Testing, Testing....

Importance of Proper Functional Testing in Gas Detection

Gas detection is a specific science. We caught up with Bob Henderson, President, GfG Instrumentation, Inc., to discuss various types of functional tests and why they are important to any gas detection program.

IHW: What is a "bump test," and how often do you recommend it be performed?

Bob Henderson: Manufacturers and regulatory agencies agree the safest and most conservative approach is to perform a functional test by exposing your gas detector to test gas before each day's use.

Oxygen deficiencies, explosive atmospheres, and exposure to toxic gases and vapors injure hundreds of workers every year. The atmospheric conditions that lead to these accidents and fatalities are usually invisible to the workers who are involved.

The only way to ensure atmospheric conditions are safe is to use an atmospheric monitor. The only way to know whether an instrument is capable of proper performance is to expose it to test gas. Exposing the instrument to known concentration test gas verifies that gas is properly able to reach and be detected by the sensors. It verifies the proper performance of the instrument's alarms; and (if the instrument is equipped with a real-time display) that the readings are accurate. Failure to periodically test and document the performance of your atmospheric monitors can leave you open to regulatory citations or fines—as well as increased liability exposure if a worker is injured in an accident.

IHW: What does OSHA say on the matter of the bump test?

BH: According to OSHA Safety and Health Information Bulletin (SHIB 09-30-2013), Calibrating and Testing Direct-Reading Portable Gas Monitors: "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."

A "bump test" (function check) is defined as a qualitative check in which the sensors are exposed to challenge gas for a time, and at a concentration to activate all of the alarms to at least the lower alarm settings.

It is important to understand what a qualitative test of this kind does and does not do. The test confirms that the gas is capable of reaching the sensors; that when they are exposed to gas the sensors respond; the response time (time to alarm) after gas is applied is within normal limits; and that the alarms are activated and function properly.

However, a qualitative function test does not verify the accuracy of the readings or output of the sensors when exposed to gas. A "calibration check" is a quantitative test using a traceable source of known concentration test gas to verify that the response of the sensors is within the manufacturer's acceptable limits. For instance, a manufacturer might specify that readings in a properly calibrated instrument should be within ±10% of the value of the gas applied. If this is the pass/fail criterion, when 20ppm H2S is applied to the instrument, the readings must stabilize between 18-22ppm to pass the test. It should be stressed that these pass/fail criteria are manufacturer guidelines. Different manufacturers are free to publish different requirements.

Performing a bump test verifies the alarms are activated and that the instrument properly responds to gas. *(photo courtesy GfG Instrumentation, Inc.)*

A "full calibration" is defined as the adjustment of an instrument's response to match a desired value compared to a known traceable concentration of test gas. Once again, the calibration procedure, including the concentration of gas applied; method used to apply gas; and method used to adjust

the readings are determined by the manufacturer. OSHA could not be more clear: Test your instrument before each day's use!

IHW: What causes an instrument to lose accuracy?

BH: The atmosphere in which the instrument is used can have a profound effect on the sensors. Each type of sensor uses a slightly different detection principle. Sensors may be poisoned or suffer degraded performance if exposed to certain substances. The conditions that can affect the accuracy of sensors vary from one type of sensor to the next.

Using a docking station for bump testing saves time and gas, and simplifies good record-keeping. *(photo courtesy GfG Instrumentation, Inc.)*

"Fuel cell" oxygen sensors consume themselves over the use-life of the sensor and will eventually need to be replaced. Defective or malfunctioning O2 sensors may need to be replaced sooner. Oxygen sensors near the end of their use-life may develop other types of performance problems, such as abnormally slow response. For these reasons, performing a daily bump test on oxygen sensors is particularly important.

Catalytic LEL combustible sensors can easily be damaged by exposure to poisons or substances that inhibit the sensor's response to combustible gas. Combustible sensors may be affected by exposure to volatile silicones, chlorinated solvents (such as methylene chloride), sulfides (including H2S), hydrides (such as phosphine and arsine), or even exposure to high concentrations of combustible gas. Sensors may also suffer loss of sensitivity due to aging; mechanical damage, due to dropping or immersion; or loss of sensitivity due to other causes.

While the electrochemical sensors used to measure toxic gases like carbon monoxide and hydrogen sulfide are not worn out or consumed by exposure to CO or H2S, they still eventually need to be replaced when they are no longer able to detect gas. Although CO and H2S sensors may last for years without significant loss of sensitivity, the loss of sensitivity at the end of life may be sudden. Incidental exposure to other substances may also reduce sensitivity. For instance, many electrochemical sensors can be permanently affected by exposure to organic solvents and alcohols. Exposure to methanol is well known to potentially affect the performance of CO and H2S sensors.

Even if a sensor is internally healthy, if gas is not capable of reaching and diffusing into the sensor because of blockage or leakage in the pump or sampling system, or because the external filter has become clogged or contaminated, the sensor cannot properly respond. Thus even "zero maintenance" instruments should be periodically exposed to gas to ensure that the instrument is capable of proper response. Even if the sensor response and readings are correct, if the alarms are not properly activated, or if the instrument fails to operate properly in other ways when exposed to gas, the instrument must be serviced to restore proper function before it can be used. IHW

Editor's Note: *Bob Henderson is President, GfG Instrumentation, Inc., Ann Arbor, Mich. If you are interested in this topic, GfG has an excellent application note, "Calibration requirements for direct reading confined space gas detectors," that discusses these issues in greater detail at the following link: https://bit.ly/3oFXbVm.*