September 19, 2003

Applications Note:

Using dilution fittings to measure combustible gas in low oxygen environments

General Discussion:

Instruments for monitoring LEL range combustible use catalytic (hot bead) sensors to detect gas. Catalytic bead sensors contain two sensing beads that are wired into opposing arms of a balanced Wheatstone Bridge electrical circuit. One bead is additionally treated with a platinum or palladium-based material that allows catalyzed combustion to occur on the treated surface of the "active" (or detector) bead. The "reference" (or compensator) bead in the circuit lacks the catalytic outer coating, but in other respects exactly resembles the active bead. In the presence of combustible gas the active bead is heated to a higher temperature than the reference bead. The difference in heat between the active and reference bead is proportional to the amount of combustible gas that is present in the atmosphere surrounding the sensor.

Combustible sensors detect gas by catalytically burning it on the active bead. The process requires oxygen. The sensor requires at least 10 percent oxygen by volume to detect accurately. A combustible sensor in a 100 percent gas or vapor environment will produce a reading of zero percent LEL.

A dilution fitting is a sample draw adapter that allows use of a standard hot bead sensor to obtain direct readings from oxygen deficient atmospheres. The adapter includes a dilution orifice designed to mix the gas sample with an equal volume of fresh air. Since fresh air contains 20.9 percent oxygen, even in the worst case, the sample will contain at least 10 % oxygen. This is an adequate concentration for the sensor to detect gas accurately.

Dilution adapters may only be used together with instruments that are equipped with continuous motorized pumps. Dilution adapters MAY NOT be used with squeeze-bulb or hand-aspirated sample draw kits.

Improper use of dilution orifices can lead to inaccurate readings. These have the potential for being the basis of flawed decisions, a major cause of accidents. Users should clearly understand the limitations before making use of this accessory.

Operational concerns:

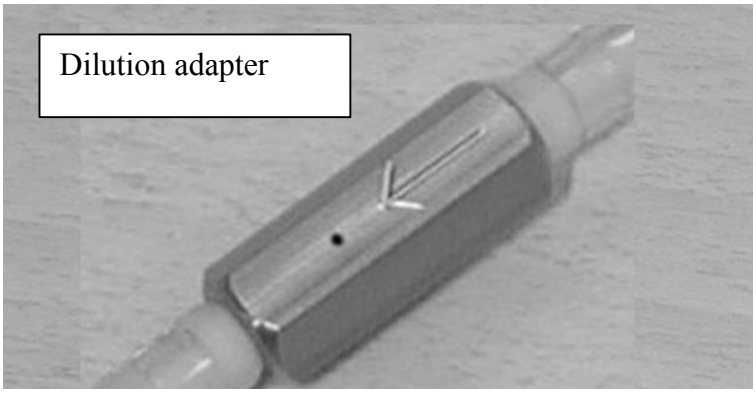
- An important consequence of diluting the sample with fresh air is that the amount of flammable/combustible gas/vapor in the sample also is diluted. Since the adapter provides a 50:50 dilution, the combustible and toxic gas readings must be doubled to obtain the true concentrations.

- The adapter should be removed as soon as dilution sampling is completed. Leaving the dilution adapter in place during normal operation can lead to potentially dangerous misinterpretation of test results.

- Make sure to locate the instrument in fresh air at all times while the dilution orifice is being used. Only fresh air containing 20.9 % oxygen should be used to dilute the sample. If the dilution adapter is located in an oxygen deficient or otherwise contaminated atmosphere, proper sample dilution will not occur, and accurate readings will not be obtained.

- The amount of air drawn into the dilution orifice is affected by the length and inner diameter of the sample draw hose. It is also affected by altitude and the flow rate of the mechanical pump contained in the instrument. Each adapter should be individually calibrated while attached to the monitor and sample probe assembly that will be used during sampling.

- Make sure that the sample tubing does not kink or become blocked during operation. Any change in the flow characteristics of the sample drawing tubing can change the dilution ratio of the adapter.



Calibration:

- The instrument should be calibrated with the dilution adapter and sample line that will actually be used in place. The arrow indicates the direction of flow, and should point TOWARDS the instrument. The adapter should be installed in between the instrument sample inlet

- Make sure that the instrument and sample line are located in fresh air. Turn the instrument on, allow it to stabilize fully with the dilution adapter and sample tubing in place, then enter the calibration mode.

- After the fresh air zero calibration step has been completed, block the hole in the adapter (dilution pore) with a finger, then flow calibration gas to the sensors through the end of the sample tubing. Make sure that the hole in the dilution adapter remains completely blocked until the span calibration step is completed. After completing the span calibration step, return the instrument to normal operation.

- Make sure the instrument, dilution adapter and sample tubing are located in fresh air. Allow the sensors to stabilize fully in fresh air. Do not block the dilution pore. The sensors should read 20.9% oxygen, 0 % LEL combustible gas, and 0 ppm toxic gas.

- Apply calibration gas through the end of the sample tubing to the sensors. The flow of gas to the instrument must exactly match the flow rate of the motorized pump. Use a Tedlar bag, calibration gas balloon or demand flow regulator to supply gas to the instrument. DO NOT USE constant flow regulators to supply gas to instruments that have been equipped with dilution adapters.

- Continue to flow gas until the readings stabilize. Make sure the hole in the adapter is unblocked. The combustible and toxic sensor channels should read approximately 50% of the values present in the calibration gas. Standard "Quad Mix" calibration gas contains 50% LEL methane combustible gas, 25 ppm hydrogen sulfide (H2S), and 100 ppm carbon monoxide (CO). While the dilution pore is open the instrument should read approximately 25% LEL, 12 - 13 ppm H2S, and 50 ppm CO.

- Continue to flow gas to the sensors while you block the dilution pore with a finger. The readings should climb back to 50% LEL, 25 ppm hydrogen sulfide (H2S), and 100 ppm carbon monoxide (CO).

Additional cautions:

- Since the dilution adapter is non-adjustable, it may be necessary to calculate an additional correction factor if the dilution ratio varies significantly from 50 / 50. The correction factor is the reciprocal of the percentage of difference between the actual reading and the expected value with the adapter in place. As an example, if the sensor is exposed to 50% LEL calibration gas, the expected reading with the adapter in place is 25% LEL. If the actual reading with the adapter in place is 20% LEL, the correction factor would be calculated as:

  1 / (20% / 25%) = 1.25

  Multiplying the actual reading of 20% by the correction factor of 1.25 provides the corrected reading with the adapter in place:

  20% X 1.25 = 25%

  Remember, you still need to double this reading (multiply by 2) to calculate the true LEL concentration. In this case:

  (20% X 1.25) X 2 = 50% LEL

- Many applications require oxygen to be measured at the same time as combustible gas readings are obtained from the low oxygen environment. Remember to block the dilution pore with a finger BEFORE taking readings for the oxygen sensor. If the dilution pore is unblocked, the sample will be diluted with fresh air containing 20.9% oxygen. Make sure to allow enough time for the sensor readings to stabilize fully after blocking the dilution pore BEFORE recording the readings.