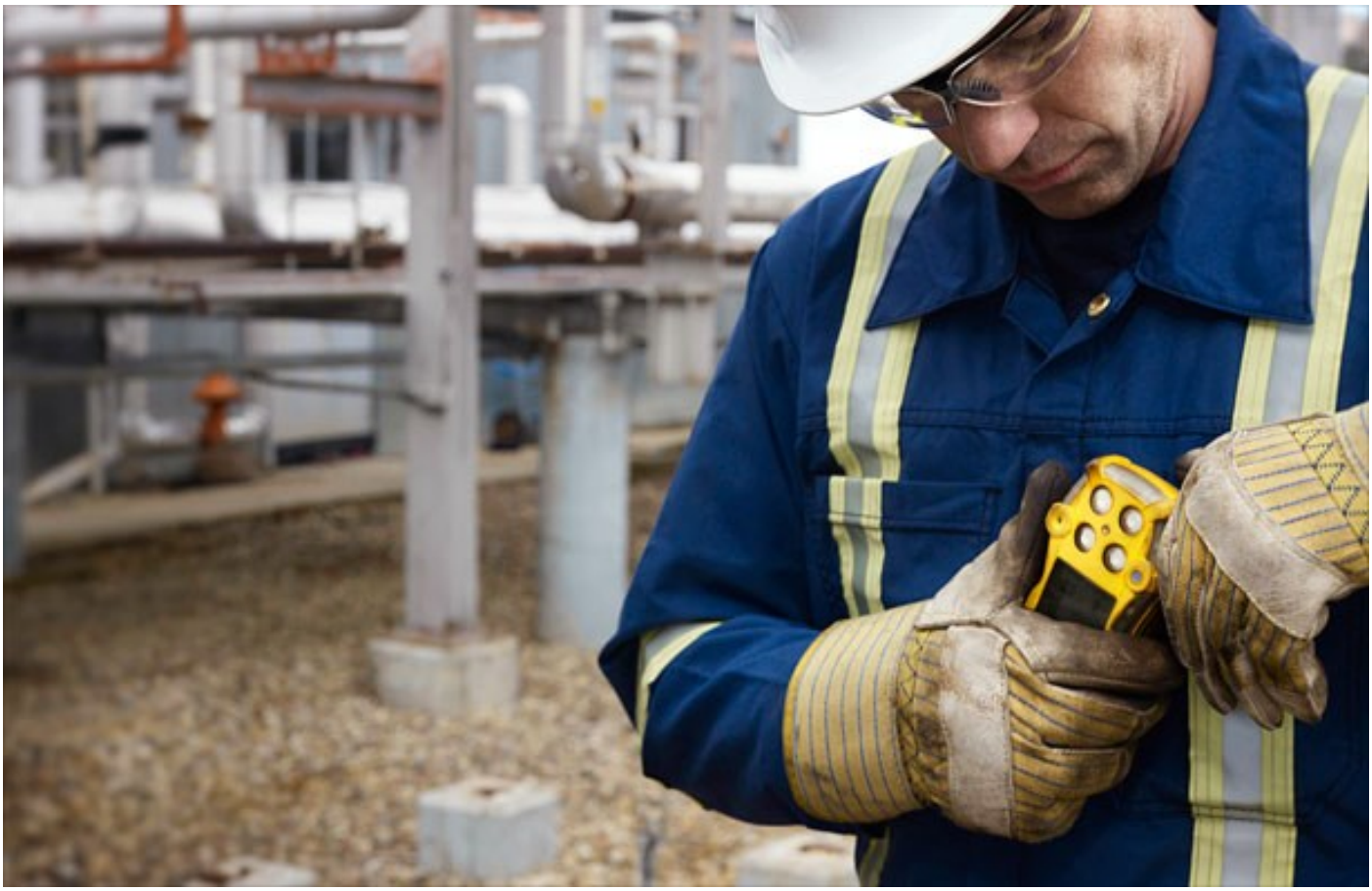
LIFE CRITICAL GAS DETECTORS – WHY TEST EVERY TIME THEY ARE USED ?

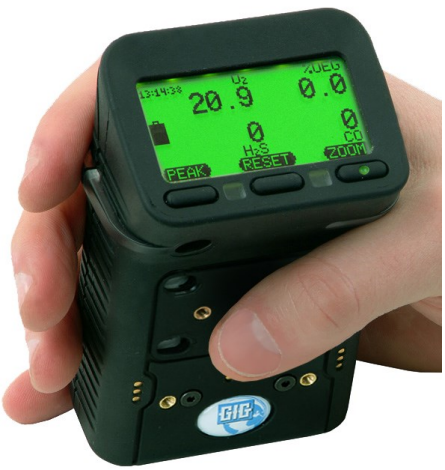
This article follows on from the work of the BSIF Special Interest Group formed to look at detection, measurement and monitoring instrumentation and their initial campaign to increase awareness for the need to 'Bump Test' gas monitors with their 'Bump It' campaign launched at Health & Safety event at the NEC in April 2018.



The remit was to produce a single page document to highlight the need for gas testing all gas detectors used in life-critical situations every time they are used. The campaign is ongoing, the premise supported by all manufacturers of gas detection equipment and many of their major customers. Julian Butler, the author of this article, is involved in this campaign and his personal mission is to make sure that ALL users of life-critical gas detectors ALWAYS do this simple task EVERYTIME an instrument is used by ANYBODY. There have been articles similar to this one published from time to time over the past 20 or so years but still there are instruments being used to this day in life critical situations which are not regularly tested.

The purpose here is to put the flesh on the bones of this campaign and to create a full understanding of why this simple process needs to be done. The 'Bump It' campaign highlighted the standard excuse used that if you have a calibration certificate for your gas monitor then it must work. I liken this calibration certificate to the roadworthiness (MOT) certificate that is issued for your vehicle. On a certain day, at a certain time your car was certified roadworthy. A calibration certificate for a gas monitor is issued with that same premise.

Let’s go back to basics to see why…



Both these certifications work on the premise that the ‘instrument’ being calibrated will continue to function as it should for the next year (or other determined time) as stated by the manufacturer. However both these ‘instruments’ can subsequently go wrong as they are electrical /electronic /chemical entities and at any time.

Oxygen deficiencies, explosive atmospheres, and exposure to toxic gases and vapours injure hundreds of workers worldwide 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 in the event that a worker is injured in an accident.

This functional “bump test” is very simple and takes only a few seconds to accomplish. It is not necessary to make a calibration adjustment unless the readings are found to be inaccurate. The regulatory standards that govern confined space entry and other activities that include the use of direct reading instruments are in agreement with this approach.

However, the definition of “bump test” has always been a little slippery. Some manufacturers differentiate between a “bump test” that provides a more qualitative evaluation of the instrument’s ability to detect gas and a “calibration check” that verifies that the response of the sensor(s) when exposed to known concentration test gas are within the manufacturer’s requirements for accuracy.

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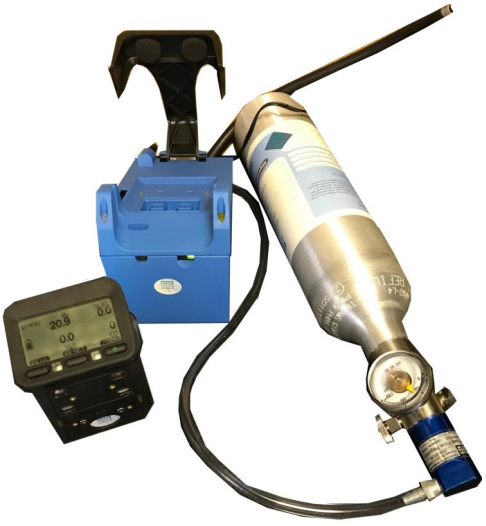
What causes an instrument to lose accuracy?

Single-sensor instruments are designed to focus on a single toxic contaminant or hazardous condition (such as H2S or O2 deficiency), or the presence of a class of atmospheric hazard (such as the presence of combustible gas). “Zero maintenance” single-sensor instruments may or may not include a meter for the display of real time readings, and they may or may not be capable of calibration adjustment while exposed to test gas. Confined space and other types of multi-sensor instruments include several different types of sensors. The type of sensors installed depends on the specific monitoring application. 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 kinds of conditions that affect the accuracy of sensors vary from one type of sensor to the next.

While the electrochemical sensors used to measure toxic gases like carbon monoxide and hydrogen sulphide 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 affect the performance of CO and H2S sensors.

The most commonly used “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.



Combustible sensors are prone to damage due to exposure to poisons or substances that inhibit the sensor’s response to combustible gas. Combustible sensors may be affected by exposure to silicone-containing substances, chlorinated solvents, sulphides (including H2S), or even exposure to high concentrations of combustible gas. Sensors may also suffer loss of sensitivity due to aging or desiccation, mechanical damage due to dropping or immersion, or loss of sensitivity due to other causes.

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” single-sensor 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.

A way forward…

Given the ever increasing requirement for documentation, the capability of instruments to log or automatically retain calibration and testing information is highly desirable. Most data logging life critical instruments automatically update and store dates and other calibration information. Even non-data logging instruments usually include the date, or number of days since the last time the instrument was calibrated.

Most leading manufacturers of gas detectors now offer automatic calibration, bump test or “docking” stations that can automatically calibrate and store instrument calibration records. Docking stations that include fully automatic calibration are redefining the way that users with large numbers of confined space instruments deal with maintenance and calibration issues. Instead of technicians or instrument specialists laboriously calibrating instruments one at a time, instrument users simply drop the gas detector into the docking station.

The docking station automatically bump tests or calibrates the instrument, then updates and stores the test results. Use of automatic calibration stations makes it possible to verify the accuracy of instruments on a much more frequent basis. Docking stations are also able to transparently improve the quality of bump test and calibration checks. Many docking station systems verify not only the final stable reading of the sensor, but the time it takes to reach the desired output level, as well as the shape of the sensor response curve, which can provide important diagnostic information on the health of the sensor.

The prices for automatic calibration stations are beginning to drop in the same way that prices for instruments have been dropping. In the past, it might take a large quantity of instruments to justify the expense of investing in a docking station. As prices continue to drop, customers with only a few instruments are finding that investing in an automatic calibration station makes very good sense.

Direct reading gas detectors are designed to help keep workers safe in potentially life-threatening environments. Verifying the proper performance of your life critical gas detectors should be a mandatory part of every program that requires their use. But more importantly, it’s an essential part of keeping your workers safe.

As the ‘Bump It’ campaign states there should be No Excuses…

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