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FIA Application Guidelines for Thermally-Enhanced Carbon Monoxide (CO) Fire Detectors

Fact File No 32

1. SCOPE

This FIA Fact File provides guidelines for the use of fire detectors utilizing carbon monoxide (CO) sensors based on electrochemical cell technology enhanced by one or more thermal sensors. It covers detectors where the thermal sensor(s) may also provide a response to fire independently. This Fact File does not give guidelines for detectors which incorporate additional or other sensing technologies. This Fact File does not give guidelines for CO gas detectors for environmental monitoring or toxic gas detection.

Application guidelines for CO only fire detectors are given in Fact File No.31 (Fact File No. 4 (revised)).

2. INTRODUCTION

CO is a known product of the combustion of carbon based material. It is an invisible and odourless gas which, unlike smoke, cannot be detected by people. In certain conditions where, due to oxygen starvation, the fire develops slowly, a significant and dangerous concentration of carbon monoxide may be present in the atmosphere before other combustion products.

When present in the atmosphere in sufficient quantity, CO can seriously impair peoples' ability to react in a fire situation and can eventually lead to their death.

Although there are many different techniques for sensing and detecting the presence of CO, the CO fire detectors currently available use an electrochemical cell. This type of CO fire detector can be easily configured into fire detection and fire alarm systems in the same way as other fire detectors. However, electrochemical cells, have characteristics that can make them sensitive to other gases, some creating a risk of unwanted alarms. Other substances may adversely affect the response of the cell by poisoning it and examples are listed later in this Fact File.

CO fire detectors without thermal enhancement are not particularly responsive to flaming fires which produce lower levels of CO, but exhibit sufficient temperature change in an enclosed space such as a hotel bedroom.

In order to combat this limitation, manufacturers have developed thermally enhanced CO fire detectors, where the response of the CO sensor is enhanced if there is a simultaneous change of temperature. In some thermally-enhanced fire detectors, the thermal enhancement may perform as a heat detector and produce a fire signal. In others, no fire signal is produced no matter what the change in temperature. These guidelines apply equally to both types of detector.

It is very important to understand that there are significant differences in the performance characteristics of CO gas detectors for environmental monitoring, CO toxic gas detectors and thermally-enhanced CO fire detectors. These differences include sensitivity levels, time of response and the specification of the sensing element. Only thermally-enhanced CO fire detectors which are recommended by the manufacturer for fire detection applications should be used.

3. Applicable Standards

BS ISO 7240-8: 2007, Fire detection and alarm systems – Carbon monoxide fire detectors using an electro-chemical cell in combination with a heat sensor.

LPS1274 issue 1 (2005), Testing Procedures for the LPCB Approval and Listing of Carbon Monoxide / Heat Multisensor Fire Detectors Using Electrochemical Cells.

BS 5839-1:2002/A2:2008, Fire detection and fire alarm systems for buildings – Code of practice for system design, installation, commissioning and maintenance.

4. General information of the application of Thermally-Enhanced Fire Detectors

Thermally-enhanced CO fire detectors are not a general replacement for smoke detectors. Although their specific characteristics can be of benefit in certain fire risk situations, it is important that, for each application, the fire risk is evaluated before a choice of detector technology is made.

As with most types of detector, there are applications where thermally-enhanced CO fire detectors are appropriate and others where they are inappropriate. The following provides information on these applications:

a) Slow smouldering fires involving carbon based materials will produce reasonably high levels of CO. Such fires can usually be detected using CO only sensors.

b) Clean burning or flaming fires, such as liquid fuel fires, produce low levels of CO as a more complete combustion occurs. As the fire develops, the air supply may be insufficient to adequately sustain the fire and oxygen starvation may begin to occur. Under these circumstances the level of CO is likely to increase.

c) Clean burning or flaming fires are likely to produce a detectable temperature increase which could be used with lower levels of CO to give an earlier alarm than would otherwise be the case if CO alone were detected.

d) Like smoke detectors, thermally-enhanced CO fire detectors benefit from the convection currents created by the heat at the source of combustion. These currents transport the CO to the sensing element. Additionally CO also diffuses within the protected volume thus sometimes enabling CO fire detectors to operate effectively in spaces where the presence of physical barriers could restrict the spread of smoke. Examples of such physical barriers include deep ceiling beams, false ceilings, partitions between adjacent rooms and hot air layers. Thermal currents however, require a more direct path so thermally-enhanced fire detectors should not be positioned where thermal currents generated from a fire are unlikely to reach the detector. In this respect, general rules that apply to the siting of heat detectors should be followed.

e) There are concerns that the application of thermally-enhanced CO fire detectors may sometimes result in early detection being ignored because the location of the fire may not be readily identified even though high levels of CO may be present. Those who are responsible for the safety of buildings and their occupants will need to be instructed on this possibility.

f) As for any detection technology, it is important that thermally-enhanced CO fire detectors are only used where the risk assessment indicates that they are appropriate for detecting the types of fire that are most likely to occur.

g) Always refer to the manufacturer's recommendations to determine the suitability of the detector for the environmental conditions.

5. Situatuions where Thermally-Enhanced CO Fire Detectors can provide a means of early fire detection

Thermally-enhanced CO fire detectors may give an earlier response in the following conditions:

a) Where there is a multiple risk of a fire developing which produces detectable amounts of CO and, in certain conditions, also heat.

b) Where there is a high risk of a slowly developing or smouldering fire which is likely to produce CO before smoke particles,

c) Where the potential presence of unwanted fire alarm sources makes the environment unsuitable for the use of some types of fire detectors. Examples include hotel bedrooms with an adjacent bathroom or shower room where steam may be present or areas where particularly dusty processes take place or where simulated smoke may be present.

d) Where the fire is likely to occur in an enclosed space causing oxygen starvation and incomplete combustion. Examples include laundry storage rooms or cupboards where a CO fire detector sited outside the door may detect a fire before smoke begins to spread outside the affected enclosure.

e) Where movement of the smoke from the source of a fire may be restricted due to hot air layering effects (stratification effect). In such circumstances, CO fire detection can be used to supplement other forms of detection technology.

6. Situations where Thermally-Enhanced CO Fire Detectors are not recommended as the prime means of fire detection

Thermally-enhanced CO fire detectors should **NOT** be used in the following situations:

a) Where fire starts with rapid flaming and the heat generated ensures rapid and complete combustion. Examples include liquid fuel fires involving flammable liquids such as solvents. In such fires, although heat may be generated, there will only be a negligible amount of CO produced.

b) Where there may be a risk of an electrical fire or overheating cables. CO may not be produced in detectable quantities.

c) For duct fire detection applications if the main objective is prevention of the spread of smoke within a building.

d) For applications where significant levels of CO may be present under normal conditions. Examples include areas where internal combustion engines are used (such as forklift trucks etc.) and enclosed or semi-open car parking areas.

e) Where the atmosphere may be polluted with substances that may cause unwanted alarms or affect the performance of the thermally-enhanced CO fire detector. Examples include alcohols, hydrogen, ammonia and certain chemicals used in sprays.

Where smoke detection is required to ensure adequate visibility is maintained. Example includes escape routes. In such situations, supplementing smoke detectors with thermally-enhanced CO fire detectors may provide some advantage depending upon the findings of the risk assessment.

7. Siting of Thermally-Enhanced CO Fire Detectors

There is no explicit guidance for the siting of thermally-enhanced CO fire detectors. It is recommended that the guidance for siting CO fire detectors given in Clause 22.4 of BS5839-1, as amended, is followed.

Where thermally-enhanced CO fire detectors are used to supplement BS 5839-1 systems they may be sited to give additional protection in situations described in section 5 above.

8. Testing, Servicing, Maintenance and Replacement

It is important to always follow the manufacturer's recommendations for testing, servicing, maintenance and replacement requirements.

Testing methods for thermally-enhanced CO fire detectors may include: a small can that delivers a measured amount of CO, another source of CO or a means of effectively mimicking CO. Safe heat generating equipment should be used to test the heat sensor within the detector. This should be done with care and a naked flame should not be used.

DISCLAIMER

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