Technical Note

Flame Detection - Field of View

What is the field of view of an optical flame detector?

As the name implies the field of view (FOV, sometimes called cone of vision) of an optical flame detector defines the unobstructed area of coverage a flame detector has for a given fuel.

The greatest sensitivity to a fire is seen directly through the centre line to the detector face, this is sometimes called on-axis sensitivity. The detection distance then rolls off the further you move away from the centre line with the shape formed by the field of view generally looking like a teardrop.

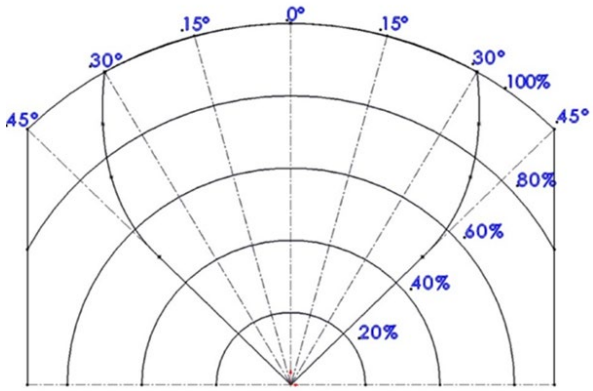

Figure 1 Typical horizontal field of view

FM3260 defines the field of view by stating "the detector response shall be at least 50% of the on-axis sensitivity (measured in units of distance) in at least four directions (left, right, up, and down)".

The horizontal field of view of a detector is typically 90° but can vary due to the optomechanical construction of the detector and / or the fuel being burnt. The vertical field of view tends to be smaller than the horizontal one due to obstructions from the reflector plates used by through-the-lens optical tests.

Some flame detectors have FOV's that are greater than 90° whilst on paper this may seem to offer an advantage in terms of coverage, there can be some unforeseen consequences for some flame detectors.

A wider FOV must be better, right?

Some manufacturers claim their flame detectors provide a FOV angle up to 120 degrees. At first glance, this characteristic may appear beneficial; however, performance evaluation testing has shown that the actual FOV coverage and detection distance claims of "wide-angle" detectors is often inconsistent. Wide-angle FOV detectors typically utilize lesser quality optical filters, and optical sensors, resulting in reduced detection range and reduced false alarm rejection capability.

In addition, these detectors are often fuel-specific, meaning the devices are "tuned" for detection of a specific fire type, like n-heptane, but fall short of their claimed capability in response to different fuel fires such as natural gas or methanol.

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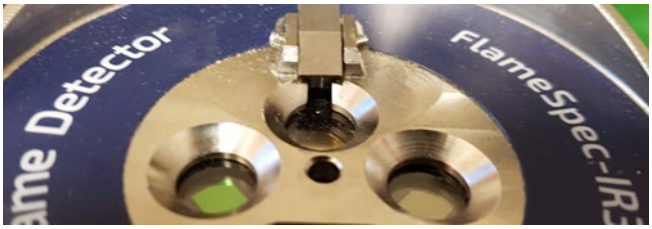
Looking at the FlameSpec design (IR3 and UV-IR) we can see each of IR sensors is tucked behind a bandpass filter selected to the wavelength of interest.



The window is tucked in a precision machined pocket that restricts incident light to 45˚ either side of the mid-point; thereby giving each sensor a 90˚ horizontal field of view.

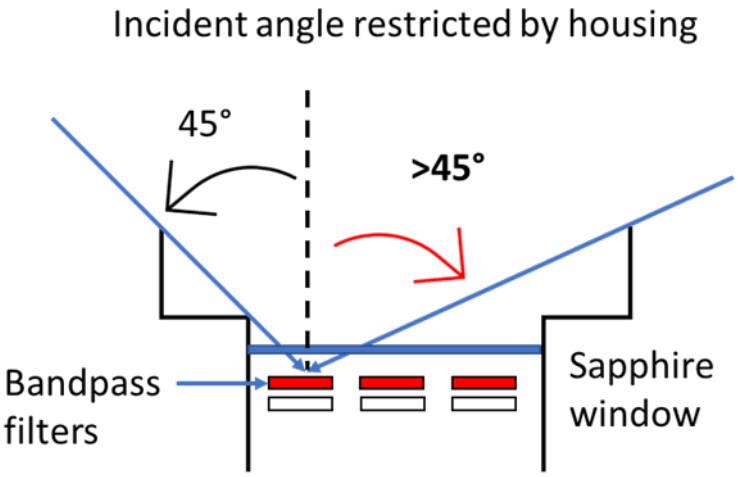
We do this because using IR sensors are affected by something called blue shift. In basic terms, the transmission properties of a bandpass filter changes depending on the angle of incoming radiation.

When IR energy enters from angles greater than 45 degrees the sensors see different wavelengths.

This unwanted additional data can distort the signals received by the detector which may impact the ability of the algorithms to correctly differentiate between fire and false alarm. This means that devices using a FOV of greater than 90 degrees may be compromised.

But not all IR detectors with a 90-degree field of view are the same

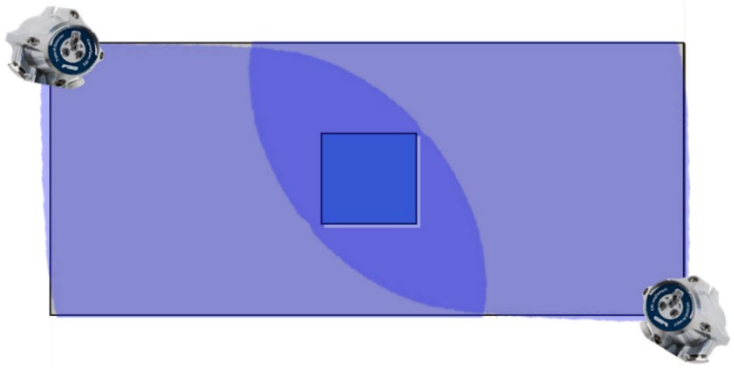
If we consider an alternative, semi-controlled design, this detector may claim to have a field of view of 90 degrees as incident light to the extreme left of the three sensors is restricted to 45 degrees, but light to the right of the centre point is unrestricted and can be impacted by blue shift.



The only way to be certain that detectors are not affected by blue shift is to ensure light entering each IR sensor is tightly controlled to 90 degrees around the central axis.

Practical installations

Practical installations tend to favour placing detectors into the corners of rooms or process modules meaning there is little or no benefit to be gained with detectors having a wider FOV. Another point for consideration is fire zoning, limiting the FOV to 90° makes zoning easier and helps ensure flame detectors from one area are not activated by a fire in an adjacent zone.



Conclusion

Total system comparisons for projects utilizing 90 degree and 120 degree FOV devices shows little or no cost savings benefit from using 120-degree devices. In fact, the costs associated with nuisance alarms and shutdowns initiated by wide angle detectors results in significantly higher life cycle costs than compared to FlameSpec flame detection systems. By utilizing a precision machined window, premium sensors and optical filters optimum fire sensitivity and maximum false alarm rejection capability is accomplished.

The superior quality, performance, and nuisance alarm rejection capability provided by FlameSpec flame detectors outweighs any perceived benefit of a “wide angle” FOV.