Incorrect use of monitoring equipment in confined spaces can endanger workers

Several workers in a vault below a bridge could have been poisoned by carbon monoxide (CO) from gas-powered tools they were using in the confined space. The air monitoring equipment being used to check for toxic gases could not sound an alarm if CO reached dangerous levels because there was no CO sensor in the instrument.

Gas monitoring instruments are designed to protect workers from unseen workplace hazards. Exposure to toxic gases or an oxygen-deficient atmosphere can cause serious illness and even death.

Gas monitors must be used whenever practicable to ensure the safety of workers in confined spaces. These monitors typically provide continuous readings of the oxygen level and any explosive gases or vapours, or other harmful gases, that may be present (for example, CO). If the concentration of any of these gases exceeds preset limits an alarm will sound, warning workers to leave the confined space.

How do I know if toxic gases are present?

The hazards of a confined space must be identified by a qualified person. Any toxic gases likely to be present will depend on the nature of the space (for example, hydrogen sulfide in a sump) and the work activities taking place within the space (for example, painting, welding, or the use of gas-powered tools).

Who is a *qualified person*?

A *qualified person* is a professional who has experience and training in recognizing hazards in confined spaces, evaluating and controlling those hazards, and using monitoring equipment. A qualified person includes any of the following:

- Certified industrial hygienist (CIH)
- Registered occupational hygienist (ROH)
- Certified safety professional (CSP)
- Canadian registered safety professional (CRSP)
- Professional engineer (PEng)

How are toxic gases measured?

Gas monitors contain sensors that detect specific toxic gases (for example, CO, hydrogen sulfide, and nitrogen dioxide), as well as oxygen-deficient and explosive atmospheres. It is vital to worker safety that these monitors be properly configured, calibrated, and maintained. Instrument inaccuracy can lead to serious accidents — for example, monitors with sensors for chlorine and hydrogen sulfide will be of no use in a confined space that contains CO and nitrogen dioxide.

A qualified person must ensure that monitoring instruments used in confined spaces have the proper sensors installed for the gases being measured.

Worker testing a confined space on a barge

How important is calibration?

Maintaining and calibrating an instrument will ensure that it is working properly so it can accurately detect the gas (or gases) it is designed for. Full calibration involves adjusting the instrument's reading to match the actual concentration of a certified standard test gas. A "bump test" verifies that the instrument is working properly by exposing it to a known concentration of gas.

Monitoring equipment must be calibrated according to the frequency specified in the manufacturer's instructions, and should be bump tested prior to use.

What about alarm settings?

Alarm settings vary depending on the configuration of the space and the gases being monitored. The Occupational Health and Safety Regulation references a table of occupational exposure limits (OELs), which includes 8-hour time-weighted averages, 15-minute short-term exposure limits, and ceiling limits.

A qualified person should set alarm limits based on all of the following:

- The hazard assessment of the confined space
- The length of time workers will be in the space
- Work activities taking place in the space
- The exposure limits for the contaminants of concern

Table 1 lists some of the more common hazardous gases that might be present in a confined space, as well as the corresponding OELs and suggested starting points for monitor alarm settings. Monitors with dual alarms should have the lower alarm set to alert workers to changing and developing atmospheric conditions within the confined space. It is recommended that the first (lower) alarm be set below the OEL (for example, to 50% of the OEL).

Table 1: Common hazardous gases that might be present in a confined space

Substance*	8-hour time-weighted average (TWA)	15-minute short-term exposure limit (STEL)	Ceiling limit (never to be exceeded)	Immediately dangerous to life and health (IDLH)	Recommended alarm settings (low / high)
Ammonia	25 ppm	35 ppm	—	300 ppm	13 ppm / 25 ppm
Carbon monoxide	25 ppm	100 ppm	—	1200 ppm	13 ppm / 25 ppm
Chlorine	0.5 ppm	1 ppm	—	10 ppm	0.25 ppm / 0.5 ppm
Hydrogen sulfide	—	—	10 ppm	100 ppm	5 ppm / 10 ppm
Methane	1000 ppm	—	—	—	500 ppm / 1000 ppm
Nitrogen dioxide	—	—	1 ppm	20 ppm	0.5 ppm / 1 ppm
Sulfur dioxide	2 ppm	5 ppm	—	100 ppm	1 ppm / 2 ppm
Oxygen	—	—	—	—	20.5% of atmosphere
Lower explosive limit (LEL)	—	—	—	—	5% LEL

* This is not a complete list. The substances to be monitored during any confined space work must be identified in the hazard assessment conducted by a qualified person.