, the structure, the obstruction, the air flow and so on, to prevent improper installation adversely affecting the normal use of the detector.

The installation spacing of LHD



Characteristic features of LHD makes itself become the best choice of fire alarm system in high risk of flammable areas, major types of industrial and commercial places, especially in some harsh environments where spot-type detectors cannot be installed.

The LHD of Anbesec has been widely applied in industrial warehouses, workshops, etc. The detector can be installed at the ceiling level or the side wall depending on the features of the protected device, getting the same detecting result as the spot-type detectors'.

2.How to determine the installation spacing?

There are different instructions from UL and FM standards, according to their own test requirements, the detector should match the figures below:

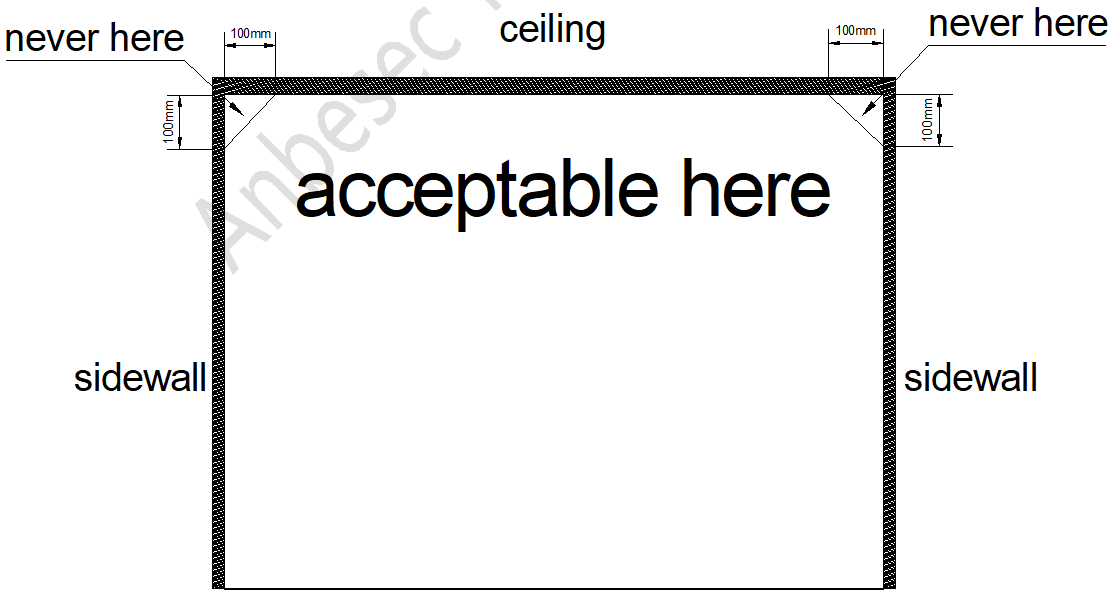
Model	Approvals/Max. Listed Spacing	
	FM	UL/cUL
NMS1001 68°C NMS1001-CR/OD 68°C NMS1001-EP 68°C	9.1m	15.2m
NMS1001 88°C NMS1001-CR/OD 88°C NMS1001-EP 88°C	9.1m	15.2m
NMS1001 105°C NMS1001-CR/OD 105°C NMS1001-EP 105°C	7.6m	15.2m
NMS1001 138°C NMS1001-CR/OD 138°C NMS1001-EP 138°C	7.6m	15.2m

NMS1001 180°C NMS1001-CR/OD 180°C NMS1001-EP 180°C	N/A Special applications	N/A Special applications

But the figures above are for reference only, it is rather difficult to determine the practical installation spacing of the LHD, because we can not predicate the information of the fire source, such as area, intensity, location and heat. Furthermore, the LHD detects the fire temperature normally through the air radiation, it is more difficult to gain an accurate spacing data of LHD installation. We should design and lay the LHD with practice, properly reduce the spacing among the LHD to guarantee the accurate fire alarm more efficiently. 5m spacing among LHDs is the optimized detection distance from our experience. If the space among LHD is too large, LHD can not easily detect the area in the middle so to cause unsafety.

1. Warehouse and workshop

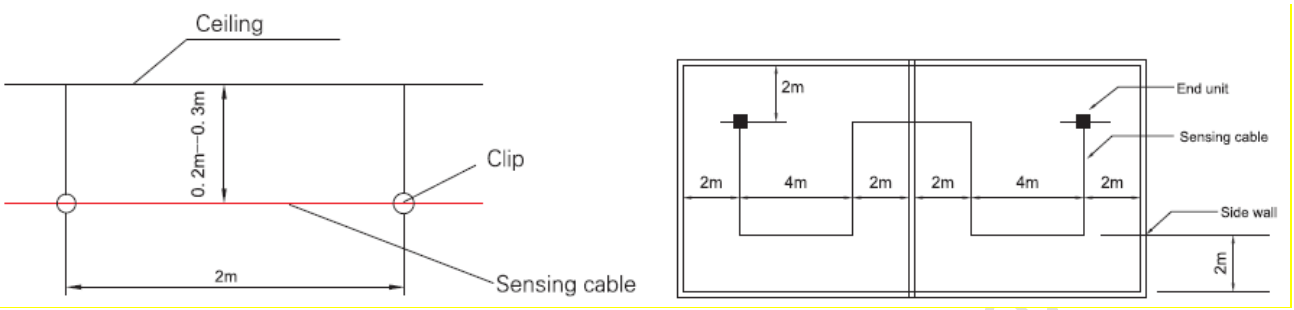
Our LHDs can be applied in industrial warehouses, workshops, etc. The detector can be installed at the building ceiling or side wall, that depends on the protected objects attributes. Furthermore, it can not be installed at the place where there is no air flow as shown below:



There are different mounting methods of LHDs for warehouse or workshop flat ceiling and sloped ceiling, we will discuss it in this section.

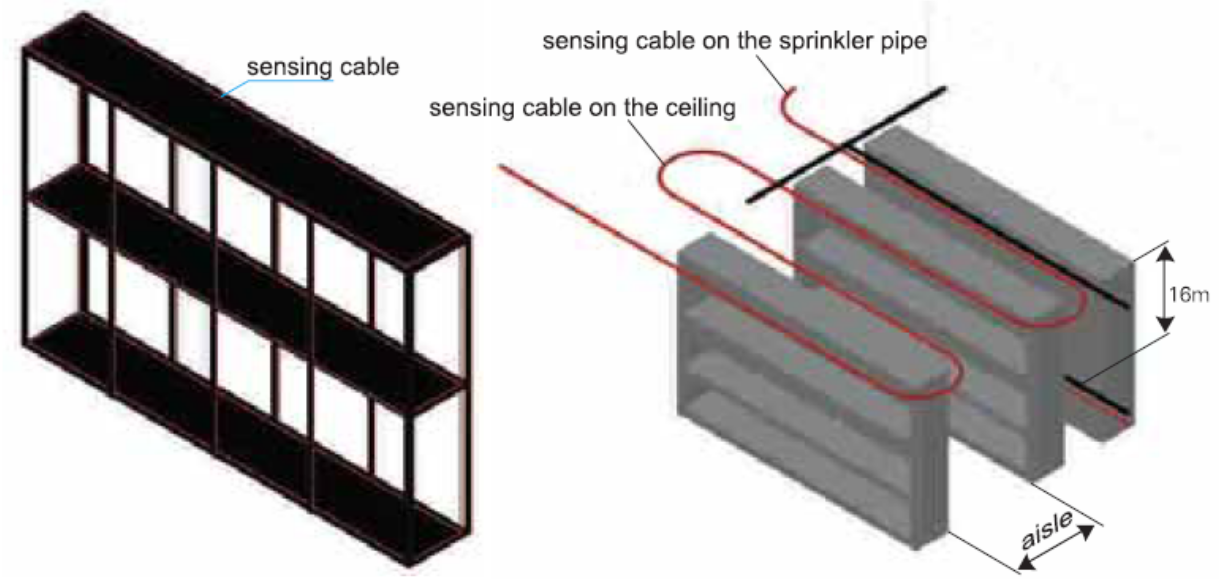
(1)Mounting at the flat ceiling

In this kind of application, LHDs should be fixed under the ceiling, 0.2-0.3 meters distance away from ceiling, and hung-up by steel wire, fastened to the steel wire with clips in every 2 meters.

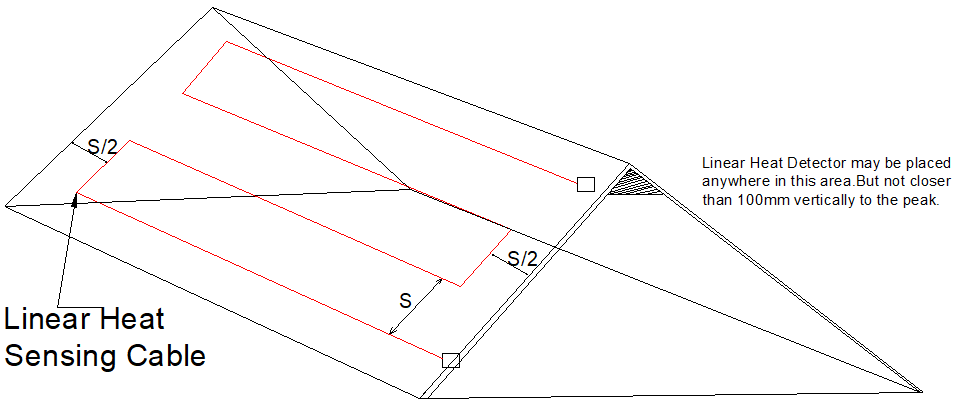


It is better to lay the cables in parallel with ceiling, the distance between cables required need to refer to the earlier statement. The distance between the sensing cable and the ground cannot exceed 9m; 3m is normally used. The distance should be reduced if the distance between the cable and the ground is more than 3m. The cable installation is suggested to close to a hazardeous area under installation permission, so that the cable could have the fast response to the fire.

In the warehouse applications, the sensing cables should be installed under ceiling, or along with the middle of warehouse shelves aisle , or laid with the sprinkler system; meanwhile the sensing cable should be mounted vertically in the ventilation areas. For protections of dangerous goods in warehouse shelves the sensing cables should be installed on each rack, but attention to no interference of rack's normal working condition, so that when shelves goods feed in / out the cable is avoided to damage. For better detection of fire at shelves' lower racks, in case that the shelve is higher than 4.5m, it is necessary to lay an extra layer of sensing cable vertically; or fit the cables along the sprinkler system together if the sprinkler system is available.



(2)Mounting at the sloped ceilings



S=MAX. LISTED SPACING

Please refer to the sensing cable installation on the flat ceiling about the cable laying space

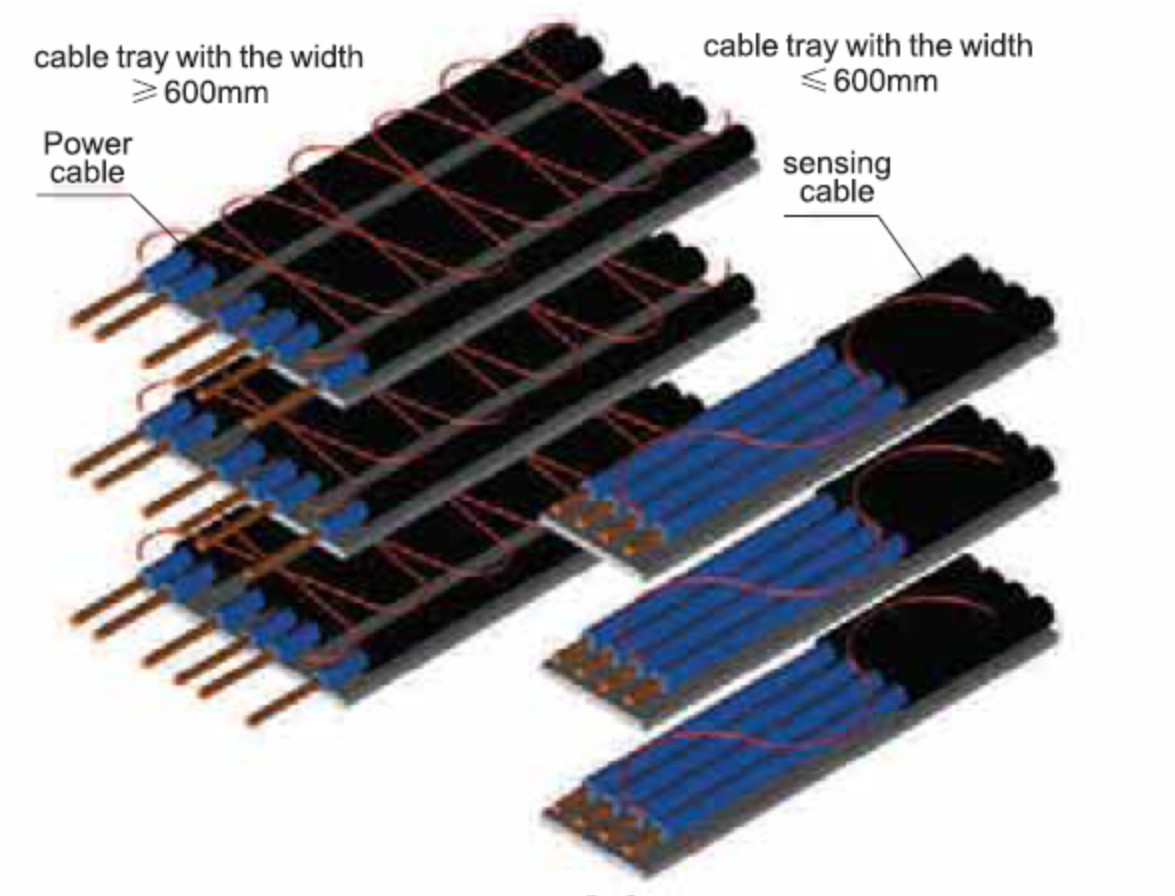
2. Installation on the cable fire protection areas, like cable trays, cable tunnels, cable trenches, cable interlayers, et

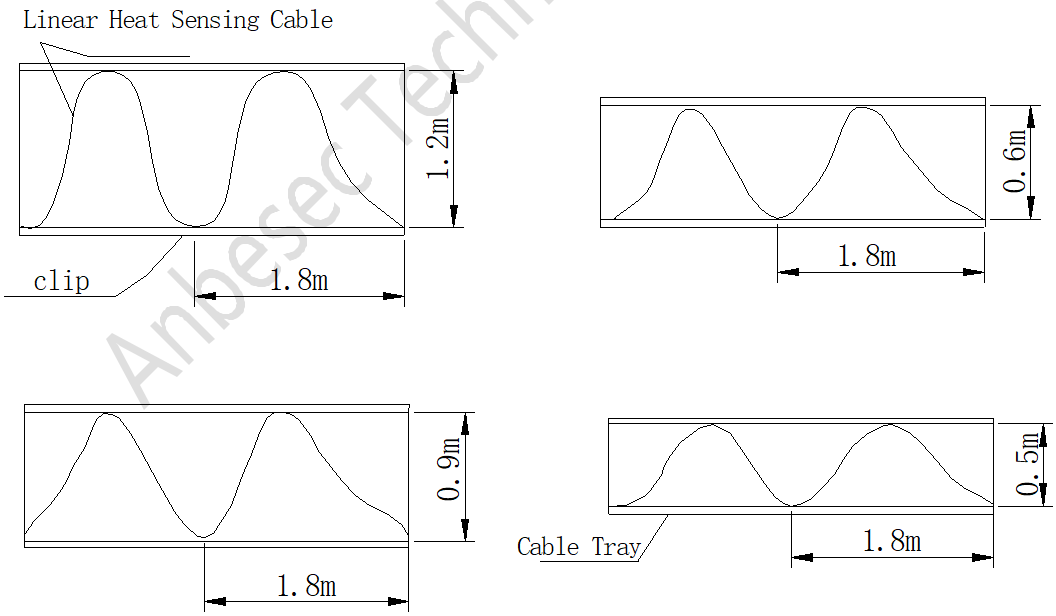
   In power plants and steel & metallurgy plants, cables are applied everywhere for electricity power, distribution, control, and communication, etc, especially at the places, like cable tray, cable tunnel, cable trench, cable interlayer, etc., where the cables are laid in high density. There is great risk on fire at those places, but with the features of fast spread-over and difficulty in fire putting out, , so effective and reliable fire detector must be applied in such places.

It is difficult to install spot-type detectors in these areas, whereas, Linear Heat Detector Systems are better fire alarm options with higher reliability, more suitable to those places. choice, which is reliable and suitable.

The linear heat sensing cables should be installed in sine wave contact, (no need of power cable replacement) or in horizontal sine wave suspension (if the power cables need to replace or maintain regularly).

When the sensing cables are installed in a sine wave pattern in the cable tray or cable trough, it should be mounted on the top of the outer layer of the power cable or control cable with the appropriative fasten accessories (Clips) to prevent detectors' mechanical damage due to pressure. See the installation below:





When the sensing cables are installed in a sine wave contact, the sensing cable length is calculated by the following formula:

Length of sensing cable = Length of the cable tray × magnification factor

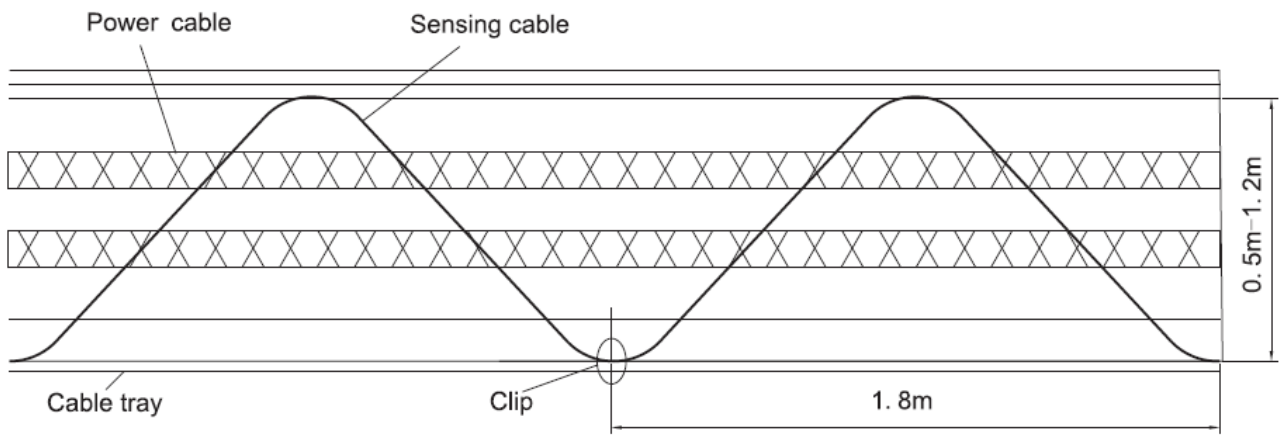
The magnification factors are shown in table 1:

Width of cable tray	Magnification factors
1.2	1.75
0.9	1.50
0.6	1.25
0.5	1.15
0.4	1.10

Table 1

Table 1

The sine wave contract installation pattern has a benefit with high sensitivity of detection. However, it is inconvenience during the maintenance of power cables. Hanging the sensing cable over the power cable can be considered for more convenience, but it comes a lower sensitivity. The way of hanging the sensing cable is shown as follows:



150mm～250mm。

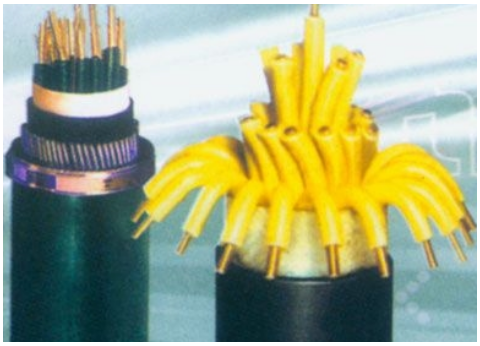
For a sine wave pattern hanging layout, the vertical height spacing between the sensing cable and the protected power cable cannot exceed 300mm, normally 150mm to 250mm is recommended.

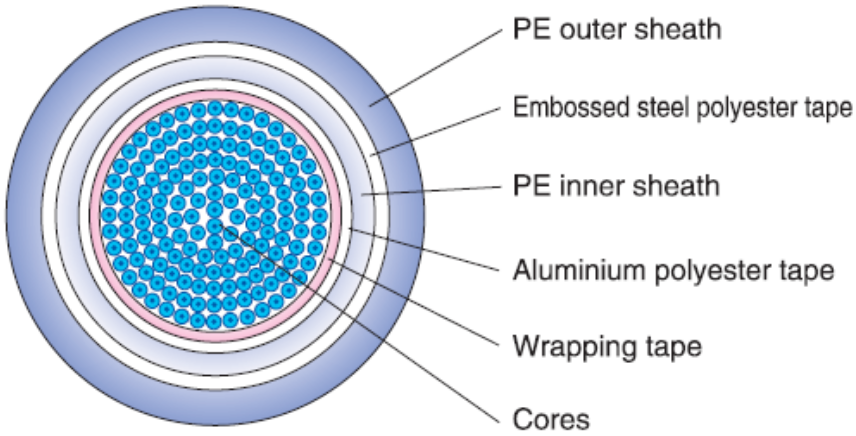
If the sine wave hanging method is used, the sensing cable should be fitted along the centre of the cable tray in order to get a better reliability. If the cable tray is wider than 600mm, 2 loops of sensing cables should be used.

The calculation formula of the length of linear heat sensing cable is same as contact method.

In addition, the sensing cable should be laid layer by layer, the reasons are as follows:

LHDs are applied to protect power cables and control cables in the trays, whose self-heating causes the fire in most situations.





Structure of power cable or control cable

When the current passes through the wire core of both power cables and control cables during the normal operation, the temperature of the cable surface rises. Even LHD detects the raise, it won't initiate a fire alarm, because the temperature is lower than the fixed temperature rating.

Contrarily, during the fault operation, the current rises rapidly by times and times, making the temperature of the cable surface rise sharply, LHD will detect this and initiate a fire alarm, preventing fire from occurring, on the premise of correct mounting methods of LHD.
During the operation (normal or fault), the power cables are not good thermal conductor. The heat of the wire core is transmitted by heat conduction to the cable surface, and the heat distributes along entire cable evenly. So it meets the requirements and standards of LHDs that laying the sensing cable layer by layer in the cable trays, meanwhile it can protect the power cable furthest.

Advantages of this method:

A. Protecting anywhere along the entire cable. Because the sensing cable is laid along the entire power cable to detect the temperature without any omissions.

B. Detecting the temperature variation which causing by the ambient factors.

C. Good sensitivity of detecting to prevent fire from occurring and make more time to extinguish the fire. Because the sensing cable is installed in a sine wave pattern, it can detect the temperature variation rapidly.

D. During the installation, pay more attention to the key parts (such as wire connector) to gain accurate detection of temperature.

For better application, pay attention to these below during the installation:

A. Forbid heavy objects overwhelming the heat sensing cable,

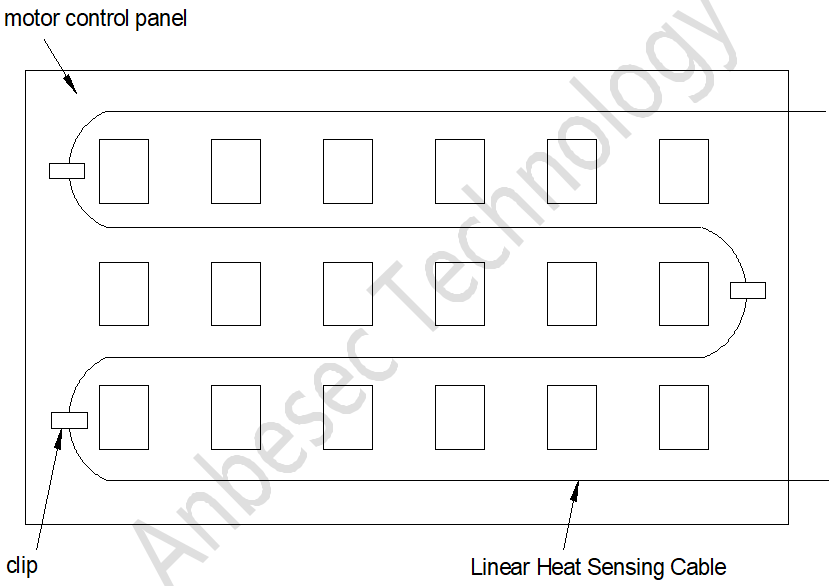
B. Forbid bending or turning the heat sensing cable with an acute angle,

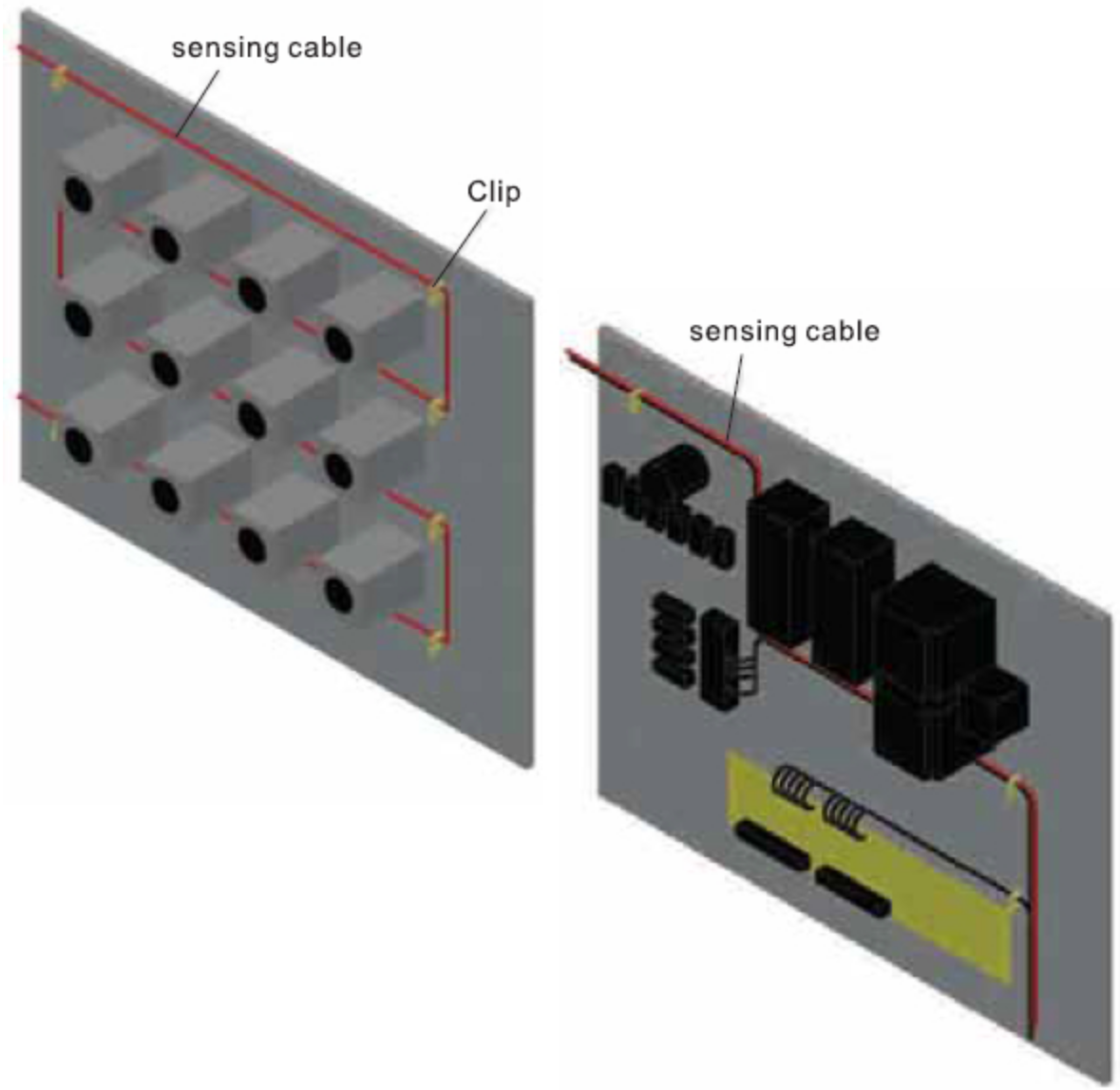
C. Prevent corrosion

D. Forbid using nonstandard accessories on the linear heat cable.

3.Power Distribution Apparatus

Taking the laced layout through a motor control panel as an example, the sensing cable is secured with the appropriative fasten accessory to protect the panel. Other equipment, such as transformers, switchgear, substations, resistor banks, etc, should be protected in the same manner if the temperatures do not exceed the limit of LHD.





For large power distribution equipment, the sensing cable should be laid close to the external surface of equipment. Contact methods is not recommended.

4.Installation on conveyor

The conveyors are applied to convey coal, hard coke, ore etc.

In the mid-17century, aerial ropeways are applied to transfer convey coal, hard coke, ore etc. Then in the mid-19century, conveyors with modern structure appeared.

Year	Invention	Country
1868	Belt conveyor	Britain
1887	Worm conveyor	USA
1905	Steel belt conveyor	Switzerland
1906	Inertial conveyor	Britain and Germany

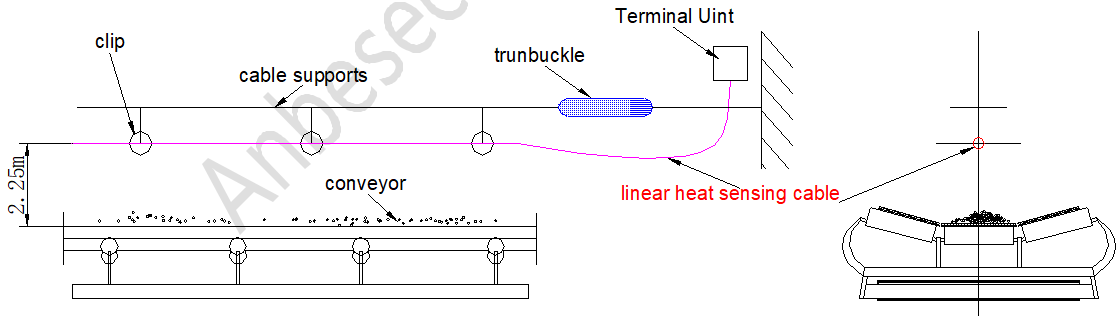
From then on, conveyors have been constantly improved by the effect of the technical progress of engineering industry, electricity industry, chemical industry and metallurgy industry. The conveyors have been used to transfer materials within the workshop and the factory, even among the cities, becoming indispensable in material handing system (mechanization or automation).

We are talking about the installation of LHD on the belt conveyor in this section. The belt conveyor transfers materials on the rolling belt which is powered by the motors. The belt roller can rotate freely in normal operating, contrarily in fault operating. In fault operating, the high friction heat will result from the belt and the belt roller, meanwhile the heat will cause burns of the material(most of time coals, with coal dust which is explosion hazard) on the belt. Based on this reason, the right type of LHDs must be applied on the conveyors.

Two alternatives of installations on conveyors

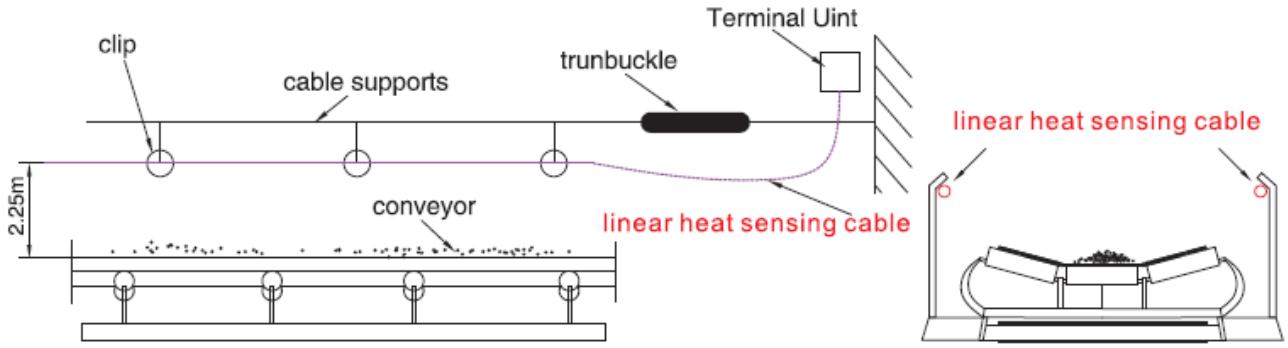
Solution 1:

A single sensing cable can be installed directly over the conveyor if the width of conveyor is less than 400mm. The sensing cable should be fastened within 2.25m heights above the conveyor. The mounting accessory can be a wire or other supporting devices. If the messenger wire is used, the wire(stainless steel wire is recommended, or galvanized steel wire instead) should be fastened with a turnbuckle at maximum distance of 75m, moreover the maximum length is 150m. Approved intermediate fastening devices(clips) are used at intervals of 4m to 5m to ensure detector tautness. Installation manners shown below:



Solution 2:

If the width of the band exceeds 400mm, Belt side installation is recommended. The sensing cable can be contacted with the heat collector and the roller bearings to detect the over heat caused by friction of bearings and coal dust. In general, the principles design and installation are based on noninterference of normal operation and maintenance. If necessary, combining over head installation and belt side installation for a high fire risk area. Installation manners shown below:



5.Application in highway tunnel and railway tunnel

It is a comparatively closed space in highway tunnel and railway tunnel with a fire hazard. The fire in tunnel has features that temperature increasing rapidly, long lasting, large areas, difficulty of entering and fire fighting, due to the limitation of escape conditions, all these increase the danger of lives.

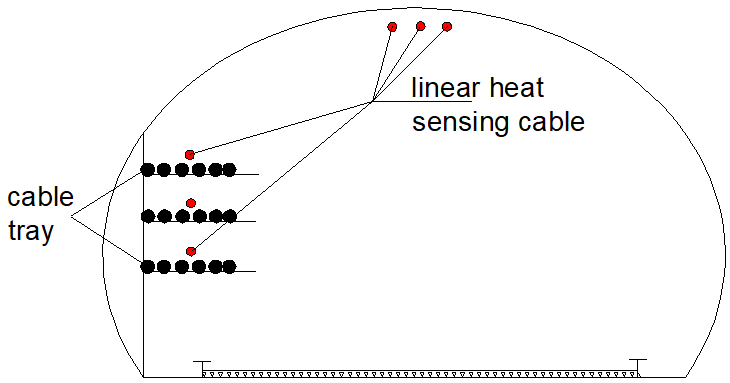
Furthermore, highway tunnels and railway tunnels are usually located in rural areas with long length measured in kilometer, the LHDs are better choice than the spot-type detectors to be installed there, which have features below: detecting anywhere along its entire length, no ambient temperature effect on the detector rating, no time effect, working in harsh environment (humid or dusty).

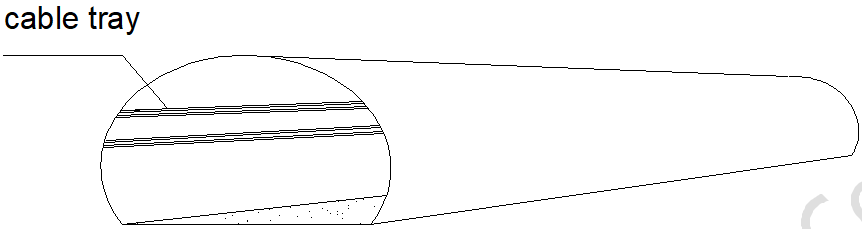
The sensing cable is typically installed on the ceiling directly over the roadway, furthermore, the cables can be laid in the cable tray and equipment rooms inside the tunnel. Either one cable or a number of cables, can be laid straightly or in parallel.

6.Application in rail transit

Rail transit nowadays is the most convenient, economic and efficient vehicle method in large and medium-sized cities worldwide.

There will various malfunctions of all equipment during the operating, specially the malfunctions of electromechanical devices, short-circuit faults and cable fires, which are the main cause of occurring the fire. For early detecting of the fire source and identifying the ignition point, LHDs must be installed properly inside the fire zonings (compartmentation method of fire zoning, please refer to related specifications).





Both overhead and side installations along the rail transit are recommended in this case. Sensing cable should be installed to protect the power cable in railway transportation. The sensing cables should be installed in a sine wave pattern, contact the power cables (if no needs to replace of power cable) or hanging along the power cable (if the power cables need to be replaced or maintained regularly). The same manner with the one in cable tray. Meanwhile, the sensing cable is fastened to the covering wire with clips at intervals of 1m to 1.5m.

7. Applications on oil tank and gas tank

It is generally known that combustion is a biogenic process with light and heat. The most striking feature of early fire from crude oil, product oil and fuel gas is mounting the ambient temperature rapidly, thus we take the testing of temperature as the detecting factor on oil tank and gas tank. Due to the install limitation of spot-type heat detector on oil tank and gas tank, spot-type detector cannot detect temperature anywhere continuously along the entire tank. Conclude that LHDs are the best choice to detect fire on oil tank and gas tank.

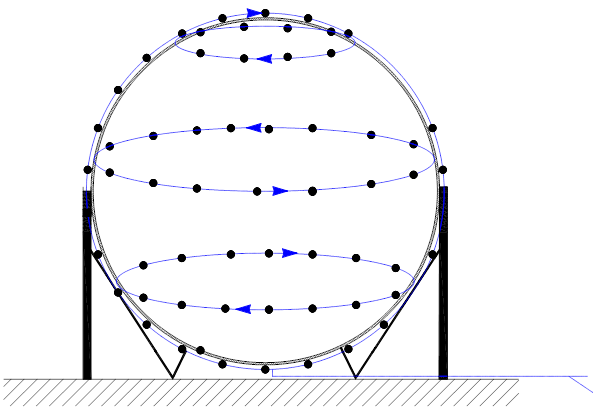
There are fixed-roof tank and floating-roof tank of oil tank and gas tank in petrochemical industry. Linear heat detectors can be installed with hanging or contact methods.

In General, both oil tank and gas tank are large-scale tanks with complex architecture. This manual will introduce the protection of Floating Roof Tanks using Linear Heat Detectors. Most fires, even explosion, happen around the sealed ring on the top, caused by the leak of oil-gas. The floating roof is the main detection area. The sensing cable should be installed around the perimeter of a floating roof

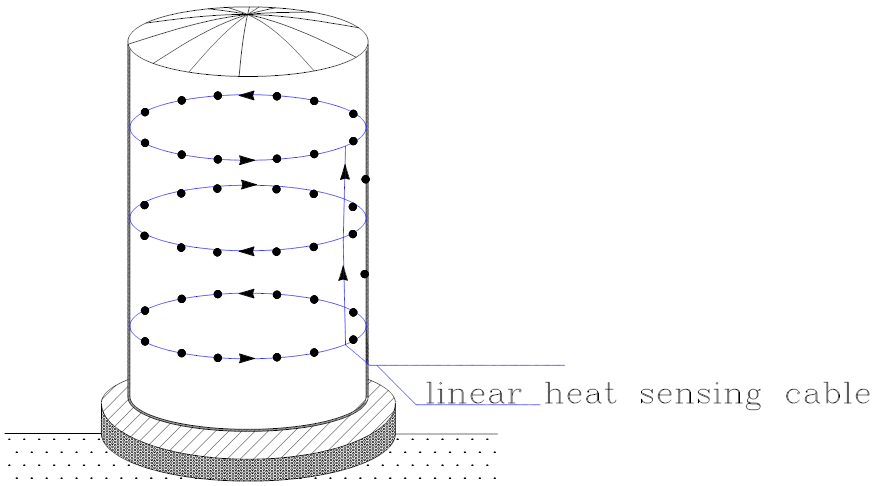
oil storage tank or run in the area between the primary tube seal and the secondary weather seal; or alternately attached to the foam or placed directly over the secondary weather seal using the clips supplied.

Due to special character of oil tank and gas tank, the connection points of sensing cable, control units and terminal units must be mounted with reliable safety barriers； both control units and terminal units must be laid within the explosion-proof zone or with other explosion-proof treatments according to the national standards and relative code of practice.

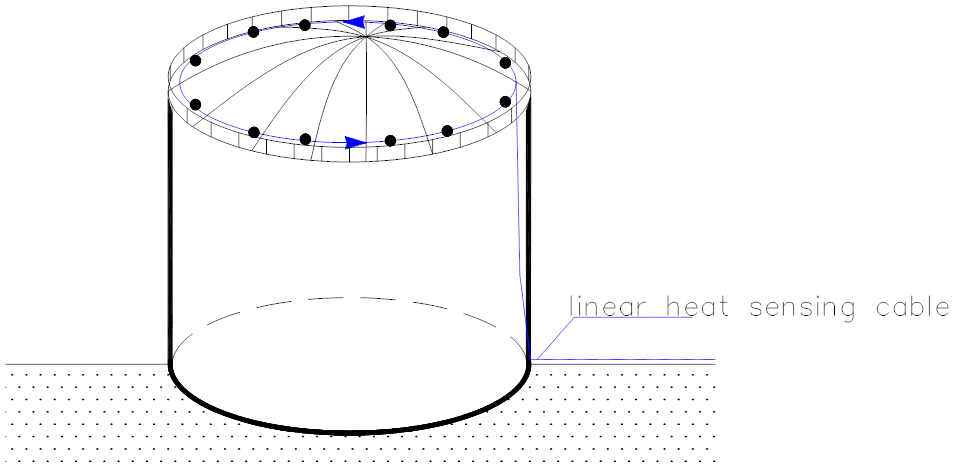
Example: The monatomic storage tank has volume of 6000m3, each of the five tanks is 20m high and 60m in diameter. All these storage tanks contain liquid of Type A and Type B with high fire risk. In the case of fire, there comes big amount of radiant heat and leak of oil. All the fuel oil contains moisture. With the temperature raise up, it may cause seething or spillover. At the mean time, water vapor comes out; cause the pressure in the tank rising, the strength of structure will be reduced by the high temperature .That is why the tank can easily get distortion, even collapse which can cause higher fire risk.



Installation on the spherical storage tank



Installation on the vertical storage tank



Installation on floating roof tanks

That is the reason for the Type A, B and C liquid tanks need to install fire suppression systems and cooling systems.

In case of accident, due to the high risk of fire, not only comes the lost of the oil and the damage of the storage devices, but also influences the working operation. If the fire spreads, it will threaten the safety of surrounding areas, lives and properties.

According to the national fire standards and regulations, taking the consideration of actual instance of the oil storage tanks, the layout design should be offered technically and economically, while it is a reference to the system design and construction scheme. In this case, every tank will be separated into 4 layers and 8 control/suppression zones. That means every semicircle in the single layer will be an

independent fire suppression zone, fitted with completed fire detection/suppression and cooling unit with the help of MS1000 linear heat detectors.
In this figure, if Tank 5 is in the case of fire, the water cooling system will start to work on Tank6, while the same on the other areas.

8.Applications in other places

For other applications, such as dust collectors, baghouse, cold storage, cooling tower, municipal facilities and high rack warehouses, please refer to ceiling installation or contact type installation in the cable tray. To prevent obstructing normal operation, the detector should be mounted close to the heating parts of the protected objects using the clips. If necessary, part of the cables can be protected by conduit. Sensing cable can be mounted on the outside wall, bottom and top of the dust collector by the clips. It can be fitted around the center pipe through bottom via conduits; mounted from pipe to the top by clips or hanging wire. If necessary, motors and bearings can be protected by linear heat detector, in order to get an early warning for fire detection system. However, the installation should not obstruct the operation of motors and bearings.

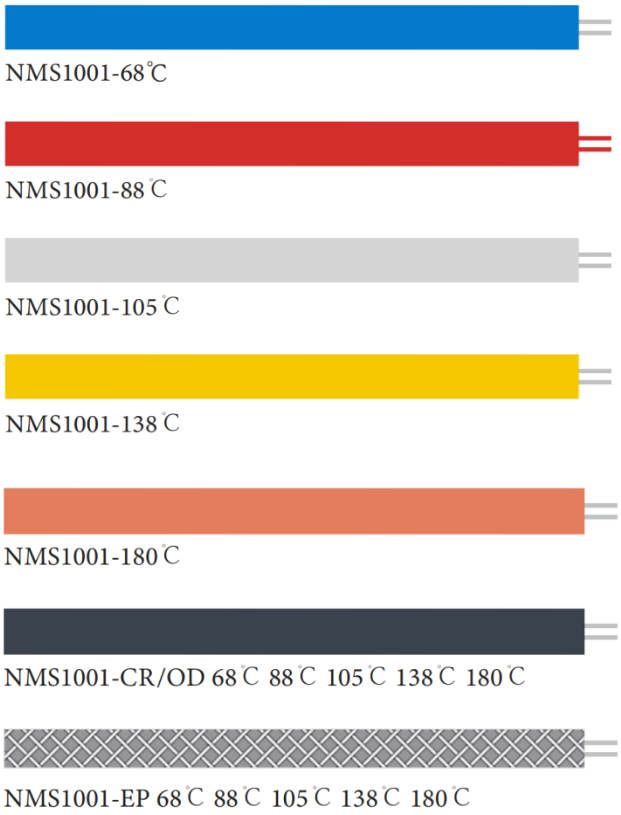
Appendix I Performance parameters of detecting temperatures

Model / Items	NMS1001 68℃ NMS1001-CR/OD 68℃ NMS1001-EP 68℃	NMS1001 88℃ NMS1001-CR/OD 88℃ NMS1001-EP 88℃	NMS1001 105℃ NMS1001-CR/OD 105℃ NMS1001-EP 105℃	NMS1001 138℃ NMS1001-CR/OD 138℃ NMS1001-EP 138℃	NMS1001 180℃ NMS1001-CR/OD 180℃ NMS1001-EP 180℃
Levels	Ordinary	Intermediate	Intermediate	High	Extra High
Alarming Temperature	68°C	88°C	105°C	138°C	180°C
Storage Temperature	UP TO 45°C	UP TO 45°C	UP TO 70°C	UP TO 70°C	UP TO 105°C
Working Temperature (Min)	-40°C	-40°C	-40°C	-40°C	-40°C
Working Temperature (Max)	UP TO 45°C	UP TO 60°C	UP TO 75°C	UP TO 93°C	UP TO 121°C
Acceptable Deviations	±3°C	±5°C	±5°C	±5°C	±8°C
Responding time（s）	10（Max）	10（Max）	15（Max）	20（Max）	20（Max）

Appendix II Parameters of electrical &physical related performance

Items \ Model	NMS1001 68℃ NMS1001-CR/OD 68℃ NMS1001-EP 68℃	NMS1001 88℃ NMS1001-CR/OD 88℃ NMS1001-EP 88℃	NMS1001 105℃ NMS1001-CR/OD 105℃ NMS1001-EP 105℃	NMS1001 138℃ NMS1001-CR/OD 138℃ NMS1001-EP 138℃	NMS1001 180℃ NMS1001-CR/OD 180℃ NMS1001-EP 180℃
Material of core conductor	Steel	Steel	Steel	Steel	Steel
Diameter of core conductor	0.92mm	0.92mm	0.92mm	0.92mm	0.92mm
Impedance of core conductor （Two-cores,25℃）	0.64±0.06Ω/m	0.64±0.06Ω/m	0.64±0.06Ω/m	0.64±0.06Ω/m	0.64±0.06Ω/m
Distributed capacitance（25℃）	**65pF/m**	**65pF/m**	**85pF/m**	**85pF/m**	**85pF/m**
Distributed inductance (25℃)	**7.6μh/m**	**7.6μh/m**	**7.6μh/m**	**7.6μh/m**	**7.6μh/m**
Insulation impedance of cores	1000MΩ/500V	1000MΩ/500V	1000MΩ/500V	1000MΩ/500V	1000MΩ/500V
Insulation strength between cores and outer jacket	**1000Mohms/2KV**	**1000Mohms/2KV**	**1000Mohms/2KV**	**1000Mohms/2KV**	**1000Mohms/2KV**
Electrical performance	1A,110VDC Max	1A,110VDC Max	1A,110VDC Max	1A,110VDC Max	1A,110VDC Max

Appendix III Structures and colors of sensing cable



CR—High Performance of Chemical Impedance

OD—Outdoor type (outdoor using, weather proof)

EP—Explosion Proof type (Used in Hazardous Areas)

Appendix IV NMS1001-CR/OD --Parameters of chemical impedance,

no influence to the outer jacket of NMS1001-CR/OD

	Chemical	Formula	Concentration	Max. Temp(°C)
Acids				
1	Acetic	C2H4O2	100%	140
2	acrylic	C3H4O2	100%	100
3	Chromic	H_2CrO_4	30%	100
4	Butyl Acrylate	C7H11O2	100%	50
5	Chloroacetic	**$CH_2CICOOH$**	50%	100
6	Hydrochloric	**HCL**	37%	150
7	Hydrofluoric	**HF**	50%	150
8	Methanesulfonic	CH4O3S	50%	66
9	Propionic	C3H6O2	100%	50
10	Butyric	C4H8O2	100%	50
11	Nitric	HNO3	65%	66
12	Sulphuric	H2SO4	98%	23
13	Phosphoric	H3PO4	85%	150
Bases				
1	Ammonia solution	NH3·H2O	30%	140
2	Hydrogen peroxide	H2O2	60%	30
3	lithium hydroxide	LiOH	100%	100
4	Potassium hydroxide	KOH	50%	121
5	Sodium hydroxide	NaOH	50%	132
6	Sodium Carbonate	Na_2CO_3	53.2%	140
7	Potassium carbonate	:**K2CO3**	53.2%	100
8	Sodium Hypochlorite	NaClO	5%	121

Hydrocarbons				
1	Benzeen	C6H6	100%	66
2	methylbenzene	C7H8	100%	20
3	Dimethylbenzene	C8H10	100%	50
4	n-hexane	C6H14	100%	150
Alcohols				
1	Methanol	CH3OH	100%	50
2	Ethano	C2H5OH	100%	140
3	Propanol	C3H7OH	100%	50
4	Butanol	C_4H_9OH	100%	121
Ethers				
1	Ether	C4H10O	100%	50
2	PHENYL METHYL ETHER	C7H8O	100%	50
Automotive Fluids				
1	Crude Oil		100%	150
2	Gear Oil		100%	150
3	Gasoline		100%	150
4	Diesel Fuels		100%	150
5	Mineral Oil		100%	150
Others				
1	Acetone	C3H6O	100%	140
2	Phenyl Methyl Ketone	C8H8O	100%	75
3	Cresol	C7H8O	100%	100
4	Dichlorobenzene	C6H4Cl2	100%	50
5	Dichloroethylene	C2H2Cl2	100%	50
6	Methanal solution	CH2O	37%	80
7	ethyl ethanoate	$C_4H_8O_2$	100%	50

8	Tetrahydrofuran	C_4H_8O	100%	50
9	dimethyl formamide	C3H7NO	100%	50
10	dimethyl sulphoxide(DMSO)	C2H6OS	100%	100
11	Aniline	C6H7N	100%	100

Appendix V: Working life of LHD

The sensing cable, a special kind of cable with heat sensibility is the main component of LHD, which can detect the environment temperature anywhere along its entire length. The LHD will initiate a fire alarm when the temperature reaches the detector temperature rating.

LHDs have unique advantages to other type detectors, making LHDs a best choice of fire alarm system in hazard flammable areas and various environments. Further introduction about working life of LHDs, different statements come from all the manufacturers, saying 5years, 8years, or even 20 years, which confuse the consumers of LHDs. There will be amount of waste of manpower resources and material resources, replacing LHDs which are still valid. Correspondingly, there will be safety hazards while using LHDs out of work, causing the loss of lives and property.

Based on our research, we found that the raw material of the sensing cable perishes through several years. Hence, the initial parameters of sensing cable change after years usage, influencing on its alarming performance. We gain the conclusion that the sensing cable should be replaced at time of ten years around, in period which the sensing cable perishes seriously after years of application experience and simulation oven testing of perish.

The information about LHDs' working life mentioned above is for reference only, please take everything into consideration as far as possible.

Linear Heat Detector

Important Installation Information - Please Read!

1.GENERAL

1.1MicroSenseWire Linear Heat Detector may be installed at the ceiling level to protect areas within buildings (area protection) in the same fashion as the more familiar spot heat detectors.The practice design and installation in different environments or industries must base on national laws, regulations and standard codes.

1.2For special applications where the detector is installed close to the hazard, the manufacturer's recommendations and/or installation instructions should be followed.

2.Storage and Shipping

2.1Each length of the Sensor Cable is individually tested for operational integrity prior to shipment from the Factory. Because MicroSense LHD is a heat-activated device, it is possible that if proper precautions are not taken to avoid high ambient temperatures during shipment or storage, the wire could be activated (shorted) before it is installed.

2.2This heat sensing cable is sensitive to heat and must be stored in areas where the temperature will not exceed the maximum ambient temperature rating of the detector. It must not be installed in contact with, or in proximity too, any heat-producing equipment or environment that exceeds its maximum ambient installation temperature.

3.Installation Warnings

3.1The Sensor Cable must never be connected to mains electrical supplies.

3.2The Minimum bending radius of the heat sensing cable should not be less than 15cm.

3.3DO NOT USE WIRE NUTS. All connections must be made via terminals and/or approved splicing devices.

3.4DO NOT PAINT THIS DETECTOR.

3.5 It should be replaced if an damage is found.