MSA Gas Detection System: Dilution Flow Panels for Combustible Gas Monitoring

Application
Catalytic combustible gas detectors have been in use for nearly 80 years and have proven their value by protecting lives and property many times over. Customized flow panels expand catalytic combustible sensor range and versatility.

Catalytic Combustible Gas Sensors
As the name implies, catalytic combustible sensors detect combustible gas presence using a catalytic bead or coil, producing an electronic signal that is proportional to the gas concentration. This sensor type requires that combustion take place for the signal to be generated, necessitating the presence of oxygen. Catalytic combustible sensors detect the presence of many combustible gases, including natural gas (methane), solvent vapors, hydrogen, ammonia, and even carbon monoxide. Due to its simplicity, rugged design, and versatility, catalytic combustible sensors are employed in many applications such as oil and gas production and refining, chemical processing, waste treatment, pulp and paper manufacturing, metal-treating, drying ovens, and landfills.

To sustain combustion, the atmosphere must contain the correct mix of fuel and oxygen (air). Limits exist at both low-end and high-end gas concentrations where combustion can occur, known as the Lower Explosive Limit (LEL) and the Upper Explosive Limit (UEL). Actual LEL levels for different gases may vary widely and are measured as a percent by volume in air. This sensor type is designed to provide advance warning of imminent, potentially hazardous situations and allow for adjustments to be made to help avoid the hazard. The sensor produces a signal between "no gas" (0%) and the Lower Explosive Limit (LEL) or (100%). Above the LEL, catalytic combustible sensors provide only ambiguous readings, due to too much fuel or too little oxygen to support combustion. Prolonged exposure to high combustible gas concentrations can also reduce the sensor's service life.

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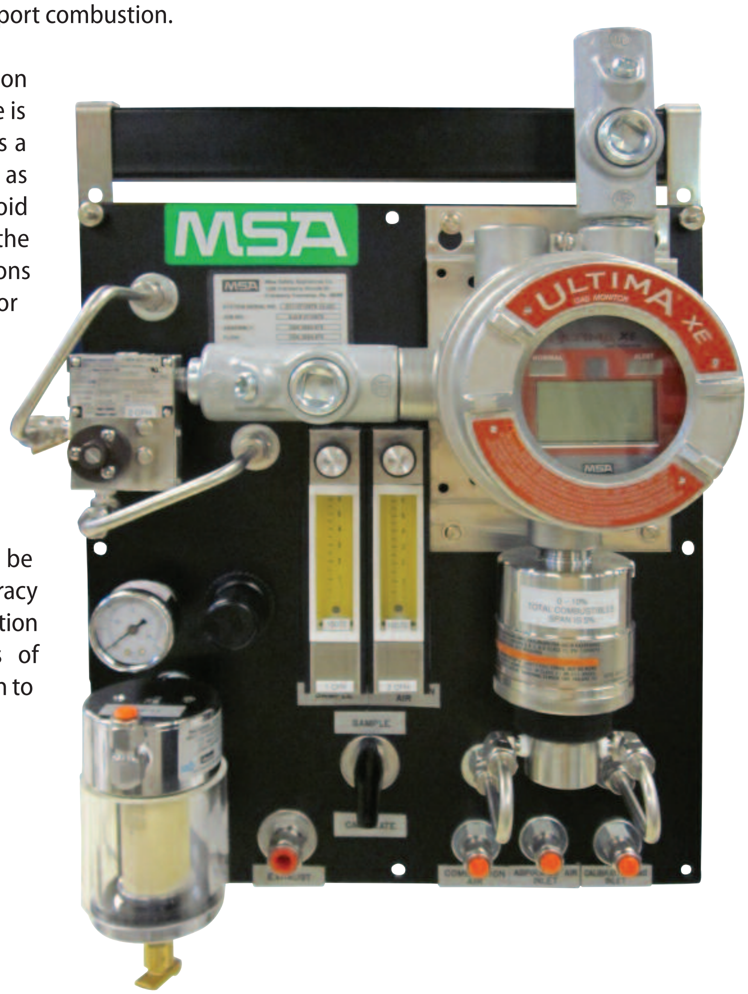
Solution

To overcome the challenges mentioned here, MSA manufactures dilution flow panels that allow users to dilute using air or oxygen samples to facilitate combustion. Two basic procedures come into play for use of dilution flow for catalytic combustible sensor flow panels; the first is to drop gas concentration to levels that sensors can handle. As stated above, these sensors are designed to monitor gas up to the LEL and are ineffective above that level. Through use of dilution, we reduce gas concentration to which the sensor is actually exposed within sensor operating range. In the heat treating of metals, atmospheres of hydrogen and carbon monoxide in the range of 10 to 30 percent are typical. Control of the oven atmosphere requires accurate measurements in order to yield the finished product's desired properties, Obviously, this atmosphere cannot contain any oxygen; a dilution ratio of 5-to-1 or 6-to-1 may be used to bring the gas concentration to scale.

Some industrial processes are performed within inert atmospheres (where oxygen is purged) to minimize combustion risk. The second procedure explained here concerns simply adding oxygen to an inert sample. Some compounds such as calcium carbide or magnesium powder react with water vapor to generate combustible gases. In an enclosed hopper, these compounds combine to form desulphurization rods for steel production; the process is conducted under a nitrogen blanket to keep compounds dry and to purge oxygen. In this example, a simple 1-to-1 dilution ratio may be used to maintain an oxygen level of 10 percent within the analysis stream in order to support combustion.

A third, but not nearly as common monitoring application via dilution is to avoid sample condensation. If a sample is drawn from a source at elevated temperature, there is a chance that some stream components may condense as the sample cools in transport to the sensor. To avoid condensation, an air dilution stream can be added at the sample tap to dilute the sample, reducing concentrations to below the dew point. For example, if monitoring for unburned fuel within a combustion process exhaust, we expect a very high concentration of by-product water vapor. Air can be blended from a compressed air source to keep the water in the vapor phase as the sample is cooled.



Conclusion

In every case of dilution sampling, flow ratios must be precisely monitored and controlled. Sensor reading accuracy is directly related to flow control accuracy. Sensor calibration should be performed under the same conditions of vacuum/pressure and flow as the monitoring application to ensure system integrity.

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