Safety Systems Depend on Reliable Field Sensors – with Particular Reference to Fire and Gas Detectors

Garth Watkins, Director Europe, Middle East, Africa
Detector Electronics Corporation
Presented at HazardEx International Conference 2009

Abstract

Because not all hazards are the same, identifying and quantifying the hazard is the starting point in choosing sensing technology. Not all detectors are the same, and they should be selected according to their ability to detect the hazard.

This paper gives a broad summary of technologies that provide users reliable responses to hazardous conditions, that minimise false alarms, and that do not require high levels of maintenance.

Any safety system is only as reliable as the weakest component; certified components with known reliability and performance data are paramount.

Gas Detection Principles

Gas detectors monitor air for unsafe gas levels – flammable or toxic. Flammable gas includes all hydrocarbons, hydrogen, and similar non-carbon substances. They should be detected well below flammable levels, usually 10% of the lower explosive limit of the gas.

Toxic gases include a huge range of chemicals whose toxicity range is equally enormous. Commonly, gases are detected at a level of parts per million to avoid exposure to dangerous concentrations. For example, the typical maximum exposure limit for Hydrogen Sulphide is 10ppm in most countries.

Gas Detection Technologies

Catalytic/Combustible Gas Sensors (CGS) detect hydrocarbon and non-hydrocarbon gases. Because these sensors burn out over time, they require frequent testing and calibration.

Infrared (IR) technology detects combustible gases containing a hydrocarbon molecular bond. Impervious to contaminant poisoning, this technology requires little maintenance and can indicate fault/failure conditions. A Point Infrared (PIR) detects gas near a single point. Open Path Gas Detection, also called line of site (LOS), covers a greater distance – the distance between the IR transmitter and receiver can be over 100 meters.

Electrochemical technology is effective primarily for toxic gas detection. While providing good accuracy and repeatability, electrochemical detectors are not resilient in high heat and in prolonged low-humidity conditions.

Metal Oxide Semiconductor (MOS) technology is used primarily for toxic gas detection. Nanotechnology enhances the newest version of MOS sensors and enables them to respond quickly and work well in extreme temperatures and humidities.

Ultra-Sonic detects high-pressure gas leaks by their acoustic signature and does not depend upon the gas cloud being transported to a sensor.

Selecting the Appropriate Gas Detector

Studies of process design drawings and Hazop (Hazard & Operability) can reveal types of gas present – individually or in a mixture. This study can indicate detector options. Choosing between catalytic or infrared is a choice of reliability, service life, and cost

Detector Electronics Corporation
T: 952.941.5665 or 800.765.3473
F: 952.829.8750
www.det-tronics.com

DET-TRONICS®
A UTC Fire & Security Company

of ownership. Choosing between electrochemical and semiconductor for H_2S is determined by environmental conditions and required response speed. For other toxic gases the choice is mostly electrochemical.

Backing up point with LOS or acoustic detectors is determined by risk management calculations. Point detectors are mostly used as the primary means of detection. Look at safety standards and whether devices have undergone third-party testing.

Flame Detection Principles

To verify that a flame exists, a flame detector must see one or all of the flame components. In a flame fueled by a hydrocarbon source, the components are CO_2, carbon, water, and heat (IR). But not all fires are the same. A hydrogen fire emits no CO_2. Flame detector technology must match the type of fire fuel it is expected to see.

Flame Detector Technologies

Ultraviolet (UV) detectors respond to a broad spectrum of flame hazards. Used indoors in a controlled environment, UV is an economical option. Lightning, the sun, and arc welding can cause false alarms. UV detectors might be impaired by certain chemicals that attenuate UV light, such as oils, silicones, and ammonia.

IR-based detectors sense IR emissions generated by any material above absolute zero. However, they can be tuned into regions of the IR spectrum and detect carbon-based fueled fires. IR detectors can give false alarms from chopped or modulated IR sources.

Multispectrum IR detectors have fewer false alarms than UV and IR detectors and have the greatest on-axis detection ranges (>60m) of any flame-detection technology.

UV/IR detectors combine UV and IR benefits, thereby reducing false-alarm issues.

Some forms of *CCTV* uses visible light for flame detection. Identification of a flame remains a significant challenge due to ambient light conditions, partially obstructed fires, and pale flames.

Selecting the Appropriate Flame Detector

Determine the technology that will most effectively identify the flame, then review the performance standards against a recognized industry standard. In Europe, the performance standard for optical flame detectors is EN54-10 ‘Flame Detection – Point Detectors.’ Note, however, that this standard applies to detectors used indoors and products approved to the standard may not work satisfactorily outdoors.

The detector manufacturer should provide documented, third-party verification for cones of vision, flame size, and response times to various fuels. Also important are optical integrity tests verifying the lens cleanliness and signal failure. Built-in, calibrated test lamps can assure you the detector is operating correctly.

Other Sensors

Heat detectors detect fires simply and cheaply when the temperature near the detector reaches the alarm set point. Indoor applications pose no problem if the monitored area is small and enclosed. However, in outdoor applications there is limited containment with external influences (wind) that make their choice impractical.

Smoke detectors determine if material that enters the sensing chamber is smoke or something else (dust). Although effective in indoor applications and even in large spaces, the simpler they and the monitoring system are, the more prone to false alarms they become. Algorithms require complex, costly signal processing to distinguish between smoke (from fire) and other elements such as steam or aerosols.

Detector Interfaces

The simplest and most used detector interface/switch is the open or closed relay contact. Because it is open or closed, it provides no other data.

The basis of most analogue instrument outputs is a 4-20mA signal. This method uses the full current output range to provide data, such as pre-alarms or instrument faults.

Addressable devices offer the full extent of signaling healthy and alarm conditions. They also provide in-depth diagnostic and logged data for a full understanding about instrument operation in the safety system. This leads to efficient operation and maintenance regimes, enhancing return on investment.

Standards and Codes

European Standards

Although most current Europe standards are written into EuroNorms with national derivatives, different adoptions of the ENs exist in each country, where local practice influences the local version.

EN61779 contains the most common standards for flammable gas detection; EN54-10 for flame. These standards refer only to the instruments, providing little guidance on their application.

International Electrochemical Commission (IEC) Standards

The complementary IEC standards can be used to manage the risk of a plant to an acceptable level. The use of flame and gas detectors become in integral part of the calculation of risk reduction and making use of products that are properly tested and fully certified to a SIL level, providing the assurance that the instruments are fit for duty.

© All rights reserved. 2009. Det-Tronics and the DET-TRONICS logo are marks of the Det-Tronics Corporation. All other marks are the property of their respective owners.

Detector Electronics Corporation
T: 952.941.5665 or 800.765.3473
F: 952.829.8750
www.det-tronics.com

DET-TRONICS®
A UTC Fire & Security Company