

**COMPARISON OF AVAILABLE TECHNOLOGIES FOR FIRE SPOTS
DETECTION VIA LINEAR HEAT DETECTOR**

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Abstract

It is very demanding to detect fire spots under difficult conditions with high occurrence of interfering external factors such as large distances, airflow difficultly, high dustiness, high humidity, etc. Spot fire sensors do not meet the requirements due to the aforementioned conditions as well as large distances. Therefore, the detection of a fire spot via linear heat sensing cables is utilized.

Key words

electric fire alarm signalling, linear heat detector, laser linear heat detector, DTS - Distributed Temperature Sensing systems

INTRODUCTION

The solution for the detection of a fire spot origin stems from the legislation of the Slovak Republic, which is harmonized with the European Union framework, as well as with the technical documentation for the devices of fire alarm signalling (hereinafter referred to only as EPS) for the premises monitored.

When speaking about the linear detector determined for the monitoring of premises, we mean such a detector which monitors and guards the premises as a line with a certain distance from the starting and ending points. Therefore, the principle of detection is represented by monitoring the signal amplitude along its whole monitored length. There must be no areas that are not monitored by this detection.

The paper deals with the system of linear heat detection via various sensing elements. The monitoring is determined for demanding environments regarding the vicinity influence as well as long distances such as conveyor tracks, tunnels, undergrounds, cable tracks, etc.

ANALYSIS OF THE PROBLEM AREA

In general, regarding the evaluation characteristics, the linear heat detectors determined for monitoring the spot of fire origin can be classified into the following five groups:

- 1 digital cables working on the principle of scattering,
- 2 analogue cables working on the principle of measuring the resistance change,
- 3 based on measuring the pressure change,
- 4 electronic sensors integrated in the cable and measuring changes of their temperature,
- 5 linear heat detection with optical fibres.

Digital cables

The principle of this method of fire evaluation is represented by the fact that the detection cable is formed by two conductors covered by specific coating insulation meltable at the temperature defined. The conductors are mutually twisted so that they apply pressure against each other. By exceeding the melting point the insulation material burns and simultaneously as a result of the twist the active mutual pressure of the cables evokes scattering. By these detection methods it is possible to go to the distance of 1500m using one evaluation unit.



Fig. 1 Digital cable working on the shorty principle (1)

The main advantages of the mentioned method are its simple installation and the fact that it belongs to verified methods of fire detection.

Nevertheless, the drawbacks are in the principle of fire detection via maximum temperature while it is not possible to change the temperature switch firmly determined by the melting point of the specific protective insulation of the conductors. At the same time, due to the principle of scattering, the location of more fire spots origin is not possible. After the conductor protection in the place of detection is burnt, it is necessary to replace the section in question by an unbroken detection cable connected via special determined connectors.

Analogue cables

This method is based on the principle of measuring the change of resistance in the sensing cable formed by four mutually insulated conductors with negative temperature coefficient detecting the fire spot. Via the fire origin or temperature increase in a certain spot of cabling, the conductor's resistance is changed. This method is suitable for sensing the line, up to a maximum distance of 300m.

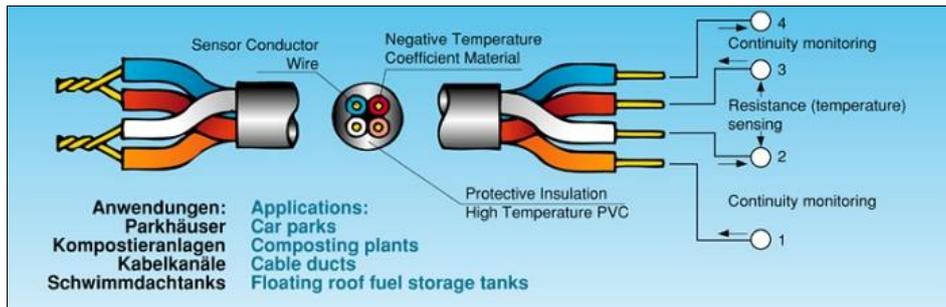


Fig. 2 Analogue cable working on the resistance change principle (1)

The advantage of the given method of fire detection is represented by a simple physical principle with a simple installation of the detection conductor.

On the other hand, the small distance of the detected area with a significant dependence on the cable length is its disadvantage. It is also impossible to detect the fire spot location with precise accuracy.

Principle based on pressure change

This principle is based on the pressure change originating as a result of the cased solid filled by a suitable medium which can be either an air or suitable gas mixture. The closed solid is represented by a metal tube having a sensor for pressure changes measurement on its end. As a result of a temperature increase, the volume of the gas in the cased tube changes and this is detected by the measuring sensor. Regarding the measured value the fire origin or its beginning phase are evaluated.

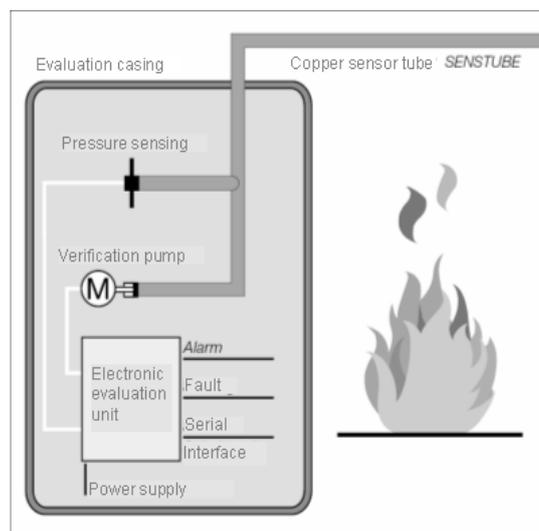


Fig. 3 Principle based on pressure change measurement (1)

The advantages of this method are the simplicity of the sensor and the relatively low purchase price. On the other hand, the disadvantage is the need to use a metal tube susceptible to corrosion which means possible difficulties in ensuring the connection tightness of the electronic sensing part. Regarding installation, this method is also quite costly as the sensing length is up to 100m. At the same time, it is necessary to mention that it is impossible to sense the individual spots of potential fire origin, it can be sensed only as a whole. There is no possibility to have different detection sensitivity within one line (within metal sensing tube) for this type of sensing and monitoring of potential fire spots.

Electronic measurement of temperature via sensors

Technicians and fire specialists try to locate the fire spot as precisely as possible. For the previous methods it is very difficult to achieve this without using a high amount of sensing devices which, on the other hand, only partially solves the requirement. The method of directed electronic sensors placed in the cable as a chute can evaluate the fire spot with the accuracy of 8 metres. This is due to the integrated sensors with 8m spacing while in one cable there can be up to 321 pieces of them and thus the overall line length of the monitored premises is 2496m.

The advantage of this method is represented by its relatively high accuracy of fire spot detection when compared to previous methods. In addition, the system based on electronic sensors has been used for a long time and is very reliable.

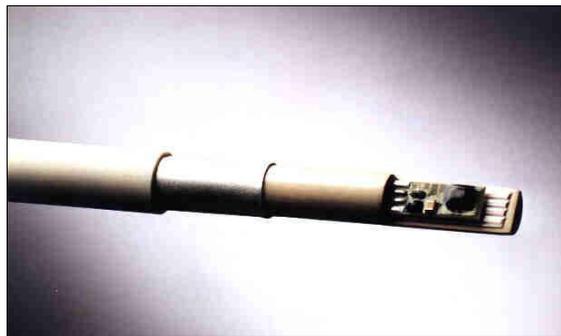


Fig. 4 Connecting of the information table to the EPS Central Office (1)

The drawbacks are the greater requirements for assembly, and connection of the sensor cable which is equipped by many sensors and therefore, is heavier and also tougher causing certain limits for assembly. At the same time, in the case of a cable fault, the complete failure of the monitored track occurs. It is necessary to mention that the sensors are susceptible to overstrain and other disturbances on cabling. The sensors are sensitive to exceeding the temperature of 100 °C; by this limit they are destroyed. In comparison with the previous methods, the sensing accuracy of the fire origin is defined by the spacing of 8m, however, it does not have to be suitable for all applications with necessary precise sensing of risky places/spots.

Linear heat detection via optical fibres

The system of linear detectors “Linear Heat Series” via optical fibres belongs to the current most precise and modern methods of detecting and sensing the fire spot. It utilizes the principle of Raman’s phenomenon of quantum mechanics and patented measurement method of Code Correlation – OTDR. Using this method the temperature profile, which can be 8,000 metres for each 10 seconds, along the whole optical fibre is measured. Thus we can obtain a large amount of data with high accuracy per one meter. Honeywell Life Safety Austria GmbH Company in their system of ESSER fire alarm signalling utilizes DTS units – Distributed Temperature Sensing systems. In this method, the light scattering or reflection in the optical fibre depending on the fibre temperature is measured. Thus the oscillation of the optical fibre atomic structure depending on the height of the temperature is achieved. The laser light is emitted in pulses into the optical fibre and regarding the principle of Raman’s phenomenon of reflection, the temperature measured and the exact spot is calculated according to the time between the direct and reflected light pulse.

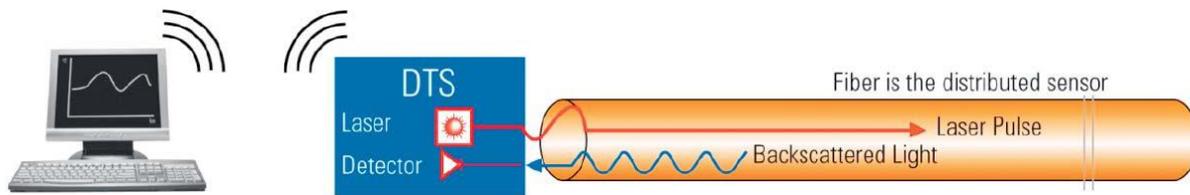


Fig. 5 Principle of sensing the increased temperature via DTS ESSER (2)

Regarding the user needs, the aforementioned method has just one disadvantage represented by the purchase price. However, there are many advantages of the method. The main advantages are: the suitability of use in extreme environments, particularly in terms of pollution, dustiness, corrosion, radioactive radiation, humidity, aggressive exhausts, explosion hazards, etc. The optical cable can be used up to the temperature of 1000°C. The producer guarantees the life of the cable for 30 years without necessary maintenance. Obviously, a suitable cable covering is required depending on the installation environment.



Fig. 6 ESSER DTS evaluation unit with optical detection cable (2)

CONCLUSION

Regarding the aforementioned methods, the following table summarizes the individual parameters.

Table 1 System comparison of described methods (1)

	Digital cable	Analogue cable	Pressure tube	Multipoint system	ESSER DTS
Measuring range (maximum)	1500 m	300 m	100 m	2500 m	2 x 8000 m
Space differentiation	no	no	no	8 m	Adjustable from 1 to 3 m
VdS certificate	-				
Temperature range	limited	limited	limited	limited	unlimited
Number of sensing points (maximum)	1	1	1	312	16000
Number of alarm criteria	1	2	2	2	5
Safe use in exterior	-	-		-	
Immunity against magnetic interferences	-	-	-	-	
Individual configuration	-	-	-		
Precise fire location		-	-		
Calculating the fire size and spread direction	-	-	-	-	
Monitoring of fire spread	-	-	-	-	
Service costs	medium	medium	high	medium	low

* System is capable to resist the temperature of 750 °C while providing important information related to fire spread.

The table unambiguously shows the advantages as well as the disadvantages of the individual described methods of detecting fire spots via linear heat detectors.

References:

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