Selecting the Right Flame Detector

Edward Naranjo, Product Manager, General Monitors
Tel: +1-949-581-4464
Email: info@generalmonitors.com • Web: www.GeneralMonitors.com

The petrochemical and other hazardous industries require continuous flame monitoring equipment to prevent catastrophic fires. To select such equipment, the users should understand the principles of flame detection and review the types of detectors available. Armed with this knowledge they will be able to match the appropriate flame detector to process and site performance requirements and to the type of hazard whose consequences the instrument is designed to mitigate.

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
- Sulphur

Principles of Flame Detection

Most flame detectors identify flames by so-called optical methods like ultraviolet (UV) and infrared (IR) spectroscopy and visual flame imaging. Flames are generally fueled by hydrocarbons, which when supplied with oxygen and an ignition source, produce heat, carbon dioxide, and other products of combustion. The intense reaction is characterised by the emission of visible, UV, and IR radiation (Fig 1). Flame detectors are designed to detect the absorption of light at specific wavelengths, allowing them to discriminate between flames and false alarm sources.

Flame Sensing Technologies

There are four primary optical flame-sensing technologies in use today: ultraviolet (UV), ultraviolet/infrared (UV/IR), multi-spectrum infrared (MSIR), and visual flame imaging. They are all based on line-of-sight detection of radiation emitted in the UV, visible, and IR spectral bands by flames. Technologies may be selected to suit the requirements of flame monitoring applications, including detection range, field of view, response time, and particular immunity against certain false alarm sources.

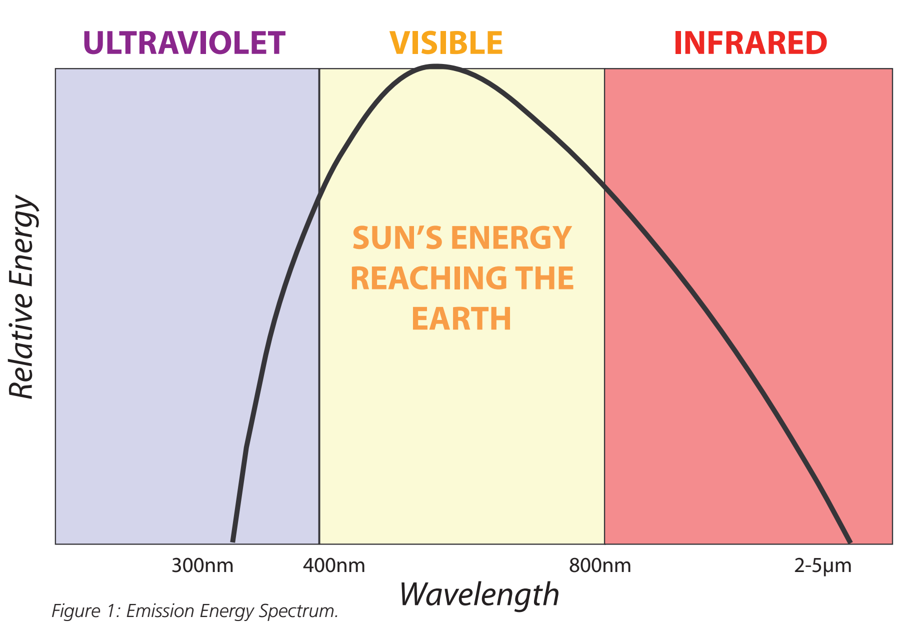

Figure 1: Emission Energy Spectrum.

UV Flame Detectors

UV detectors, such as the General Monitors Models FL3101H and FL3111, respond to radiation in the spectral range of approximately 180-260 nanometers. They offer quick response and good sensitivity at comparatively short ranges (0 – 50 ft). Because they are susceptible to arc welding, halogen lamps, and electrical discharges like lightning, they tend to be sited indoors. Thick, sooty smoke can also cause failures due to attenuation of the incident UV radiation.

UV/IR Flame Detectors

When a UV optical sensor is integrated with an IR sensor, a dual band detector is created that is sensitive to the UV and IR radiation emitted by a flame. A combined UV/IR flame detector, such as the General Monitors Models FL3100H or FL3110 (Fig 2), offers increased immunity over the UV detector, operates at moderate speeds of response, and is suited for both indoor and outdoor use. As with UV detectors, however, the detection range of these instruments may be reduced by heavy smoke.

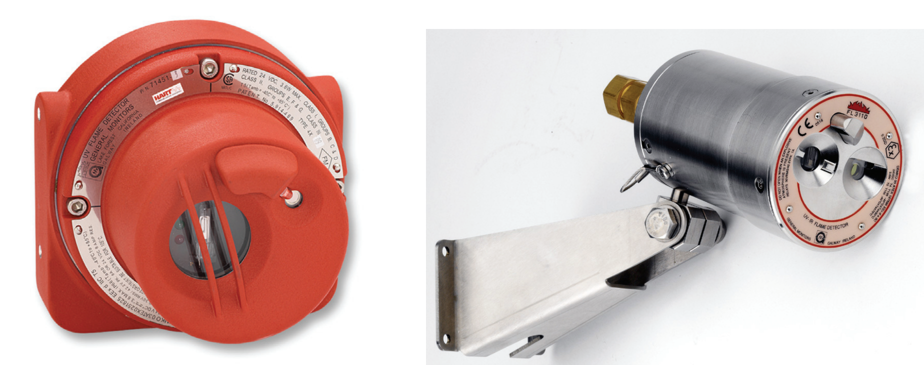

Figure 2 – Examples of UV/IR Flame Detectors

Multi-Spectrum Infrared Flame Detectors

Multi-Spectrum IR flame detectors use multiple infrared spectral regions to further improve differentiation of flame sources from non-flame background radiation. These flame detectors, such as the General Monitors Model FL4000H (Fig 3), are well suited to locations where combustion sources produce smoky fires. They operate at moderate speed with a range of up to 200 feet from the flame source — both indoors and outdoors. These instruments exhibit relatively high immunity to infrared radiation produced by arc welding, lightning, sunlight, and other hot objects that might be encountered in industrial backgrounds.

Figure 3 – General Monitors' FL4000H MSIR Flame Detector incorporates Neural Network Technology to discriminate between a real fire and false alarm source.

Visual Flame Imaging Flame Detectors

Visual flame detectors employ standard charged couple device (CCD) image sensors, commonly used in closed circuit television cameras, and flame detection algorithms to establish the presence of fires. The imaging algorithms process the live video image from the CCD array and analyse the shape and progression of would be fires to discriminate between flame and non-flame sources. CCTV visual flame detectors do not depend on emissions from carbon dioxide, water, and other products of combustion to detect fires, nor are they influenced by fire's radiant intensity. As a result, they are commonly found in installations where flame detectors are required to discriminate between process fires and fires resulting from an accidental release of combustible material.

Despite their advantages, visual flame detectors cannot detect flames that are invisible to the naked eye such as hydrogen flames. Heavy smoke also impairs the detector's capacity to detect fire, since visible radiation from the fire is one of the technology's fundamental parameters.

Industrial Process and Plant Flame Detection Requirements

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

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 recognises 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 is at supplying early warning against fires and detonations.

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 fields of view of about 90° to 120°.

Self 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 procedure is designed to 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 about once every minute. If the same fault occurs twice in a row, then a fault is indicated via the 0-20 mA output or a digital communications protocol like HART or Modbus.

Conclusions

After gaining a better picture of the potential flame hazard, the principles of flame detection, and the types of flame detection technologies available today, users will be in a better position to select a flame detector. Defining the requirements for an application is also essential, as such factors as the type of fuel, minimum fire size to be detected, and the configuration of the space to be monitored can influence the choice of instrument.