# WHITE PAPER

## Keeping You Safe At Sea

Keeping teams in the marine industry safe at sea is something Crowcon are extremely passionate about. This paper is aimed at exploring the dangers and challenges individuals face, and offers resources and solutions that can safeguard crews in this sector from the unpredictability of working upon the waves.

The gas-related risks encountered vary greatly depending on the type of vessel and the materials being carried. Vessel types include LNG carriers, bulk carriers, oil tankers, LPG carriers, FPSO and shuttle vessels to name a few. Within all of these vessel types, dangerous gas concentrations can form in the atmosphere at any time.

The presence of liquid gas, fuel, chemicals and other fossil fuels in vessel environments pose extreme dangers, including a risk of explosion, asphyxiation from the lack of oxygen during normal transport, loading and unloading and other processes, for instance cleaning.

Due to the many and varied risks, it is important for crews to be properly equipped with the correct detection equipment, and that all of it is suitably maintained. This paper will explore how to maintain these safety responsibilities in the face of demanding logistical and timeframe considerations.

CROWCON
Detecting Gas Saving Lives

# A Challenging Environment

Working in the marine sector is hazardous and challenging, with wide ranging risks to deal with, from severe weather, to working within restricted spaces. These are just some of the challenges that are prevalent in this industry.

However, it isn't just the challenges of the ocean environment that go hand in hand with working in the marine sector, there are also hazards raised by the applications and equipment used on board. Marine applications can sometimes generate extreme temperatures, high humidity, a range of pressures, both clean and dirty conditions. There is a need for $O_2$ monitoring in some cargo, and the monitoring of flammable and toxic gases within void spaces, pump rooms and elsewhere on board, as well as fixed systems with sampling to ensure all round safety when no one is present in a location.

As mentioned earlier, the task being undertaken depends on which fuels, chemicals, and gases (or solvents) are present. Applications of concern that may be subject to the presence or build-up of toxic or flammable gases include the gas supply in engine room pipelines, the inerting or purging of cargo, presence of vehicles or exhausts from generators and other equipment, clearance measurements in tanks and cargo bays, confined space entry such as into a hold space, and leak detection.

Carbon monoxide CO, which is often referred to as the 'silent killer' due to its odourless and colourless characteristics, is of particular concern. CO can be generated just by bacterial action on bulk cargos like wood chips, or when a carbon-based fuel, like gasoline, charcoal, propane, or oil burns with incomplete combustion. Nitrogen Oxides ($NO_x$) is also generated by combustion at high temperatures. These dangerous gases can both come from engine exhaust fumes, however CO doesn't need the high temperatures. All it needs is incomplete combustion, or just combustion without enough oxygen present, which can be from onboard generators or even cooking ranges, and it has a very real impact on human health.

CO enters the bloodstream through the lungs and makes it difficult for the respiratory system to distribute oxygen around the body as the blood cell oxygen transport sites become temporarily used up by the carbon monoxide. Individuals will then experience shortness of breath, particularly when undertaking strenuous activities. If ingested in such large volumes as to use up the majority of the red blood cell oxygen transport sites, it can lead to unconsciousness and even death.

NOx accumulation can also cause breathing problems, headaches, chronically reduced lung function, eye irritation, loss of appetite and corroded teeth. It is worse for asthma sufferers, with exposures often leading to attacks.

Oxygen deficiency is also a risk in marine applications and is often caused by the process of oxidation. When metals rust, which is a form of oxidation, oxygen is consumed by the oxidation process using it up. In confined spaces, which are common on ships, any reduction in oxygen is bad, because it then isn't available for people to breathe. If the compartment where oxidation is occurring has no way to allow a circulation of fresh air in, then it could quickly become an oxygen deficient atmosphere.

When the level of oxygen in the air drops below 19.5% it becomes dangerous for those entering. As oxygen levels deplete further individuals will experience respiration difficulties, from 16 % - fainting, nausea, sickness, unconsciousness, and finally comas and death when levels reach 4 to 10%. As most vessels are made of steel, and steel is subject to rusting, it is important to remain aware of this issue and to implement

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proper monitoring within the relevant ship environments – either using fixed apparatus or by carrying out confined space entry checks using portable gas detection equipment.

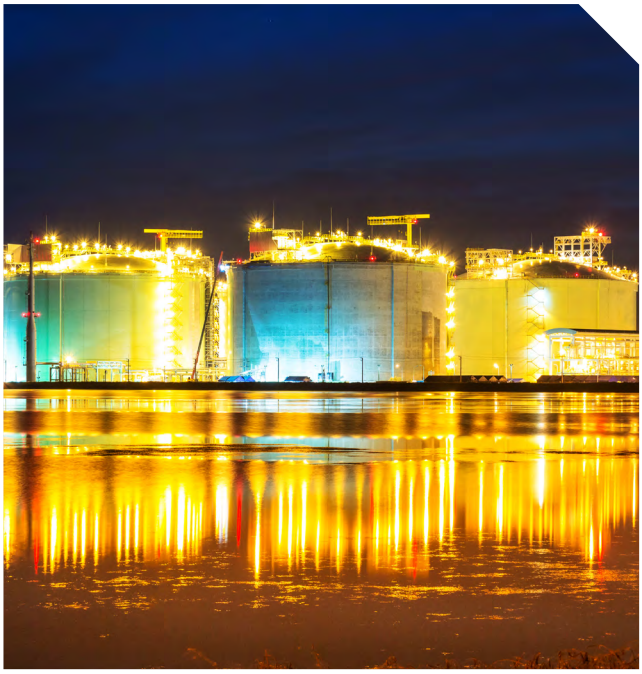
Monitoring within confined spaces is particularly important in line with the risks mentioned above. Confined spaces include tanks, manholes, boilers, furnaces, hoppers, vaults, trenches, bins, pipes, and vaults.

Another risk within vessels is the risk of combustion or explosion from the gases present. Combustible gas risks include methane, hydrogen, propane, LPG, solvents and gasoline fumes among others.

Toxic gas risks are also often present in ships. Hydrogen Sulphide ($H_2S$), for example, can form in vessels and if present at moderate levels can cause a range of health issues from irritation to the eyes and respiratory system, apnea, coma, convulsions, to dizziness, headache, weakness, irritability, insomnia and stomach upsets.

Safety4Sea reported on the dangers of hydrogen sulphide in their editorial, drawing particular attention to an incident where dangerous levels of Hydrogen Sulphide ($H_2S$) gas formed within a waste oil tank on a vessel. The high concentration of gas was caused by biodegradable cleaners breaking down oils in an anaerobic (low oxygen) environment evolving $H_2S$ as a by-product. The situation had existed for a long time and was noticed by the crew due to the 'rotten eggs' smell. Crew onboard utilised detection equipment and found significant $H_2S$ concentrations (>200 PPM) in the vessel's engine room bilge holding tank. This concentration of the gas is considered Immediately Dangerous to Life and Health (IDLH).

Cargo tanks can utilise vapour emission control systems to analyse waste vapour gas for oxygen content and other gases. Installing this type of system provides information on the contents of confined spaces containing potentially dangerous or unbreathable atmospheres.



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## Challenges – servicing and calibration

It is clear from the risks outlined so far that implementing reliable and robust gas detection equipment on every vessel is paramount. Without the correct equipment, monitoring of the presence and concentration of hazardous gases within marine environments could not take place. Regular servicing and calibration ensure ongoing safety, lowering risks to the crew.

Calibration on board can require a wide array of instruments and procedures for which maintenance personnel can need significant training. It is the responsibility of the Chief Officer who is accountable for the condition monitoring and maintenance of all the portable and fixed gas measurement devices on a ship. Where gases are needed to calibrate or regularly test systems, that responsibility extends to checking the gas inventory on board, and any consequent safety measures, for example observance of high pressure cylinder storage.

Each gas detector has a calibration period, and each unit needs to be calibrated for a specific gas type, sometimes more than one gas type, such as combustible gas and oxygen. There can be limitations to the calibration of devices on board and so it is necessary to understand these and follow the manufacturers handbooks for full usage information. Due to the varying complexity of the calibration, some instruments may need to be serviced or calibrated ashore.

In order to stay abreast of the dates for calibration and monitoring, equipment used for this purpose should be noted with the next due date for calibration and servicing. This avoids important dates being overlooked or missed.

Calibration of some equipment types requires the use of gas concentrations that are not acceptable for use or storage on some vessels. This equipment must therefore be periodically removed for calibration or maintenance elsewhere.

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## Timeframe and logistics

Clearly calibration and maintenance of equipment is very important. However, on board there can be timeframe related challenges, as well as logistical issues to overcome to fit all of these tasks in. When the crew's safety depends on ongoing maintenance these tasks cannot be overlooked.

Marine sector gas detection can be designed in during the ship design or building process, for example many drilling vessels, FPSO and support or operation vessels for drilling, as well as carriers. Or it can be fitted subsequent to a risk assessment being carried out.

Alternatively the need for calibration and equipment servicing on active vessels can be obviated by maintenance in port. This can be specifically tricky to schedule as vessels dock at ports across a very short time span, usually between 24 and 72 hours only. Most vessel owners choose not to liaise directly with the service provider due to time constraints and scheduling issues and will approach the ship chandler about miscellaneous items.

Under the SOLAS regulations, as detailed below, the vessel must have a means of calibration on board and will be required to show proof of this calibration on all detectors before leaving for the next port.

As this window for calibration turnaround is very fast, often utilising the Original Equipment Manufacturer (OEM) is not the fastest choice, this is where the ship chandler and marine equipment supplier can help to respond within quick timeframes. Crowcon can help with these calibration and servicing requirements, as can other third party calibrator and fire system inspection companies, specifically those actively in contact with the vessels as they arrive at port.

Timeframes and logistical requirements vary depending on the region, within China vessels usually only stay for 24-48 hours at the dock and there is little time for customers to ship devices back to supplier offices. Third-party suppliers can, in this case, provide the calibration work, and, due to often having an office near the dock, will be able to turn work around quickly and efficiently.

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## Compliance with Regulations

The monitoring of hazardous gases on board a ship is required to ensure the safety of the crew. It is also a legal requirement for every ship to carry at least one portable atmosphere-testing instrument, with a minimum of being able to measure concentrations of oxygen (O2), flammable gases or vapours, hydrogen sulphide (H2S) and carbon monoxide (CO) prior to entry into enclosed spaces.

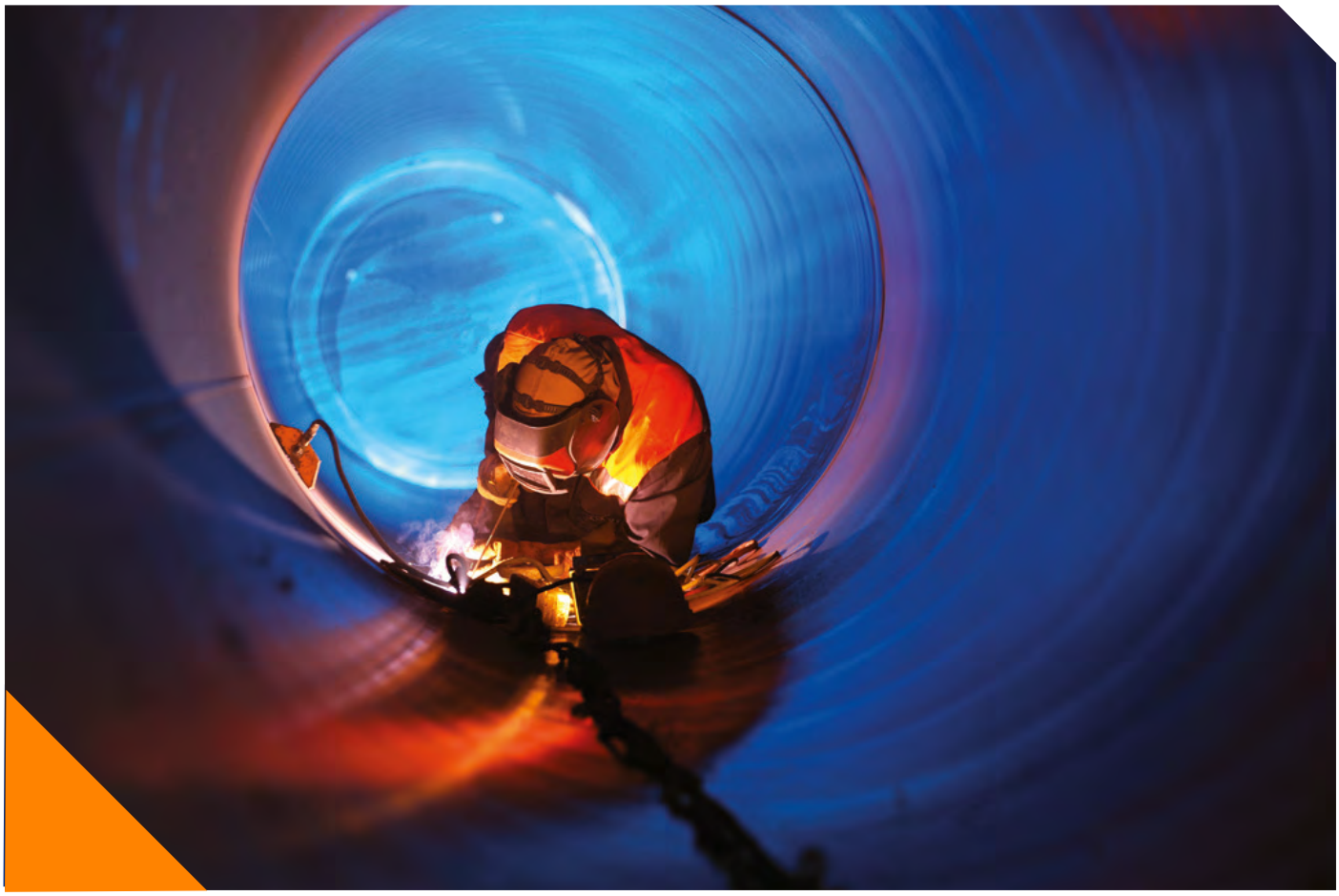
The SOLAS regulations XI-1/7 requires that vessels must have at least one portable gas monitor on board for oxygen and flammable gas detection. The regulation also requires personal and fixed detectors to be widely used in various locations throughout the vessel.

SOLAS is The International Convention for the Safety of Life at Sea and is an international treaty that requires specific safety standards for marine vessels.

Marine Equipment Directive 2014/90/EU (MED) is the European Union marine safety standard which establishes performance and testing standards which have to be met by equipment placed on board an EU ship. It covers equipment outlined under the International Conventions, as developed by the International Maritime Organization (IMO). These include life-saving appliances, navigation equipment, radio equipment, marine pollution equipment, and those relating to the prevention of collisions.

In North America, the US Coast Guard (USCG) regulations require minimum standards for recreational vessels and their safety equipment.

As a result of the multiple different standards, all products sold for use on a vessel must comply with the standards relevant to the country in which the ship is registered. For example, products fitted to a European-registered vessel undergoing a re-fit in Singapore must comply with the European MED directive.



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## Prevention Through Detection

Utilising the appropriate detection equipment can be overwhelming due to the array of applications within a vessel that require monitoring, and the varied array of fixed, portable and area gas monitors available.

The capability and type of gas monitors required obviously depend on the type of vessel, what it is carrying and what confined spaces it has. Either fixed or portable gas detection monitors may be suitable for your vessel or environment and so it is important to liaise with reliable and reputable providers that meet compliance standards when specifying or investing in new equipment, or servicing existing equipment.

If the requirement is to detect gas around a person’s breathing area, then a portable gas detector is the recommended choice. Crowcon’s portable monitors such as the Gas Pro, T4 or Gas-Pro TK are all suitable for marine usage and meet the relevant safety standards. Portable monitors can be attached to workers clothing using clips and ensures they can remain informed about the risk of areas as they move around and work within them, ensuring they know to leave the dangerous space if necessary.

Fixed systems, such as Crowcon’s Xgard Bright and Xgard, and Control Panels such as Crowcon’s Gasmonitor Plus, Vortex and Addressable Controllers, are relevant for monitoring within environments where space is at a premium but where gas dangers are present. They are versatile and so can be tailored to work within a variety of spaces to detect a number of gas types. There is also the SMART S-MS MED fixed detector and the MULTISCAN++MED control panel which are specially designed to meet with the harshest conditions of Marine environments and are Marine certified by Lloyd’s Register.

# The SMART S-MS MED is designed specifically for use in marine environments and is certified by the Lloyd's Register in accordance with MED/3.54 Regulation.

## SMART S-MS MED


Designed to meet with the harshest conditions of marine environments, the SMART S-MS MED line allows for the monitoring of flammable gas contents by employing catalytic or infrared technologies.

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## Providing Peace of Mind

Ensuring safety for marine personnel working on board challenging vessels internationally is extremely important. Crowcon is passionate about doing just this. We offer a wide range of robust and reliable equipment, with compliance to international standards and regulations, as well as calibration and servicing solutions to meet the challenges of those working within the marine industry with limited infrastructure and restrictions on various gas types, concentrations and pressures.

Choosing a reputable provider is the best way to ensure the safety of your team, providing peace of mind for all on board to undertake their daily activities without the added pressure of maintenance and calibration.

For more information about gas monitoring in marine environments and the detection equipment Crowcon offers, get in touch with a member of our friendly team.

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