APPLICATION BRIEF

Gas Detection For Life | **Accurately measure flammable gases**

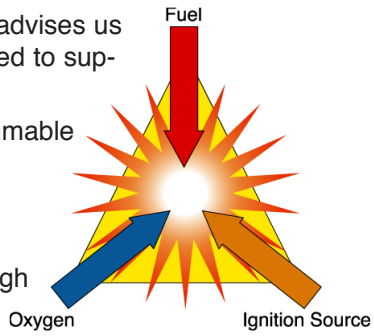
ACCURATELY MEASURE FLAMMABLE GASES

Today, there are a variety of sensors used to detect flammable gases. There are also many different flammable conditions, each requiring a specific type of sensor to be accurately measured. When selecting a flammable gas monitor, it is critical that you understand the differences and choose the appropriate sensor for the environment to be measured.

LEL and UEL Ranges

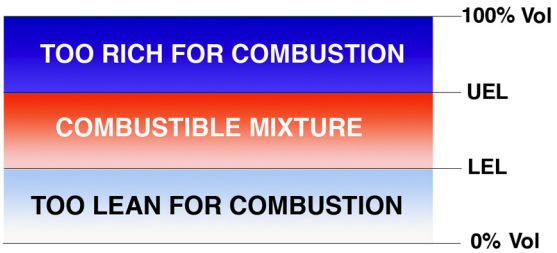
The familiar "fire triangle" advises us that three things are needed to support a fire or explosion:

- Source of fuel (e.g. flammable gas or vapor)
- Air (oxygen)
- Source of ignition (e.g. spark, open flame, or high temperature surface)



Many commonly encountered gases and vapors (natural gas, methane, propane, hydrogen, alcohols, etc.) are flammable within a range of concentration known as the explosive or flammable range. This range is defined by the lower explosive limit (LEL) and upper explosive limit (UEL) and is different for each flammable gas. For methane, the LEL and UEL in air are 5.0 % and 15.0 % by volume, respectively [NFPA reference]. At concentrations below the LEL, the mixture is too lean (insufficient fuel with respect to oxygen) to sustain combustion, and at concentrations above the UEL, the mixture is too rich (too much fuel with respect to oxygen) to sustain combustion.

Safety instruments using catalytic bead type sensors are intended for use below the LEL, and typically scaled from 0-100 % LEL. This means that the full-scale indication on the monitor is the minimum concentration that could sustain combustion.



Monitoring Above the LEL Range

While most safety-related instruments focus on the sub-LEL range, there are many applications or industries where it is necessary to measure concentrations of flammable gases and vapors above the LEL. For instance, a ***utility*** company trying to pinpoint a gas leak may subject its leak detector to concentrations far above the LEL. Another common application is in ***landfills***, where inspection wells are monitored to track the condition of the landfill or to verify that methane produced in the fill is not migrating off site. In monitoring of these inspection wells, concentrations of methane can be well above the LEL or even above the UEL and are often deficient in oxygen.

For these situations, a catalytic bead type LEL range detector is not suitable, and can indicate dangerously low false readings. Remember, the catalytic bead type sensor must "burn" the gas on the surface of the bead. If the mixture is above the UEL (too rich), the instrument may actually indicate a very low reading or no reading due to insufficient oxygen. In addition, subjecting a catalytic bead sensor to very high gas concentrations can result in damage to the sensor, including loss of sensitivity that can also produce erroneously low readings.

For applications of this type, where very high gas concentrations may be encountered, the most commonly used method of detection is thermal conductivity (TC).

Thermal Conductivity

A thermal conductivity detector is based on the principle that gases differ in their ability to conduct heat.

A TC detector will consist of two elements, typically a pair of wires (filament) or thermistors that are heated above ambient temperature. One of the elements (active) is exposed to the gas sample to be measured, and the second element (reference) is exposed to a reference gas (typically air for this type of instrument).

If the sample gas has a different thermal conductivity as compared to the reference gas, the temperature of the active filament will change as compared to the reference element. As with the catalytic bead type sensor, the resultant temperature change results in a resistance change that is measured with a Wheatstone bridge circuit to produce a digital reading proportional to the gas concentration.

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The TC sensor can be used for a variety of gases, and does not require oxygen to operate. Because the thermal conductivity of different gases as compared to air can vary widely, and be either positive or negative in direction, the thermal conductivity detector must be tuned or calibrated for a specific gas or vapor. The most notable advantage of the TC type detector is it's ability to detect concentrations of flammable gases and vapors up to 100 % by volume, well above LEL and UEL ranges.

Sensor Type	Measuring Range	Advantages	Disadvantages
Catalytic Bead	0-100 % LEL	Low cost, wide range of flammable gases	Requires oxygen, degrades as it's used, limited measuring range
Thermal Conductivity TC	0-100 % Volume	Wide dynamic range, doesn't need oxygen to operate, immune to catalyst poisoning	Doesn't detect all flammable gases

GX-2003 - Unique 5 in 1 Sensor Packaging

In the past, you may have had to buy a separate instrument in order to obtain each of these sensor types. Fortunately, RKI has developed the GX-2003, which includes both catalytic bead and thermal conductivity sensors, and will automatically switch from a % LEL to a % Volume range.

GX-2003
5 sensor configuration

Most competitive instruments with dual range combustible capability do not have the sophistication to automatically select the appropriate sensor to use based on the gas concentration being encountered. If the instrument does not autorange like the GX-2003, then the user must manually select the range to be monitored, which may require extra precautions to ensure that the readings are accurate or to avoid damaging the catalytic bead sensor. When the GX-2003 detects high levels of methane, the display will dynamically change from the % LEL to the % Volume range. At the same time the catalytic sensor is protected from being exposed to a concentrated sample that is well over scale. This autoranging combustible capability provides users with the flexibility to do general-purpose safety monitoring as well as detection of very high levels of flammable gases and vapors without any extra precautions or procedures.

Ordering Information

The GX-2003 comes in a variety of configurations. The part numbers listed below are all the configurations that include the 100% Volume TC sensor.

Part #	Description
72-0280RK	GX-2003, 5 sensor, % Vol (CH4)/LEL/O2/CO/H2S with alkaline batteries
72-0281RK	GX-2003, 5 sensor, % Vol (CH4)/LEL/O2/CO/H2S with Ni-Cad battery pack
72-0281RKC	GX-2003, 5 sensor, % Vol (CH4)/LEL/O2/CO/H2S with Ni-Cad battery pack and 115VAC charger
72-0281RKA	GX-2003, 5 sensor, % Vol (CH4)/LEL/O2/O/H2S with Ni-Cad battery pack and 12VDC charger
72-0252RK	GX-2003, 3 sensor, % Vol (CH4)/LEL/O2 with alkaline batteries
72-0253RK	GX-2003, 3 sensor, % Vol (CH4)/LEL/O2 with Ni-Cad battery pack
72-0253RKC	GX-2003, 3 sensor, % Vol (CH4)/LEL/O2 with Ni-Cad battery pack and 115VAC charger
72-0253RKA	GX-2003, 3 sensor, % Vol (CH4)/LEL/O2 with Ni-Cad battery pack and 12VDC charger

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