Portable Gas Detection
IR & Catalytic Combustible Detection

Technical Bulletin

Combustible sensors detect gas concentration in terms of either the lower explosive limit (LEL), that is, the lowest combustible gas concentration capable of igniting in air, or in percent by volume. Combustible gas detectors can use catalytic or infrared (IR) technology.

Catalytic bead technology is an extremely reliable method for detection of explosive atmospheres and is the preferred choice for general purpose combustible detection. Key advantages of catalytic bead technology include detection of any combustible gas and that LEL response to different combustible gases can be calculated on a linear curve.

One limitation of catalytic technology is that these sensors require a minimum oxygen level in order to determine a gas sample's potential combustibility. In situations where oxygen levels are below 10%, a dilution tube can be used with catalytic sensors to introduce sufficient oxygen into samples to enable LEL detection.

IR sensor technology is also used for detection of combustible gases; an advantage of IR sensors is the ability to determine gas concentrations of up to 100% by volume. Additionally, IR sensors do not require oxygen to operate. Although IR sensors consume less power than do catalytic bead sensors, battery and detector technology has advanced such that many catalytic bead detectors provide battery usage over multiple work shifts.

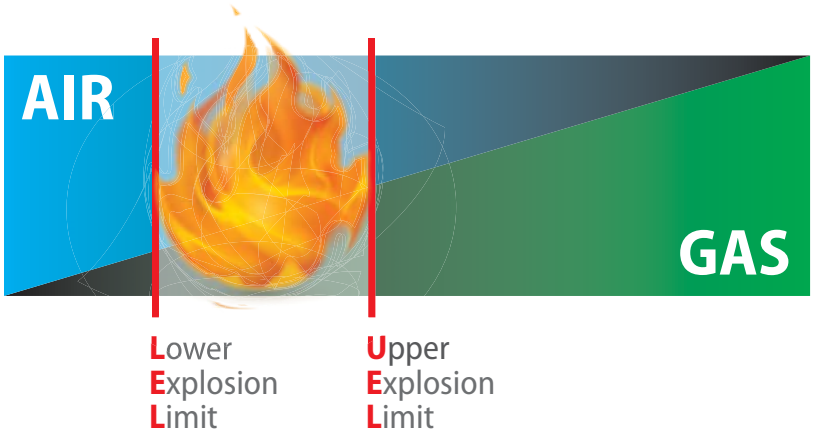
A significant limitation of IR technology is that it cannot detect certain explosive gases such as hydrogen. Although this detection gap may be compensated by relying upon hydrogen cross-interference on a carbon monoxide (CO) sensor, this action is not recommended best practice and may place users at risk if neither sensor is operating properly. In addition, if an IR sensor is calibrated to a specific gas such as methane, response curves to other gases are nonlinear and are less predictable.

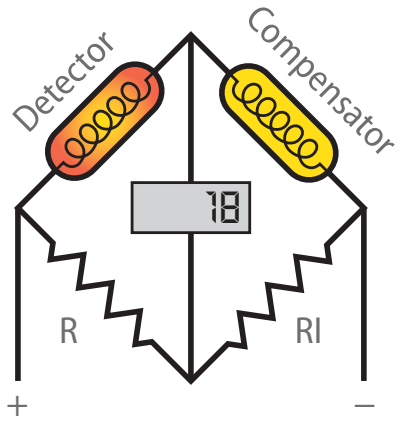
MSA's ALTAIR® 4X Multigas Detector uses catalytic bead combustible sensors while MSA's ALTAIR® 5X Multigas Detector is available with both catalytic and IR combustible technology.

How does catalytic combustible gas detection work?

When gas reaches the catalytic bead sensor, combustion occurs and energy releases. This energy release causes temperature increase, changing electrical resistance inside the sensor that is reported by a change in sensor signal.

Catalytic bead combustible sensors are fast, reliable and can monitor a wide range of combustible gases, including hydrogen. However, this technology does have some disadvantages. Catalytic bead sensors are subject to sensor poisoning from exposure to silicones and lead compounds. Catalytic bead sensors can burn out or become inhibited due to presence of combustion by-products and sulfur compounds such as hydrogen sulfide (H_2S). These sensors also require oxygen to operate and can have concerns when used within high humidity environments.





IR vs. Catalytic **Combustible Detection**

Catalytic bead sensors: what to know

- Catalytic bead sensors function based upon micro-combustions that occur on the detector bead's catalytic surface. Combustion changes bead temperature that changes coil resistance, that is in turn read by the instrument. The greater the gas concentration, the greater the temperature change that occurs, and the higher the resulting gas reading. When O_2 levels drop below 10%, micro-combustions change from lack of O_2 and inaccurate readings can occur. If O_2 level is below 10%, use either a dilution tube fitting (blends a low oxygen sample with ambient air in order to mix in sufficient oxygen to enable LEL detection) or a pumped instrument, or use an infrared detector.
- Silicone poisoning is the most common way to destroy a catalytic bead sensor, as silicones are used in many polishes, soaps, sealants, and lubricants. Do not polish your instrument with Armor All; instead waterproof the unit with sealant or clean with industrial cleaners, as silicone agents will destroy catalytic bead sensors within short periods of time.
- Catalytic bead sensors are designed to read from 0-100% LEL. When gas is applied that is above 100% LEL, the instrument locks in over-range alarm (application of gas from a butane lighter is an example) and the catalytic bead shuts down to avoid damage to the catalyst. To reset this alarm condition, the ALTAIR 4X Multigas Detector must power down and restart within fresh air. After an over-range condition occurs, it is best practice to calibrate the instrument.

Note: *Altair 5X Multigas Detector with Methane IR will automatically activate the catalytic bead when below 5% methane.*

Advantages of MSA XCell® Combustible Sensors

MSA XCell Sensors for catalytic combustion provide high accuracy, fast response and increased durability. In addition, XCell Sensors offer life of more than four years, double the lifespan of typical catalytic combustible sensors. MSA has developed a sensor using **two detector beads,** doubling sensor life versus traditional one-detector sensors. Two detectors operate independently and at different times throughout the life of the sensor.

Poison Resistance

Most sensors have filters and bead chemistry to help protect against poisons; however over time, these substances reach the bead's detector and slowly deactivate parts of the catalytic surface , reducing sensor sensitivity.

MSA XCell Ex Sensors resist poisons in multiple ways:

- Patented pressed pellet silicon scrubber
- Active chemical filter to remove sulfur compounds including H_2S (hydrogen sulfide)
- Two detectors with optimized bead chemistry (if a poison reaches past the scrubber and filter, only one of the two detectors would be impacted)

Increased Durability

In the past, the combustible sensor has been one of the least impact-resistant instrument components, as a catalytic bead is typically suspended between two posts by a very hot, very thin filament wire. Instrument impact causes the bead to shift and eventually break. MSA's new patent-pending design secures the bead with metal alloy support wire to greatly reduce tfilament wire stress.

Increased Performance

In addition to longevity and durability, the XCell Ex Sensor also offers a new performance standard. On-board ASIC (Application Specific Integrated Circuit) adjusts and digitizes the signal side of the sensor, resulting in standard digital output, providing greater immunity to radio frequency interference (RFI) and electromagnetic interference (EMI). In addition, control of the integrated ASIC also results in more accurate and stable results over a very wide range of temperatures and humidity.

How does infrared (IR) combustible detection work?

The IR gas detection method is based upon absorption of infrared radiation at specific wavelengths as radiation passes through a volume of gas. IR gas detectors use an infrared energy source and may use two detectors that convert the energy into electrical signals. One detector monitors environmental gas as the other acts as a reference gas. Gas concentration is determined by comparing relative values between the two detectors.

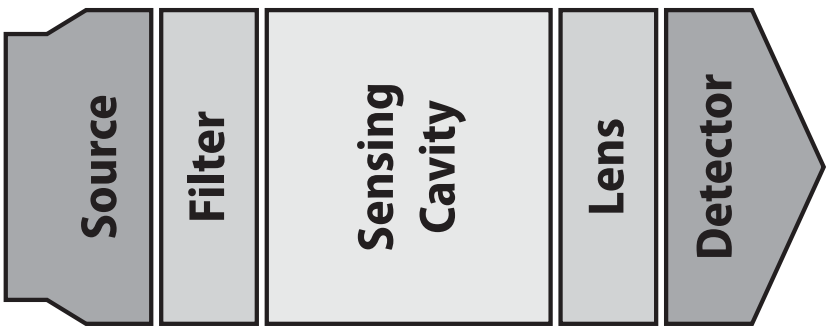
With use of IR sensors, the amount of gas is determined by how the amount of that gas absorbs, rather than by chemical reaction. The following figure shows the basic layout of a portable instrument IR sensor. A special source emits light that passes through a filter. This filter screens out all but a very specific set of wavelengths in the infrared part of the spectrum (just slightly longer wavelengths than the eye can detect). The light wavelength that is allowed to pass through must match the wavelength that is easily absorbed by the gas of interest. The amount of light energy received at the detector decreases as more of the target gas passes into the sensing cavity.

IR detectors offer some advantages when compared to catalytic detectors. IR sensors are not affected by poisons such as silicones and lead compounds. Because no sensor combustion occurs, IR sensors do not experience corrosion due to by-product exposure. In addition, R sensors require less frequent calibration. They do not require oxygen for operation, allowing sensors to be used for inert gas sampling when oxygen concentration is below 10%. IR sensors have a long life, typically more than five years depending upon operating conditions.

IR technology also has its own disadvantages. As IR gas detection is based upon the ability of some gases to absorb IR radiation, gases that do not absorb IR energy (such as hydrogen) are not detectable using IR sensors. Detection using IR sensors is limited to specific hydrocarbons. IR sensors also have higher cost than that of catalytic sensors.

MSA offers IR sensors for detection of carbon dioxide, butane, methane, and propane. Carbon dioxide (CO_2) is an example of an important gas that is difficult to detect reliably using typical electrochemical cells. IR sensors that are commonly used to detect CO_2 or hydrocarbons approach gas detection in a completely different way.

Users should consider the detection environment and types of combustible gases to determine the best option for detecting combustible gas.



MSA—**The Safety Company**

Our business is safety. We've been the world's leading manufacturer of high-quality safety products since 1914. MSA products may be simple to use and maintain, but they're also highly-sophisticated devices and protective gear — the result of countless R&D hours, relentless testing, and an unwavering commitment to quality that saves lives and protects thousands of men and women each and every day. Many of our most popular products integrate multiple combinations of electronics, mechanical systems, and advanced materials to ensure that users around the world remain protected in even the most hazardous of situations.

Trust & Durability

For nearly 100 years our passionate mission of safety empowers us "The Safety Company" to protect lives. We are committed to providing the latest in innovative, best-in-class safety solutions that feature integrated systems capability and allow our customers to return safely to their families and friends.

Every day our customers place their lives in our hands. In response, we provide them with protection they can trust, and their stories become our stories. Hand in hand we partner with our customers to earn that trust.

MSA: Because every life has a purpose.

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.

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