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Weekly Safety Meeting

Calibrating and Testing Direct-Reading Portable Gas Monitors (DRPGMs)

DRPGMs are designed to alert workers to toxic gases, oxygen-deficient, combustible atmospheres existing in workplace environments. Some examples of these include permit-required confined spaces, manholes, and other enclosed spaces. The Occupational Safety and Health Administration (OSHA) standards require the use of gas monitors for permit-required confined spaces, hazardous waste operations, and emergency response, etc.

OSHA recommends employers develop standard procedures for calibrating and using DRPGMs, including documentation verifying proper maintenance and calibration of their instruments.

Instrument inaccuracy, due to improper or irregular maintenance and calibration can lead to exposure to hazardous levels of toxic gases or to an oxygen-deficient atmosphere. This exposure can cause workers to suffer serious injuries or illness, and even death. Flammable gas explosions are often catastrophic, resulting in worker injuries and death, or destruction of property.

The best way to verify that a DRPGM can detect accurately and reliably is to test it with a known concentration of gas. This procedure verifies response of sensors in the instrument for accuracy and tests that the alarms function properly.

The International Safety Equipment Association (ISEA), a trade association for manufacturers of protective equipment, including DRPGMs, recommends at a minimum verifying the operational capability of these instruments before each day's use, with additional testing conducted as necessary.

Calibration: The Key to Accurate Readings

Operators using DRPGMs to detect the presence and concentration of toxic and combustible gases, as well as oxygen deficiency or oxygen enrichment (which is a fire and explosion hazard) should remember the following:

- Not to rely solely on their sense of smell to alert them to these hazards;
- Employers should ensure that workers use these instruments when working in areas with potential hazardous atmospheres;
- Perform "Calibration" to a DRPGM measuring accuracy relative to a known traceable concentration of test gas, comparing sensor's response to a known reference point concentration of the test gas, that has not passed its expiration date;

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- Calibrate sensors in environmental conditions (temperature, humidity) that are the same as (or like) the actual workplace conditions, following the manufacturer's guidelines for proper calibration;
- Employers should ensure standard procedures for regular calibration that conform to the manufacturer's instructions, internal company policy, and/or the appropriate regulatory agency guidelines; and
- Employers should keep calibration records for the life of each instrument. This record enables operators to quickly identify a DRPGM that has a history of excessive maintenance/repair, or is prone to erratic readings, and to track drift of the sensors to determine when they need replacement.

Calibration Drift and Causes

An instrument's reference point can shift, and the reading will shift accordingly and be unreliable. This is called "calibration drift," and it happens to all sensors over time. When an instrument experiences calibration drift, it can still measure the quantity of gas present, but it cannot convert this information into an accurate numerical reading.

Calibration checks or "Full Calibration," with a traceable gas concentration will verify or update the instrument's reference point.

Operators should conduct these procedures daily, or more frequently if needed, to ensure that the instrument will continue to produce accurate readings.

The Causes of "Calibration Drift" Most Often Are:

- Degradation caused by exposure to phosphates, degradation of phosphorus-containing components, degradation of lead-containing components, gradual chemical degradation of sensors and drift in electronic components that occur normally over time, use in extreme environmental conditions, such as high/low temperature, humidity, and high levels of airborne particulates;
- Exposure to high concentrations of the target gases and vapors, exposure of catalytic hot-bead LEL sensors in the instruments to volatile silicones, hydride gases, halogenated hydrocarbons, and sulfide gases, exposure of electrochemical toxic gas sensors to solvent vapors and highly corrosive gases; and
- Handling/jostling of the equipment causing enough vibration or shock over time to affect electronic components and circuitry.

Bump Tests, Calibration Checks, and Full Calibration Bump Test (or Function Check)

This is a qualitative function check wherein a challenge gas is passed over the sensor(s) at a concentration and exposure time sufficient to activate all alarm settings. This confirms gas can get to the sensor(s) and that all the instrument's alarms are functional. The bump test or function check

does not provide a measure of the instrument's accuracy. When performing a bump test, the challenge gas concentration should trigger the DRPGM's alarm(s).

Calibration Check or Full Calibration

Calibration check and a full calibration verify DRPGM accuracy. Each method is appropriate under certain conditions.

A calibration check verifies sensor(s) and alarms respond within the manufacturer's acceptable limits by exposing the instrument to a test gas. Operator compares the reading to the test-gas concentration (as indicated on the cylinder containing the test gas). If the instrument's response is within the acceptable range of the test-gas concentration (typically ± 10-20% of the test-gas concentration), then the calibration check verified the instrument's accuracy. (Note: OSHA recommends that operators check with the instrument's manufacturer for the acceptable tolerance ranges.) An operator should "zero" an instrument (reset the reference point, in some cases "zero air" gas may be needed) before conducting the calibration check to ensure that the calibration check results are accurate. When performing a calibration check, the test-gas concentration should be high enough to trigger the instrument's alarm(s).

If calibration-check results are not within the acceptable range, the operator should perform a full calibration. A full calibration adjusts the instrument's reading to coincide with a known concentration (i.e., certified standard) of test gas. Test gas used for calibration gas should always be certified using a standard traceable to the National Institute of Standards and Technology (NIST).3

When to Perform a Bump Test vs. a Full Calibration

In the past, there has been some confusion regarding proper calibration procedures and frequency. To clarify this issue, ISEA updated its position statement on instrument calibration in 2010, stating, "A bump test . . . or calibration check of portable gas monitors should be conducted before each day's use in accordance with the manufacturer's instructions." If an instrument fails a bump test or a calibration check, the operator should perform a full calibration on it before using it. If the instrument fails the full calibration, the employer should remove it from service. Contact the manufacturer for assistance or service.

Conclusion

Many workplaces can expose workers to a risk of injury, illness, or death from respiratory hazards such as oxygen deficiency and combustible or toxic gases. DRPGM technology and products exist to minimize such risks. Properly daily verification of the function and accuracy of instruments before each day's use will help to ensure that each worker finishes the job safely.

WORKER SAFETY: THE NUMBER ONE REASON FOR PROPER AND REGULAR CALIBRATION

Safety Meeting Sign-In Sheet

Supervisor:	Subject:
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Name (print clearly)	Signature	Comments / Safety Concerns / Training Requests