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# FIA APPLICATION GUIDELINES FOR CARBON MONOXIDE (CO) FIRE DETECTORS

Fact File No 0004

## 1. INTRODUCTION

Carbon monoxide (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 human beings. When present in the atmosphere in sufficient quantity, carbon monoxide can seriously impair the ability of people to react in a fire situation and can eventually lead to their death. 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 known means of detection are able to operate.

Although there are many different techniques for sensing and detecting the presence of carbon monoxide, currently available fire detection products use an electrochemical detection cell. This offers clear advantages both in term of cost and power consumption. The electrochemical cell can be easily configured into fire detection and fire alarm systems in the same way as other traditional fire detectors. Electrochemical cells, however, have characteristics that can make them sensitive to other substances thus 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 these guidelines.

While these application guidelines are based upon currently available detectors, it is important to be aware that advances in detection technology are likely, in future, to further improve the performance of CO fire detectors.

**It is very important to understand that there are significant differences in the performance characteristics of Carbon Monoxide gas detectors for environmental monitoring, domestic Carbon Monoxide gas detectors and Carbon Monoxide fire detectors. These differences include sensitivity levels, time of response and the specification of the sensing element. Manufacturer's information and recommendations should be used to verify the correct application of each type of CO detector.**

## 2. GENERAL GUIDANCE ON THE APPLICATION OF CO FIRE DETECTORS

**IMPORTANT NOTE:**

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 CO detectors are appropriate and others where they are inappropriate. The following list provides general guidance on these issues.

2.1 Where there is a slow smouldering fire, there will normally be reasonably high levels of Carbon Monoxide. In addition, in the early development of most fires some degree of CO will be present.

2.2 Clean burning or rapid burning flaming fires, such as liquid fuel fires, produce low levels of CO gas 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.

2.3 Like smoke detectors, carbon monoxide fire detectors will benefit from the convection currents created by the heat at the source of combustion. These currents assist the CO to reach the sensing element of the detector. However, as a gas, carbon monoxide will also diffuse within the protected volume thus possibly enabling CO fire detectors to operate effectively in spaces where the presence of physical barriers may have restricted the spread of smoke. Examples of such physical barriers include heavily beamed ceilings, ceiling voids, transportation of the gas to adjacent rooms and hot air layers.

2.4 There are concerns that the application of 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.

**IMPORTANT NOTES:**

a) As for any detection technology, it is important that CO fire detectors are only used where the risk assessment indicates that they are appropriate for detecting the types of fire that may occur.
b) Detectors that combine CO with one or more of the other detection technologies (multi-sensor detectors) are becoming available. These may offer additional advantages over single sensor detectors.
c) Always refer to the manufacturer’s recommendations to determine the suitability of the detector for the environmental conditions.

## 3. RISKS WHERE CO DETECTORS CAN PROVIDE A MEANS OF EARLY FIRE DETECTION

3.1 Where there is a high risk of a slowly developing or smouldering fire. A CO fire detector may give an earlier response where carbon monoxide is likely to be produced before smoke particles.

3.2 Where it would not have been possible to use smoke detectors because of the potential presence of unwanted fire alarm sources. Examples include bath rooms and showers where steam may be present or areas where particularly dusty processes take place or where simulated smoke may be present.

3.3 Where a smoke detector may be inappropriate, a CO detector may, in some applications, be a better option than a heat detector. An example of this may be in an area where a specific type of fire risk can be identified such as in sleeping accommodation.

3.4 Where the fire is starved of oxygen causing incomplete combustion. Examples include enclosed spaces such as a laundry storage room or a cupboard where a CO detector sited outside the door may detect a fire before smoke begins to spread outside the affected enclosure.

3.5 Where CO detection can supplement other forms of detection technology in applications where movement of the smoke from the source of a fire may be restricted due to hot air layering effects (stratification effect). In these circumstances the diffusion process of the CO gas may assist the detection of a fire. In addition to diffusion through thermal barriers within a room, the diffusion of the gas is also likely to permit penetration into, for example, roof spaces and voids.

## 4. SITING OF CO FIRE DETECTORS

It is recommended that the rules for the siting of conventional smoke detectors as defined in Clauses 12 and 13 of BS5839 Part 1: 1988 are applied. These rules have been based on the convection process for smoke transportation. In addition, the siting for the CO fire detectors may also benefit from the gas diffusion process.

It is however important that when siting any type of fire detector that all relevant data, especially in relation to likely fires, the site conditions and the environment, is taken into account as part of the selection process. It may be of benefit to use a combination of different types of fire detectors to increase the overall level of detection performance and reliability.

## 5. RISKS WHERE CO FIRE DETECTORS ARE NOT RECOMMENDED AS THE PRIME MEANS OF DETECTION

CO detectors should NOT be used:

5.1 Where fire starts with rapid flaming and the heat generated ensures rapid and complete combustion. A CO detector will respond only when such a fire becomes more developed and oxygen starvation occurs.

5.2 Where there may be a risk of an electrical fire or over heating cables. Carbon monoxide may not be produced in detectable quantities where pyrolysis of material rather than self-sustained combustion is involved.

**Note:**
Pyrolysis is defined as the decomposition of a substance by heat, such as an overheated cable or other overheated plastics material. i.e. not burning with a flame

5.3 For the detection of liquid fuel fires e.g. heptane and other flammable liquids, producing low levels of CO gas.

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

5.5 For applications where significant levels of carbon monoxide may be present under normal conditions e.g. in areas where internal combustion engines are used (such as forklift trucks etc.) and enclosed or semi-open car parking areas.

5.6 Where the atmosphere is abnormally polluted with substances that may affect the performance of the CO detector e.g. alcohols (including ethanol and methanol), hydrogen (as found in battery rooms) and ammonia or other substances of a similar nature. Chemicals used as propellants in sprays can cause unwanted alarms. Silicon based materials, especially those included in sprays, may, over a period of time, cause clogging of the membrane within the electrochemical cell thus requiring preventive maintenance in order to obtain continued effective operation.

5.7 For some types of life protection applications, such as on escape routes, where smoke detectors are used to trigger an alarm during a fire before smoke levels on the escape routes make them unusable. In some circumstances, CO fire detectors may be slower to respond. A combination of the two detection types may provide some advantage depending upon the findings of the risk assessment.

## 6. LIFETIME FACTORS INCLUDING TESTING, SERVICING, MAINTENANCE AND REPLACEMENT

The electrochemical cell within the CO detector has a loss of response with time. In certain environments the degradation in detector sensitivity may occur at a faster rate than for smoke or heat detectors. **It is therefore important to always refer to, and follow, the manufacturer's recommendations for testing, servicing, maintenance and replacement requirements.**

***Testing methods for CO fire detectors may include: a small can that delivers a measured amount of CO, Joss sticks or a means of effectively mimicking CO gas. Manufacturers' guidance on test methods should be followed.***

**March 2001**