Dealing with Confined Space Entry

Confined spaces can be found in a wide variety of industries and applications and these environments can present an array of hazards for operators. As the name might suggest, a confined space is a location with a limited volume size and can be defined as having the following attributes:

- The space itself must be large enough for a worker to enter but be too small to allow continuous worker occupancy to take place
- The area features limited openings for entry and exit, causing air flow to be compromised

There are many examples of confined space environments in industry including aircraft fuel tanks, underground utility vaults, wine fermentation tanks and sewers.

Some confined spaces may require permits to enter, owing to the fact that they contain potentially hazardous atmospheres or materials that have the potential for engulfment. Inwardly sloping walls or floors can also pose dangers, because they reduce the volume of the space, and may also require a permit to enter.

Regardless of whether the area is permit required or not, all confined spaces should be treated as sources of potential gas hazards.

Why are confined spaces dangerous?

The limited volume size in a confined space allows dangerous gases to build up more quickly. In addition, inadequate air flow can allow the displacement of Oxygen by other gases, causing the risk of asphyxiation to an operator entering the area.

Some confined spaces require a permit to enter, due to the danger associated with them. Regardless of whether a permit is required, all confined spaces should be treated with caution and these environments need to be fully evaluated for hazards before they are entered. This includes stratified testing of the atmosphere in the space, prior to entry, to ensure it is free of gas hazards.

What gas hazards are likely to be encountered in confined spaces?

Typically, confined spaces can contain a variety of hazards including Hydrogen Sulphide (H_2S), Carbon Monoxide (CO), Methane (CH_4) and Oxygen deficiency.

H_2S

H_2S or Hydrogen Sulphide is a toxic gas that is produced as a by-product of microbial activity. It is highly toxic and at concentrations less than 30ppm is identifiable by its strong odour of rotten eggs. At concentrations higher than 30ppm, H_2S paralyses the olfactory nerve, stopping the sense of smell. At concentrations of 500 to 700 ppm, death will occur within 30 mins to 1 hour. Hence you cannot rely on smell: you need a gas detector.

CO

CO or carbon Monoxide is a toxic gas that is produced by the incomplete burning of fossil fuels such as oil, gas and coal. During normal combustion, Carbon Dioxide is produced (CO_2) but when there is not enough Oxygen, CO can be produced instead. CO is absorbed by haemoglobin in our blood and prevents Oxygen being absorbed, causing the victim to die of asphyxiation. At concentrations of 400ppm, CO will start to cause nausea, dizziness, headache and sickness. At concentrations of 800ppm, death will occur half an hour after exposure. CO has no odour, it is invisible and highly toxic.

CH_4

CH_4 or Methane is a combustible gas that is produced by the decomposition of organic materials. CH_4 is also the main constituent of Natural Gas (typically makes up 94% – 98% of natural gas) and as a result, leaks in gas pipes can be another source of Methane.

Oxygen Deficiency

Normally Oxygen makes up 20.9% of the atmosphere and an Oxygen deficient environment is described as one where Oxygen levels are 19.5% or less. Oxygen can be displaced by toxic or inert gases. Microbial action, oxidation caused by rusting metal and combustion can also cause an Oxygen deficient environment. At 19.5% Oxygen the operator will feel drowsy. At 17% and less cognitive processes and coordination will be severely compromised. At levels of 6% or lower, death will occur quickly. Some confined spaces – such as ships – are filled with an inert gas to limit the amount of O_2 below 2% and thus the risk of an explosive atmosphere.

Although these are the most likely gases to be encountered in confined spaces, other gases can also be found. This means that the use of a multi-gas portable is essential for any worker planning to enter this type of location.

Conducting a pre-entry check before entering a confined space

Testing the atmosphere of a confined space at all levels is essential as some gases are heavier than air (such as H_2S, which is slightly denser than air), some lighter (such as CH_4), and some the same density (such as CO). It's important to use a multi-gas detector capable of monitoring for the gas hazards expected to be in the location in question.

A multi-gas portable capable of providing simultaneous monitoring of H_2S, CO, Oxygen and combustibles (%LEL) is essential for safe confined space entry (please note: the sensors used with any portable device must reflect the known hazards likely to be in the environment). Additional protection can be provided by a 5-gas portable gas detector, allowing an extra sensor to protect against other potentially deadly gas hazards that are specific to a jobsite or industry.

To avoid unnecessary risk, the operator should not directly enter the area but test the atmosphere from outside of the confined space. The use of a gas monitor and pump combined with a sampling hose will allow the operator to take readings at various levels, without actually having to enter the area themselves. Sampling hoses are available at different lengths to fit the different confined space requirements.

Many gas detection companies like BW Technologies by Honeywell can provide confined space gas detector kits, which include all the equipment needed to safely monitor a confined space prior to entry. Some devices, like the GasAlertMax XTII and the GasAlertMicro5 from BW Technologies by Honeywell are already optimised for confined space use with an integrated pump and a sampling hose with particulate filter supplied as standard.

Once the space has been fully evaluated for gas hazards and is deemed to be safe for worker occupancy, it's important to keep continuously

monitoring the area to ensure that its atmosphere remains safe. If a hazardous atmosphere is identified at any point, the operator must leave the area immediately, re-evaluate the space and take corrective measures.

Ensure you have the right equipment to do the job

A 4-gas portable detector like GasAlertMax XTII by BW Technologies by Honeywell, which is capable of monitoring CO, H_2S, combustibles (%LEL) and O_2 depletion with integrated pump and sample hose supplied as standard, is the ideal solution for confined space entry.

When additional industry specific gases are likely to be present a 5-gas monitor such as GasAlertMicro5 from BW Technologies by Honeywell is an ideal choice, because it provides one further sensor and supports a wide range of additional gases.

Depending on the type of area being accessed, you may also require additional specification such as water resistance; particularly important for locations like sewers where water is likely to be present.

Because space can be limited, it can be advantageous to have both hands free to undertake the sampling, so a carrying holster which can also accommodate the sampling hose can help to simplify pre entry checks.

While working in the confined space, the portable detector can be clipped to clothing (usual fastening is a crocodile clip), allowing hands to remain free to do work required in the area, whilst continuous monitoring is taking place. Additional ways of using the device hands free include the use of neck straps, armbands or hard hat clips.

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Make sure your equipment can keep you safe with bump testing

Workplace environments can be harsh and gas detectors can be subjected to all kinds of conditions that can affect their operation. The only way to guarantee an instrument will detect gas accurately and reliably is to test it with a known concentration of gas. Exposing the instrument to test gas will show whether the sensors respond accurately and the instrument alarms properly.

The instrument reading is compared to the actual quantity of gas present, as indicated on the cylinder. If the instrument's response is within an acceptable tolerance range of the actual concentration, then its calibration is verified.

One way to help simplify mandatory bump testing requirements is to use an automatic test station like MicroDockII from BW Technologies by Honeywell; this device works with all of BW Technologies by Honeywell's portable gas detection range, providing simple, one button bump testing in less than two minutes. MicroDockII is designed to conform to the most advanced legislations and provides a simple solution to portable device safety. Because of its simple docking facility and easy operation, MicroDockII also helps to reduce the training needed to carry out bump testing, helping to provide cost-savings on the ongoing cost of portable gas detection.