High Performance Optical Chamber

Technology Guide

Introduction

Typically photoelectric smoke sensors/detectors have been more sensitive to smoke emitted by smouldering fires and less sensitive to smoke emitted from flaming fires (see **fig 5** on page 2). Generally if the sensitivity to the flaming fire is improved, the sensitivity to the smouldering fire would become very high, significantly increasing the possibility of unwanted alarms.

Unwanted Alarms

In the UK, the level of false alarms due to apparatus has been rising year on year with an estimated national cost as high as £1Billion. Although 90% of installed AFD systems give no problems and have saved life and property, it is the rising number of unwanted fire signals from the other 10% of installed systems - the "rogue" systems - which must be addressed. In 1996, these were responsible for 187,000 unwanted fire signals, constituting a real danger; while the fire brigade is dealing with a false alarm they are not available to tackle a real fire.

Chamber Design

To produce a stable smoke sensor/detector with the minimum of unwanted alarms the sensitivity to smoke produced in smouldering fires should be reduced rather than increased. To overcome this problem Hochiki undertook a major research project to examine the key parameters of light scattering principals.

Hochiki's research found that redesigning the internal optical angle and chamber structure within the photoelectric smoke sensor/detector, the chamber design could minimise the differences in sensitivity to smoke particles produced by flaming and smouldering fires. By honing this angle Hochiki developed the **High Performance** optical chamber that would be more equally responsive to all smoke types:

SLK-E

(original chamber design)
Original angle of internal optics resulted in a different response to each test fire

SLR-E3 / ALG-E / ACA-E

(current chamber design)
Current angle of internal optics results in a consistent response to each test fire

Smoke Detection Principles

When a light source (incident light) hits a smoke particle it is deflected and becomes scattered light, generally known as "backscatter". The angle at which this light is scattered is known as the Scattering Angle.

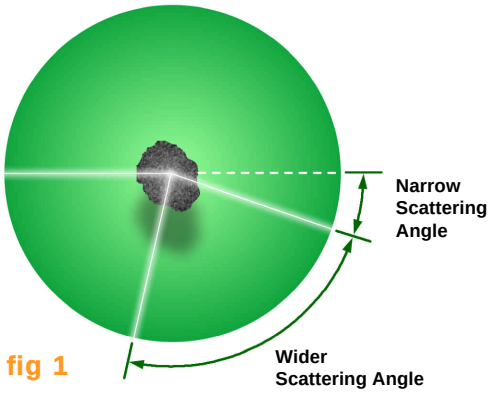


fig 1

As the Scattering Angle increases the relative sensitivity of the smoke sensor/detector to the type of fire is reduced, allowing the sensor to give a flatter response across the different test fires (see **fig 4** on page 2).

The amount of 'backscatter' is dependent on particle size and colour of smoke:

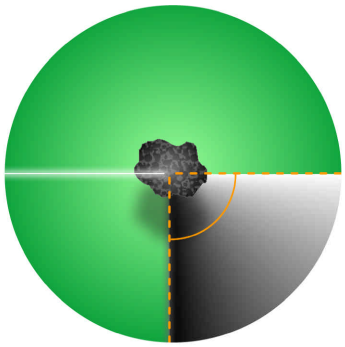


fig 2

The above diagram represents the intensity and scattering angle for kerosene smoke particles, the test for flaming fires producing black smoke. Note the low intensity.

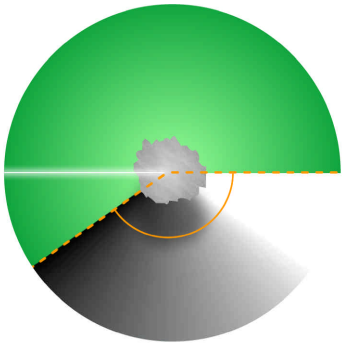


fig 3

The above diagram represents the intensity and scattering angle for paper smoke particles, the test for smouldering fires producing white smoke. Note the higher intensity and wider angle.

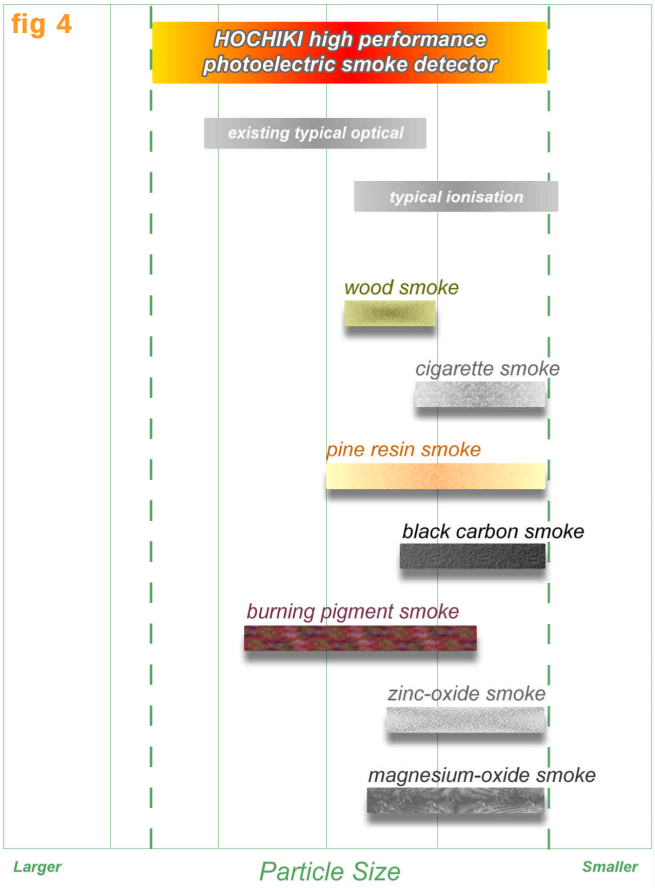
This new generation of photoelectric smoke chamber gives very similar sensitivity results to that of an ionisation smoke chamber, allowing Hochiki to phase out ionisation detection (an environmentally unfriendly technology) in the majority of cases. When considering the recent regulations brought in under the 'RAMRoad', the Radioactive Material (Road Transport) Regulations 2002, which are imposing stringent safeguarding controls on distribution of products employing ionisation technology, **High Performance** optical technology provides an alternative solution.

This chamber design has also removed the requirement for additional thermal elements to achieve the high performance which generally add cost and complexity to the product. This then allows the thermal elements to be used to supply additional functionality (for example the ACA-E multi-sensor).

Particle Sizes

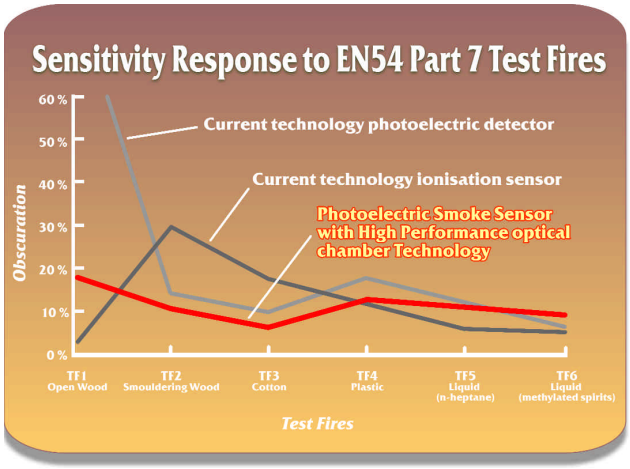
This innovative chamber design has been used both in Hochiki's conventional detector (SLR-E3) and analogue sensors (ALG-E and ACA-E) and this change has allowed these Photoelectric smoke detectors and sensors to exceed the EN54 part 7:2000 standard. The illustration left (**fig 4**) shows the effect of this in a more practical form, showing the causes of smoke in terms of particle sizes and the ability of Hochiki's **High Performance** optical smoke chamber to detect the widest range of particles. It can be seen that the performance of Hochiki's **High Performance** optical detector exceeds the combination of both the typical optical and ionisation smoke detectors.

fig 4



The Sensitivity Response graph below (**fig 5**) shows the response to the EN54 test fires and the sensitivity of the Photoelectric smoke detector (SLR-E3) against a typical ionisation smoke detector.

fig 5



High Performance Optical Chamber Products

Key Shared Benefits:

- **Removable High Performance optical chamber**
- **LPCB approved**
- **No disposal costs**
- **Complies with 'RAM Road' legislation without additional documentation**

SLR-E3
Conventional Photoelectric Smoke Detector

- Wide voltage range 9.5 - 30V for use on fire detection **AND** security systems
- Third terminal for remote indicator output

ALG-E
Analogue Addressable Photoelectric Smoke Sensor

- Variable sensitivity
- Third terminal for remote indicator output

ACA-E
Analogue Addressable Photoelectric & Heat Multi-Sensor

- Incorporates an Optical & Heat element
- Variable sensitivity
- Can support complex false alarm reduction algorithms

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