

## Introduction

Hazardous process owners, managers, and engineers often require optical flame and gas detection systems be installed at their facilities to detect and/or mitigate a catastrophic fire, explosion, or toxic gas release. Prior to selecting an optical flame detector, users must assess the fire hazards and scenarios present, understand the principles of optical flame detection, and specify the appropriate detection technology from the many options available today. Armed with this knowledge, stakeholders will be able to select the most suitable flame detector for their facility and ensure optimal flame detection system performance and overall facility fire protection.

### Typical Flame Hazards

The range of potential flammable hazards is expansive and growing as materials and processes become more complex. Increasingly sophisticated flame sensing technologies with embedded intelligence are required to detect the most common industrial fuels:

- Alcohols
- Diesel
- Gasoline
- Kerosene
- Jet Fuels
- Ethylene
- LNG/LPG
- Hydrogen
- Paper/Wood
- Textiles
- Solvents
- Sulfur

### Principles of Flame Detection

Optical flame detectors sense the presence of flames within their field of view through utilization of ultraviolet (UV) and infrared (IR) spectroscopy, alone or in combinations, and also via visual flame imaging. Hydrocarbon fire hazards, most common in the petrochemical oil and gas industries, produce heat, carbon dioxide and combustion byproducts when ignited. The intense reaction is characterized by

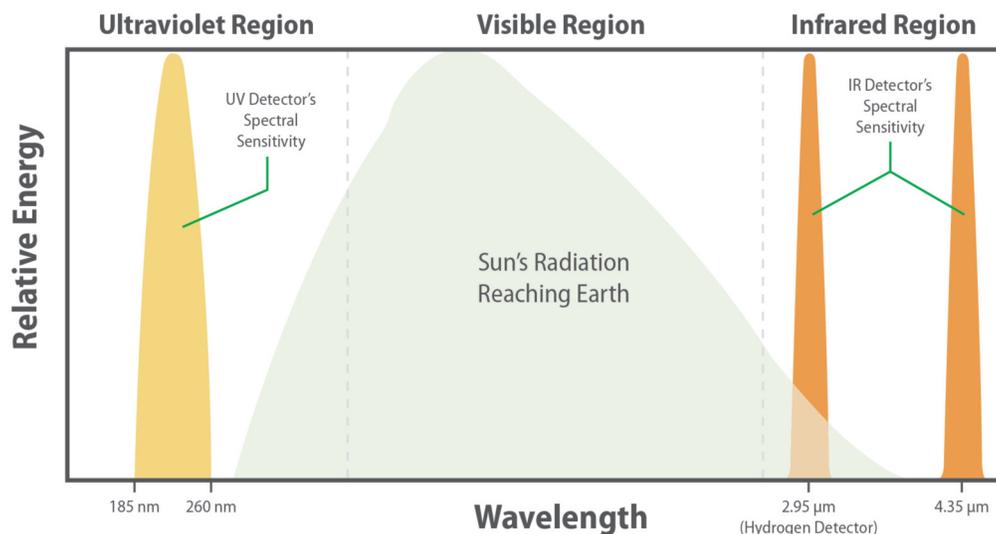
the emission of visible, UV, and IR radiation. Flame detectors are designed to measure the emitted radiant energy at specific light wavelengths, allowing them to discriminate between real flames and false alarm sources. Non-hydrocarbon fire hazards also exist, and special optical sensing attributes and signal processing is used in instruments specially designed to detect these types of fire hazards. The presence of multiple fire hazard types or fuels at one jobsite may require dedicated or complimentary flame detection instrumentation depending upon the results of the hazardous operation analysis.

### Flame Sensing Technologies

There are two primary optical flame-sensing technologies in use today: combination ultraviolet/infrared (UV/IR) and multi-spectrum infrared (MSIR). These instruments provide an adjustable field of view and when installed correctly, will sense and alarm to the presence of detected radiation in the UV, visible, and IR spectral bands by flames (see Figure 1). Detection instruments should always be selected to suit the requirements of the application which commonly include fuel type(s), fire size, maximum detection range, Field of View limits, fire alarm response time, and potential nuisance or false alarm sources.

### UV/IR Flame Detectors

When an optical UV sensor is integrated along with an IR sensor into a single instrument, a dual band detector is created that is sensitive to the UV and IR radiation emitted by a flame. The combined UV/IR flame detector offers increased immunity over either sensor type alone, and offers moderate speeds of response. UV/IR flame detectors are well suited for both indoor and outdoor use. However, as with UV detectors, alarm detection range may be reduced by the presence of dirt, dust, fog, and heavy smoke.



## Multi-Spectrum Infrared Flame Detectors (MSIR)

MSIR instruments measure radiant energy in multiple discrete infrared spectral regions to provide enhanced discrimination against non-fire radiant energy/false alarm sources. MSIR flame detectors are well suited for applications where dirty, smoky fires may occur. They deliver exceptional detection range to most hydrocarbon fuels, up to 200 feet away depending on fire type and size, and at moderate speed of response. These detectors are also suitable for outdoor and indoor coverage. These instruments provide the best overall sensitivity to a fire along with the highest level of immunity to infrared radiation produced by arc welding, lightning, sunlight, and other hot objects that might be encountered in industrial backgrounds.

## Industrial Process and Plant Flame Detection Requirements

When configuring a flame detection system for a plant and evaluating the various flame detection technology alternatives available today, it is useful to consider the following flame detector performance criteria:

- False Alarm Immunity
- Field of View (FOV)
- Detection Range
- Self Diagnostics
- Response Time

### False Alarm Immunity

False alarm rejection is one of the most important considerations for the selection of flame detectors. False alarms are more than a nuisance — they are both a productivity and cost issue. It is therefore essential that flame detectors discriminate between actual flames and radiation from sunlight, lightning, arc welding, hot objects, and other non-flame sources.

### Detection Range and Response Time

A flame detector's most basic performance criteria are detection range and response time. Depending on a specific plant application environment, each of the alternative flame detection technologies recognizes a flame within a certain distance and a distribution of response times. Typically the greater the distance and the shorter the time that a given flame sensing technology requires to detect a

flame, the more effective it will be in providing early notification of a fire alarm and initiating mitigation actions.

### Field of View (FOV)

Detection range and FOV define area coverage per device. Like a wide angle lens, a flame detector with a large field of view can take in a broader scene, which may help reduce the number of flame detectors required for certain installations. Most of today's flame detector models offer an overall FOV between 90° to 130°. The center axis is generally the vector of maximum sensitivity; meaning it normally defines maximum detection range to a specific fire type/size. This is often referred to as a the "on-center or on-axis aim point" of the detector.

### Self-Test Diagnostics

To meet the highest reliability standards, continuous optical path monitoring (COPM) diagnostics are often built into optical flame detectors, like those manufactured by General Monitors. The self-check system is designed to continuously ensure that the optical path is clear, the detectors are functioning, and additionally, the electronic circuitry is operational. Self-check routines are programmed into the flame detector's control circuitry to activate every two minutes. If the same fault occurs twice in a row, then a fault is indicated via trouble relay output, analog 0-20 mA output or a digital communications protocol like HART or Modbus.

### Conclusions

After gaining a better picture of the potential flame hazards, the principles of optical flame detection, and the types of flame detection technologies available today, users will be in a better position to select the optimal flame detector for their application. Defining detector performance requirements is also essential including site specific parameters such as flammable fuel type(s), minimum fire size to be detected, high risk fire ignition zones to be protected and potential false alarm sources present.

Contact MSA for additional assistance is assessing your application requirements and identifying the optimal hazard detection system to meet your needs.

Note: This Bulletin contains only a general description of the products shown. While uses and performance capabilities are described, under no circumstances shall the products be used by untrained or unqualified individuals and not until the product instructions including any warnings or cautions provided have been thoroughly read and understood. Only they contain the complete and detailed information concerning proper use and care of these products. Specifications subject to change without notice.

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