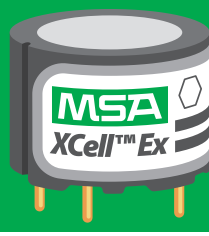
SensorTalks

LEL Sensor



Types of Sensors

Ex Sensor

- >4-year life using dual detector beads
- Industry-leading response time
- Run up to 3 shifts/low power consumption
- Robust filter helps to keep sensors free of poisons and inhibitors

Ex-M Sensor

- Additional stability for extended CH_4 exposures found in mining/liquified natural gas (LNG) application
- >4-year life using dual detector beads

Ex-H Sensor

- Specialized: increased response to select solvents and heavy hydrocarbons (acetone, nonane, methyl ether keytone [MEK], xylene).

LEL

- **Lower Explosive Limit**—the lowest concentration that a combustible gas or vapor can ignite and burn
- **Upper explosive limit**—the highest concentration for ignition
- Dependent by and a fixed property of the molecule
- Examples of methane and propane
- MSA uses methane as a pentane simulant for calibrations, bump tests and reference factors

Cal Gas Choices

- 1.45% vs. 2.5% methane
  - 2.5% methane may be preferred in mining applications
  - 1.45% is preferred in industrial/fire applications

Cal Gas	Methane	Methane	
Concentration (% VOL)	1.45	2.50	
Set span value of ALTAIR® 4XR to the following if detecting:			LEL Value (% VOL)
Methane	33%	57%	4.4
Propane	46%	79%	1.7
Butane	45%	78%	1.4
Pentane Simulant	52%	89%	1.1
Hydrogen	32%	56%	4.0

Flashpoints

- Greater than 37°C—difficult to impossible to detect
  - Can give a lower response, can take minutes to respond, or no response at all
  - Larger, slow-moving molecules that have a hard time diffusing (see Filter section)
- Flashpoints are tricky with regard to temperature
  - Flashpoints do not change
  - Outside temperature can create a hazard if temperature is above the flashpoint or mask a hazard if the temperature is below the flashpoint
    - › Diesel and jet fuel
    - › Spain in summer or Norway in December
    - › PID is the correct tool overall because, regardless of temperature, flashpoint is too high to detect with LEL

Filters

- MSA has some of the best filters on the market due to expertise and experience in APR
- **Pros**
  - High resistance to inhibitors and poisons
  - Sensors are more durable and longer lasting due to high resistance against inhibitors and poisons
- **Cons**—Alcohols and large molecules *(acetone, MEK, benzene, toluene, naptha)* get slowed down in the filter

Poisons

- Catalytic bead in LEL sensor has millions of reaction sites
- Poisons permanently bond to these sites
- Silicone is the highest poison category *(caulks, epoxies, silicone based cleaning products, greases, degreasers)*

Inhibitors

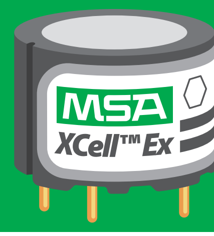
- Bond to reaction sites on the catalytic bead, these can be reversed by exposure to methane gas and burned off
  - Heat the catalyst that is around the resistor to burn off inhibitors
- H_2S and carbon from industrial coking ovens/forges
  - High concentration of combustible molecules
  - Large molecules which are difficult to burn

Cross Reference Factors

- All gases are unique in their response and how they burn
- Methane as a pentane simulant
  - Calibrated with methane and span gas set to pentane
  - If reading anything other than pentane, use a cross reference factor to adjust screen reading
  - Example of known methane area—take reading x 0.57

MSA
The Safety Company

SensorTalks
LEL Sensor



PPM vs. LEL

- Tipping point in deciding whether to use LEL sensor or PID
- LEL is higher up the scale and concerned with mitigating the risk of fire/ignition
- LEL is read as percent volume
  - 1% Volume of a gas equals 10,000 ppm
  - Low alarm is set to 10% of LEL
  - Benzene as an example
    - › LEL = 1.2% Volume
    - › Alarm at 10% of LEL = 0.12% benzene
    - › Equals 1200 ppm
    - › Respiratory health hazard at 1 ppm = PID

Thermal Conductivity

- Customer may see spikes in readings in an inerted space, when they are 'sure' it is clean of combustible vapors
- Effect on the LEL sensor from gases used for inerting confined spaces, *(think of how hot or cold steel can get in a short amount of time, while Styrofoam remains more temp neutral)*
- Nitrogen will not have much of an effect *(air is 70% nitrogen)*
- **False positive:** argon *(pulls heat from the catalytic bead)*
- **False negative:** helium

Vapor Pressure

- For something to be detected by an LEL sensor, it has to be in sufficient quantity as a vapor or gas in a space
- Assume that it is a liquid since gas is already in the air
- Temperature dependent, determines how much of a volatile liquid has turned into a vapor
- Higher vapor pressure liquids will turn to vapors more easily
- Lower vapor pressure liquids are harder to turn into vapor. For example, boiling water at high temps forces it into a vapor state and gasoline at extremely low temps easily turns into vapors.
- Ties into flashpoints
- May lead to the use of a PID sensor versus LEL

Dual LEL Beads

- One bead is on and one is off.
- Switch during each Zero Calibration.
- Switch does not occur on bump tests.
- One bead can fail a calibration and the next bead can pass. Still OK to use.
- Must be aware of yo-yo pass/fail/pass.

Heavy Hydrocarbon Sensor

- Volatile chemical could have a flashpoint of <38°C, but still seem to not be detected by LEL sensor
- LEL can have a very slow response to large molecules such as Ethanol *(wineries, distilleries, corn-to-ethanol plants)*, Methanol (methanol plants) and Toluene *(chemical and industrial plants)*
- MSA offers an Ex-H sensor, but it has limitations

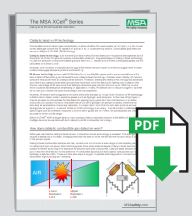
Inert Monitoring

- Need 10% or greater oxygen content to work
- Inert gases are used for purging confined spaces and displace oxygen reducing the probability of a fire or explosion
- Infrared sensors (IR/Advanced) are the preferred option for inert monitoring.

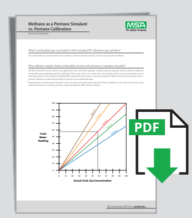
Tools

MSA XCell® Sensors

MSA ALTAIR® Gas Detectors: Cold Weather Performance



IR & Catalytic Combustible Detection



Methane as a Pentane Stimulant

MSA
The Safety Company

Commonly Asked Questions

What does it mean when a sensor is under/over range and what should I do?
The Sensor needs to be calibrated, the instrument could have been powered off when it was still detecting gas concentrations and was not allowed to clear out or was not zeroed properly.

What are some common scenarios where "sensor error" displays?
Sensor not seated properly within instrument, damage to sensor pins or sensor body (leaking, corrosion), damage to printed circuit board.

Do you have a list of known interferences or contaminants?
Refer to the following document:
https://msa.webdamdb.com/bp/#/folder/1777763/47088752

What causes sensor drift?
Many environmental conditions can affect sensor readings and can often look like sensitivity drift, including gas interference and cross-sensitivity. Refer to the following document for more information:
https://msa.webdamdb.com/bp/#/folder/1777763/68776031

Why is the LEL negative or why am I getting a reading when no combustible gas is present?
Negative sensor readings, or readings where no known gas is present commonly occur when your instrument has been "zeroed" in a contaminated atmosphere, where small levels of the sensors' target gasses are present. When the instrument is later in a clean-air environment, the sensors will show a negative reading that corresponds to the concentration on the contaminant that was present during the zeroing operation.

The Safety Company

MSA operates in over 40 countries worldwide. To find an MSA office near you, please visit ***MSAsafety.com/offices***.