How To Make Your Workplace Safer

Testing Your Gas Detector Properly Could Save Your Life!

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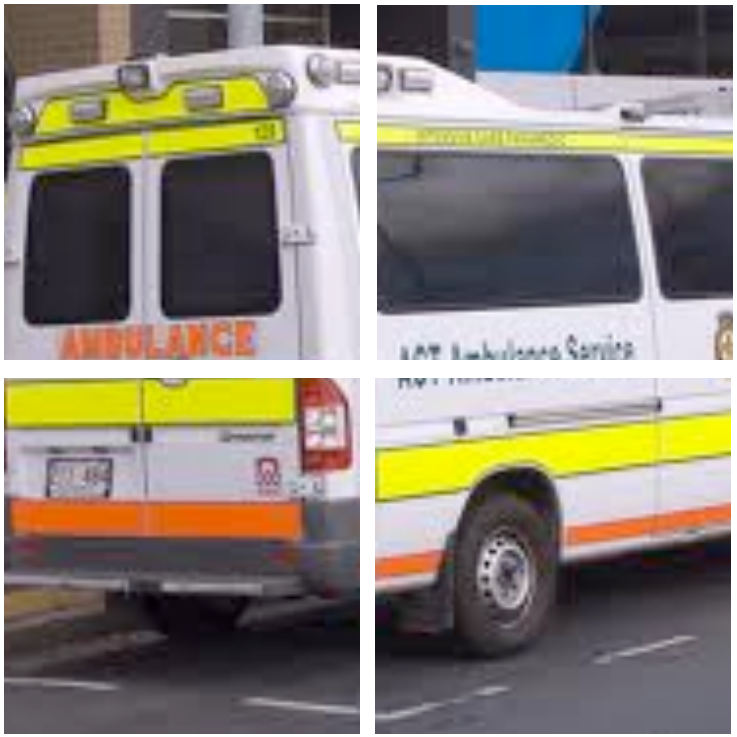


How important is it to check your gas detection device?

According to NIOSH, atmospheric hazards account for **40% of the deaths in confined spaces**.

OSHA found that oxygen deficiency or gas poisoning accounted for a similar percentage of deaths in industry. OSHA stated that asphyxiation was the main hazard in confined spaces, and that atmospheric hazards were the leading cause of death (1).

Individuals still take their life in their own hands by not taking the small amount of time and cost to properly check their gas detection device prior to entering hazardous environments.

Fatality in LPG tank from Oxygen Deficiency

A worker collapsed in an LPG storage tank at a service station due to lack of oxygen. The tank had been purged with nitrogen several times and left to stand for an hour. The supervisor then put his head in the opening of the tank and sniffed the atmosphere but did not detect the smell of LPG.

An employee then entered the tank without any safety equipment. Shortly afterwards he collapsed. A second person then entered the tank to attempt a rescue and also collapsed. The supervisor then introduced pure oxygen instead of air into the tank (this was dangerous as it added to the risk of explosion). The service station employee survived, although there was a delay during the rescue process due to difficulties of access (2).

The Top 8 Reasons Your Gas Detector Won't Work

Here are the top eight reasons your gas detection device may fail:

1. Environmental
Dirt, dust and water impact. These physical affects can block gases and vapours from entering the sensor chamber preventing detection of the gases. This can be either within the sensor area, sampling pump or sample lines.

2. Physical Affects
Dropping and other abuse can damage the instrument from working properly or at the least change the ability of the detector from measuring accurately.

3. Gas Exposure
High gas exposure will change the calibration curve of the sensors causing false or inaccurate readings. Extremely high concentrations can kill the sensor's ability to measure gas. Further, many sensors can fail but not provide a warning that they have failed. In fact, many provide a zero (0) indication on the meter reading which suggests they are working correctly when they are not.

4. Catalytic Sensors Affected by Poisons and Inhibitors
Catalytic combustible gas sensors can be poisoned by silicone based compounds and airborne lead. These kill the sensor. Inhibitors such as sulphur compounds and chlorinated compounds reduce the sensors response (ability to measure). This can slow the sensor response and in some cases reduce the sensor's ability to measure some gases. For example, being able to measure pentane but not methane due to the reduced sensitivity.

All gas detection devices must be calibrated regularly and function/ response tested prior to use for maximum accuracy and safety.

Death by Hazardous Atmosphere and Oxygen Deficiency in Sewer

A water board employee was working to clear a blocked sewer. The equipment the employee was using to unblock the sewer became caught and the employee entered the sewer to free the equipment.

The clearing of the blockage produced a gush of water and released sewerage gases, and the employee collapsed as he was about to climb out of the access hole. A boy on work experience with the employee attempted to pull him out but was unsuccessful. The employee fell back into the sewer and the boy went to get help. The employee was unable to be resuscitated after being pulled from the sewer (2).

5. Electrochemical Sensor Poisoning
In this case sensors can be poisoned by other gases which are adsorbed into the sensor chamber and react with the electrode catalyst.

6. Temperature Affect
Storing instruments in environment which is either too cold or too hot can affect the ability of the sensors to measure accurately.

7. Moisture
Moisture condensing on or in sensor: this can happen to Oxygen sensors when moisture condenses in the capillary tube in the sensor. It will cause the sensor to fail.

8. Calibration Drift
All sensors from all manufacturers drift over time. Calibration brings the sensor back into equilibrium and provides accurate readings

Making Safety Easy

How do I make sure my sensors work?

The only way to guarantee that a gas detection instrument will detect gas accurately and reliably is to **test it with a known concentration of gas**. Exposing the instrument to a known concentration of test gas will show whether the sensors respond accurately and whether the instrument alarms functions properly.

How do I test my gas detection instrument?

Here are the terms used in the industry for ways of testing your gas detection instrument:

- Calibration
- Verification
- Bump Testing
- Function Testing
- Challenge Testing
- Response Testing

Brothers die From Carbon Monoxide Poisoning

Two brothers died of carbon monoxide poisoning in an underground water tank on their father's farm. They had been using two petrol-driven pumps over two days to pump the water out. On the second day, when the water level was lower, it became apparent that neither of the pumps was fitted with a hose long enough to reach the bottom of the tank. To overcome the problem, one pump was lowered about a metre into the tank and secured by ropes.

One brother got into the tank when it was nearly empty. He collapsed and the other brother and a friend quickly climbed in and attempted to rescue him. The second brother collapsed. The friend attempted to rescue the two brothers, but he was also affected by fumes and had to get out of the tank. Neighbours pulled the two brothers from the tank, but both were dead on arrival at the local hospital.

Tests later revealed that the petrol-driven pump was discharging a very high level of carbon monoxide from its exhaust. Calculations confirmed that a lethal concentration of carbon monoxide would be generated in quite a short period of time after lowering the pump into the tank (2).

Q: Who Should Be Testing?

A: All testing other than calibration should be done by the operator (end user).

What do these terms actually mean?!

The above terms are used by the gas detection industry globally, but the definition these terms are inconsistent. In fact the term "Bump Testing" can be defined differently from one person to the next. This is a major cause for concern, as it creates confusion. Here we will define calibration, verification and bump testing and note when the other terms are used.

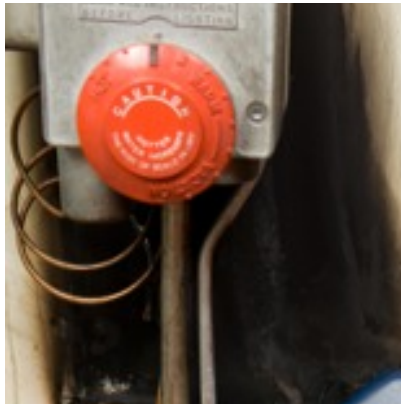
Instrument Verification

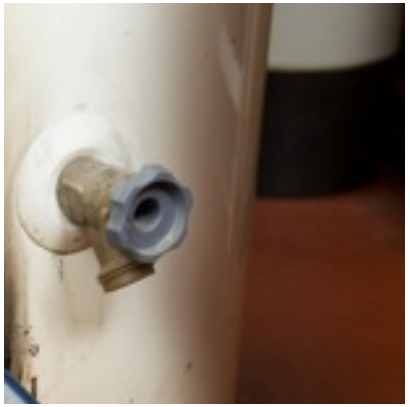
Verification is the process of determining the instrument is still accurate and is within accuracy requirements for all sensors. The procedure **does not make any instrument adjustments** but rather compares the instrument response to a known concentration of test gas over a specific length of time.

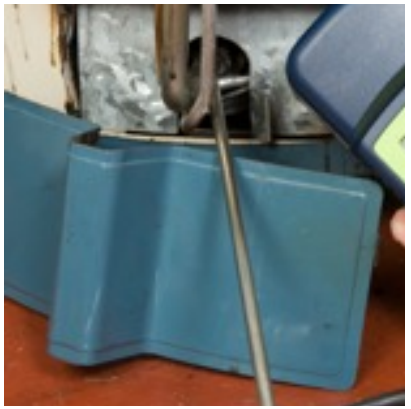
Provided the response reaches a satisfactory level relative to the test gas (+/-) then the instrument is considered accurate and is ready for use. The customer would determine what level of accuracy was acceptable (example +/- 10%). Typically this would take 90+ seconds depending upon sensor type.

Should the sensor fail to respond to a satisfactory level then the instrument should be taken out of service and sent for calibration.

The terms function test, functional bump test or response test are often used for this process. AS/NZS 60079 uses the term 'response check' to describe this test.







Q: Do I Need To Use Test Gas?

A: Yes, testing your gas detection instrument with test gas is the only way to ensure the gas detection device is working correctly and that you can be confident it will measure the atmosphere you are working in.

Gas Calibration

Calibration is all about ACCURACY. Calibration refers to an instrument's measuring accuracy **relative to a known concentration of gas**. Calibration determines the relationship between an instrument's readings and actual concentration of the component gas of interest.

The more accurate you want your instrument the more often you will calibrate it. Issues affecting sensor performance noted above will also determine frequency of calibration. Your application should determine calibration frequency.

Calibration requires adjustment of the instrument either manually or automatically and therefore should be limited to those with appropriate training or via pre-programmed calibration systems.

Bump Testing

The term bump testing is now used globally but is defined differently by many users which causes confusion. It is important that all employees are clear on what is required when using the term “Bump Testing” in order to prevent miscommunication and misunderstanding in the workplace which could lead to a fatality.

Q: What do I do if the Sensor fails the Test?
A: Should any sensor not respond or the alarms not react, the instrument should be taken out of service and sent for maintenance and calibration.

Common Definition 1

Bump Testing is the process of applying a test gas to the instrument and observing that each sensor responds to the gas with their reading increasing (LEL, toxic sensors) or decreasing (O2) and that all alarms, both visual and audible, turn on. This demonstrates the overall operation of the gas detector but **does not check the reading response for accuracy**.

This test confirms that the instrument will detect gas in the workplace. This type of bump testing is really confirming the instrument works. The typical length of the time this test takes would be 30 around seconds depending upon the sensor type.

Common Definition 2

Several standards and resource materials define the term ‘bump testing’ for the process we have defined above as ‘verification’. **In this case they are checking for accuracy of the sensors where in definition #1 they are not.**

Q: How often should I bump test?
A: PRIOR TO USE!

What are the Bump Test Standards?

What do different standards or reference materials recommend about “bump testing”?

“It is recommended that this is done by personnel actually operating the apparatus and is strongly recommended that it is performed before each day of use”

AS/NZS 60079.29.2.2008: Gas Detectors- Selection, use and maintenance

“Gas monitors used for the purpose of atmospheric monitoring within a confined space should be maintained and used in accordance with manufacturer’s instructions and warnings and in reference to AS/NZS 60079”

AS 2865-2009: Australian Confined Space Standard:

“A bump test or full calibration of direct-reading portable gas monitors should be made before each day’s use in accordance with manufacturer’s instructions using appropriate test gas”

OSHA – Verification of Calibration of Direct-Reading Portable Gas Monitors Bulletin SHIB 05-04-2004:

“The only way to ensure that a combustible gas meter is accurate and fully functional is to complete a function or bump test before use. A functional or bump test is a field test that is done at the start of each shift or before the meter is used”

Worksafe Alberta Bulletin

CSA (Canadian Standard Association) requires by law *all instruction manuals include a statement for testing gas detectors prior to use.*

“Any atmospheric testing and monitoring in a confined space should be carried out by a competent person using a suitable, correctly calibrated gas detector”

Safe Work Australia: Code of Practice Confined Spaces:

*“Most gas detector manufacturers recommend a daily functional test in line with 60079 which involves the simple application of a test gas in order to trigger the alarm modes and demonstrate overall operation of the equipment.Recent advice from the **International Safety Equipment Association** extends this to carrying out a function test if there is a change in custody of the equipment, which could include one user handing over a detector to another.”*

The COGEM GUIDE to Gas Detection: 2012

Manufacturers and standards associations are strongly recommending bump/function/ response/challenge testing prior to starting a day’s work.

CAC Gas & Instrumentation Pty Ltd has joined together with Scientific and Technical Gases Ltd (UK) to market their precision gravimetric calibration gas and high purity specialty gases throughout Australia and New Zealand.

With over 75 years of experience in calibration gases, gas detection and gas analysers, CAC brings practical knowledge and skills in understanding customers requirements and providing a total customer solution. CAC provides specialty calibration gas mixtures that are presently a challenge to obtain even in small quantities.

Visit www.cacgas.com.au for more information and resources

Document References

1. Epidemiology of Confined-Space-Related Fatalities - Authors Anthony Suruda, M.D., M.P.H., Dawn N. Castillo M.P.H., James C. Helmkamp Ph.D., Ted A. Pettit, M.S., R.E.H.S.

2. "Compliance Code-Confined Spaces"-- Worksafe Victoria, September 2008.