WHITE PAPER

The Importance of Gas Detection In The Construction Industry

How to minimise gas hazards and risk with the application of advanced gas detection technology

People who work in the construction industry are exposed to the risk of harm arising from hazardous gases. In 2019/20 there were 8 fatalities and more than 200 non-fatal incidents related to harmful gas exposure in the UK, whereas the previous two years recorded two fatalities in total within the UK construction industry.

It is evident that volatile organic compounds (VOCs), which are emitted as harmful gases, pose a significant risk to employee health and safety in the construction industry. Minimising the risk of harm due to dangerous gases is a problem that demands urgent attention.

The risk comes from a variety of sources – naturally occurring, industrial, and by-products of combustion and other construction activities. In the construction industry, there are five main sources and applications of hazardous gases – building material storage, welding, trenching, land clearing, and demolition.

In this whitepaper, we will examine the main sources and applications of dangerous gases, the risks that they pose, and how the risks are being managed, both globally and nationally in the UK.

CROWCON
Detecting Gas Saving Lives

Construction applications that apply or generate hazardous gases

Building material storage

The construction industry uses a number of VOCs and hazardous chemicals such as adhesives, paint, and flammable gases which are stored on site in tanks, cylinders and containers. If these items are incorrectly stored or damaged during transit, they can pose a hazard to site personnel including the risk of asphyxiation or explosion.

In the UK, the Health and Safety Executive (HSE) sets out guidelines for the safe storage of hazardous chemicals and gases, which includes guidance for correct ventilation, compatibility with other stored materials, stacking and storage layout, on-site transportation, container maintenance, and containment of leaks and spills.

Welding

Welding is a construction activity that uses hazardous flammable gases, such as acetylene, argon, hydrogen, and propane. The most common type of on-site welding is MIG or TIG welding which often uses a carbon dioxide and argon mix.

During welding activities, fumes are released as the metal is heated above its melting point, causing evaporation and condensation into fumes. In addition to metal particulates that may affect long term health, welding fumes may contain nitrogen oxides, ozone, hydrogen chloride, phosgene, and carbon monoxide, which makes them a potential risk to on-site personnel, especially in confined spaces. Appropriate ventilation is essential if some serious health risks are to be avoided.

In 2018, the International Agency for Research on Cancer (IARC) classified welding fumes as a carcinogen, based on strong evidence. Therefore, welding fumes need to be carefully monitored and controlled to ensure health and safety of construction workers.

Trenching & Excavation

All construction projects involve some degree of land trenching and excavation. As well as the risk of cave-ins, digging activities can also result in the release of toxic gases when gas pockets are breached or sewer or gas pipes are accidentally ruptured.

Additionally, exhaust gases from machinery can accumulate to dangerous levels and reduce the oxygen levels in the trench or hole. Some common gas types including carbon dioxide are far denser than air and can collect in depressions, holes and trenches, where they may cause their own health effects in addition to reducing the oxygen intake of anyone operating in the hole or trench. Some flammable gases common on building sites are even denser and can pool unseen in the bottom of trenches where they may be ignited by a hot surface or a spark.

Land Clearing

During land clearing activities, the chances of a gas pipe rupture is increased. Underground pipe location technology has improved in recent years with the application of electromagnetic and radio detection tools, but these methods are never fail-safe. If a gas pipe rupture goes unnoticed, the risk of explosion and consequent harm to personnel increases considerably.

Demolition

Demolition activities often take place in hazardous environments such as old industrial buildings. The risk of unintentionally releasing hazardous gases such as carbon monoxide, methane, or hydrogen sulphide is high during demolition works.

Action on hazardous gases in construction

Managing the risk of hazardous chemicals

In the United Kingdom, the Institution of Occupational Safety and Health (IOSH) has released guidance on managing the risk caused by hazardous chemicals, including VOCs.

The four main steps that IOSH identifies as crucial to managing the risk of hazardous substances, including dangerous gases, are:

1. Understand the health consequences of accidental exposure
2. Ensure safe handling, storage, and use of the chemical
3. Apply safety measures to minimise exposure risk and protect workers
4. Establish robust emergency procedures.

An important part of the process is to undertake a thorough risk assessment. However, unlike a typical risk assessment of controlled risks, you should also assess any uncontrolled risks to help identify potential exposure to hazardous gases. For example, in the case of on-site excavation, it is advisable to assess the risk of releasing gases from an underground pocket, such as methane gas.

A thorough risk assessment will help you to create a risk mitigation strategy and emergency response procedure. For instance, you may decide to fit excavation machines with methane gas detectors as a control measure to mitigate the risk of exposure or explosion.

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Global focus on construction health and safety

Over the past three decades, there has been significant global action to improve health and safety standards for construction workers.

The International Labour Organization (ILO) has been instrumental in improving health and safety in the construction, including reducing the risk of exposure to hazardous chemicals and gases.

Back in 1992, the ILO published a code of practice entitled Safety and Health In Construction which is still relevant today. The code of practice sets out guidelines for various construction activities and how to mitigate the risk of harm.

For instance, in section 9.1, the code of practice sets out some general provisions to avoid accidental exposure to dangerous fumes and gases during excavation, earthworks and working in shafts or underground tunnels. The guidance suggests the provision of adequate ventilation to avoid fumes and gases, as well as carrying out investigation work to identify possible gas pockets.

In today's world, we have technology at our disposal that can do more than provide basic provisions and preventative measures. Gas detection technology is sufficiently advanced to provide early warning of the presence of dangerous gas and prompt an emergency response.

Health and safety standards on hazardous gas exposure

Several health and safety standards and guidelines apply to the construction industry, from various organisations and bodies.

Below, we have listed the most relevant standards relating to the control and risk management of gas exposure on construction sites.

Control of Substances Hazardous to Health (COSHH) Regulations

The COSHH regulations state that measures must be in place to reduce the risk of harm caused by gas and fumes during engineering activities such as welding, soldering, and cutting.

An example given in the regulations is that gas emissions from metalworking fluids (MWF) can cause occupational asthma if inhaled frequently. Carbon monoxide exposure is another example that is given as a risk that needs addressing in construction.

Health and Safety Executive (HSE)

The most recent HSE regulations on health and safety in construction in the UK are the Construction (Design and Management) Regulations 201 (CDM) which includes guidance on gas installations, use of hazardous gases, and potential emergency procedures related to gas and chemicals.

The HSE sets out a standard model for reducing and managing construction health risks – Assess, Control, and Review. This model can be applied to the management of gas exposure risk in the following way:

- **Assess** – Plan an overall strategy using the relevant guidance and regulations (such as COSHH). Identify gas hazards, such as material storage, welding, excavation work, etc. Assess the severity of potential gas exposure. Consult workers on their concerns and how to best manage the risk of accidental gas exposure.
- **Control** – Prevent the risk of gas exposure by performing site investigations. Control the risk by applying measures such as gas detection technology. Train workers to use the control measures effectively.
- **Review** – Ensure that adequate supervision and maintenance of control measures are in place. Monitor the control measures to ensure effectiveness, such as regularly checking on the accuracy of the gas detection devices. Take action to correct any problems and continuously improve safety levels on site.

National Examination Board in Occupational Safety and Health (NEBOSH)

NEBOSH provides training and certification in health and safety for the construction industry in the form of the International Certificate in Construction Health and Safety. The certification covers the identification of construction workplace hazards, including dangerous gases. NEBOSH also provides training and qualification on methods for controlling workplace hazards within the construction industry.

Chartered Institute of Building (CIOB)

CIOB issues training, guidance, and policy documents to reduce the risk of injury and fatality in the construction industry. CIOB provides an online academy that provides training courses to improve awareness around construction industry risks and hazards, including gas exposure.

Once construction work commences, there is an increased risk of carbon monoxide.

Gas detection – reducing the risk of hazardous gas exposure

Gas detection is an important control measure to help reduce the risk of harm to construction workers. Gas detection can be applied at various stages of the construction process.

Gas detection at the design and planning phase

The CDM regulations state that the Principal Designer must consider potential hazards at the design stage. The designer and planning officers should raise any gas risk concerns that are picked up when surveying the site and recommend the provision of gas detection in specific areas.

Underground gas detection

Earthworks and excavation are the most likely activities to result in the release of gas pockets such as methane or carbon dioxide that have been trapped underground. Gas taps can be installed prior to excavation and readings taken from gas detection devices.

Rupturing buried services

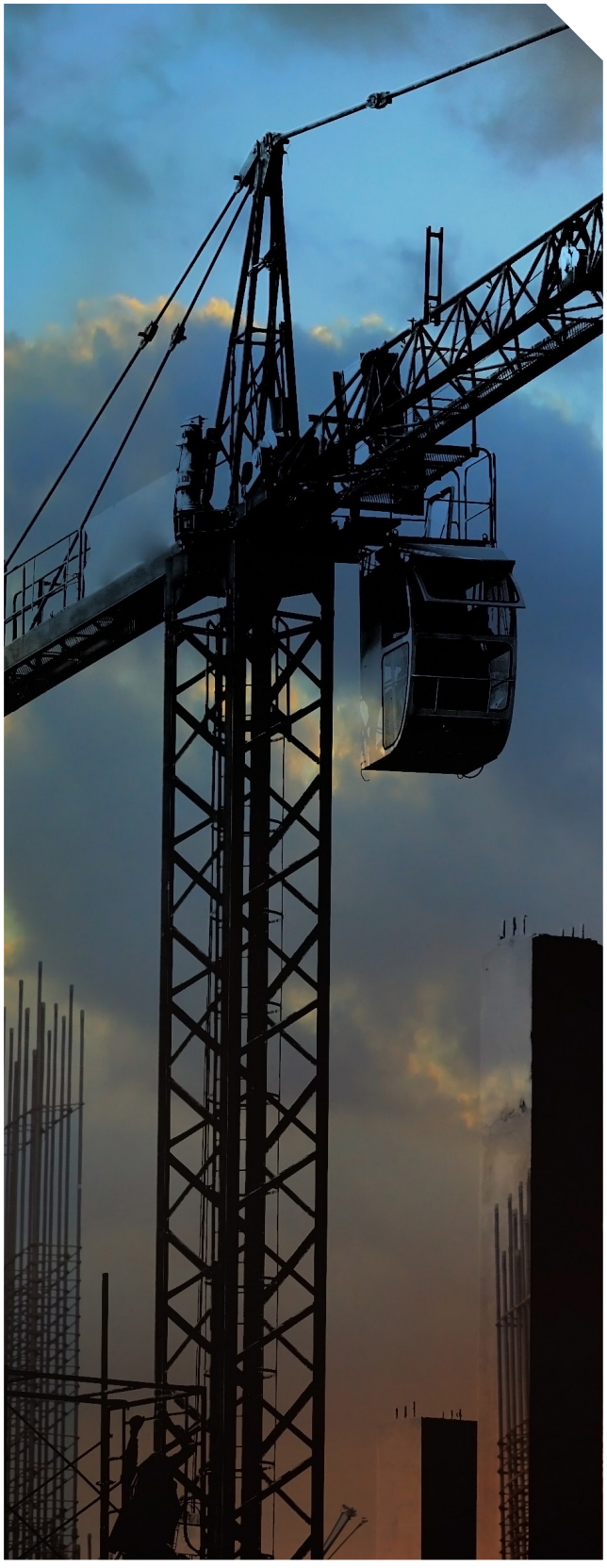
A thorough paperwork survey and ground scanning survey should be done prior to construction work to reduce the risk of accidentally rupturing a gas pipe.

Above ground construction activities

Once construction work commences, there is an increased risk of carbon monoxide poisoning due to exhaust fumes or exposure to hazardous gases as a by-product of common activities such as welding. Gas detection technology should be applied at this stage, with devices fitted inside excavator and bulldozer cabs, for example. Avoiding false alarms is similarly important, for example using CO sensors that are not upset by the hydrogen evolved by reactions of cement on aluminium shuttering.

Underground construction activities

Mining and tunnel boring activities create a high risk of toxic gases building up or being released into the environment. Machinery will produce carbon monoxide (CO) and other exhaust fumes that can be potentially deadly. Naturally occurring gases such as nitrogen monoxide (NO), nitrogen dioxide (NO2), carbon dioxide (CO2), and hydrocarbons (HC) may be released.



Taking air samples to reduce risk

Personal sampling

Construction workers can be issued with a pump and filter system that collects on-site air samples. The filters are taken at the end of a set time period and analysed in a lab. Although this does not offer immediate protection against gas exposure, it can alert engineering managers and health and safety officers to any growing risks.

Static air sampling

Devices can be set up to measure the air quality continuously at specific locations, including the detection of harmful and odourless gases. Static air sampling devices provide immediate measurements and alerts but are limited by the fact that the air is static and may be affected by other gases such as hydrogen. They will need frequent calibration and maintenance.

Pumped sampling

Pumped air sampling is more accurate than static air sampling, as the air is pumped through the filters. However, it doesn't give an immediate reading, as the filters need to be analysed in a lab.

Air Pollution in the Construction Industry

Hazardous gases are not the only thing to be aware of in the construction industry. According to data from the United Nations Environment Programme, emissions of air pollutants from the construction industry reached the highest levels reported in 2019. The UN research found that the industry accounted for 38% of total global energy-related CO2 emissions. The industry is also responsible for emissions of other harmful pollutants including particulate matter (PM) and nitrogen dioxide (NO2), which the Centre for Low Emission Construction (CLEC) has identified as the 'main concerns for human health'.

Within construction sites pollutants are produced by the diesel engines found in off-road machinery and static engines such as power generators, which are generally known as 'non-road mobile machinery' or NRMM. Emissions can also be generated by plant and vehicles and through activities such as land clearing and demolition

Air quality monitoring technology

RAMP - A low-cost air quality monitoring platform for the remote measurement of up to five gaseous chemical pollutants, and is also capable of monitoring temperature, humidity, particulate matter and meteorological conditions. With specific value in the construction sector, the device allows users to easily monitor air quality, and take action where necessary based on real time data.

Gas detection technology

Gas detection is a necessary control measure to meet health and safety standards and comply with regulations in the construction industry. Here at Crowcon, we offer a wide range of gas detection products to help you improve construction site safety.

Our personal portable gas monitors such as the T4, Gasman and Detective+ offer versatility and flexibility in use and again if heightened gas levels are detected can activate alert systems, enabling workers within construction environments to take immediate appropriate action.

Our fixed gas monitors Xgard and Xgard Bright provide constant readings from a specific location and therefore can be implemented throughout a construction site for a cross section of monitoring reports. Site-wide warning systems offer data from a number of areas and can be analysed within a central control room and across the safety network. If abnormalities are detected, automatic alerts and safety measures can be activated to provide safety fall backs, alongside options to remotely shut down an area and isolate hazards.

In conjuction with our fixed gas detectors our control panels Gasmaster, Gasmonitor, Vortex and GM Addressable Controllers provide flexible controlling as well as be fully customised to meet your on-site demands.

For more information about gas detection solutions for the construction industry, or to ask further questions about best practice on monitoring gases in construction, get in touch today.