Working in Confined Spaces

What you should know

People are killed or seriously injured in confined spaces every year; yet this concern is often the 'poor relation' when company management sits down to consider safety issues. It is important to read through all legislation related to working in confined spaces and understand how this applies to your organisation. Your life and that of others could depend on it. Where a risk assessment has been undertaken which identifies risks of serious injury from work being done by anyone in a confined space, international standards and best practice require certain actions. In a nutshell, these key duties are to avoid entry to confined spaces whenever possible by doing the work from the outside. If entry is unavoidable, however, follow a safe system of work and put in place adequate emergency arrangements before the work starts.

What constitutes 'A Confined Space'?

Generally speaking, they are spaces where there is a risk of serious injury or death due to the size, access to, and content of the space including dangerous conditions such as a lack of oxygen, or gas from hazardous substances. However, it's not possible to categorise confined spaces at work completely. For example, certain locations can become a confined space temporarily, when work or modifications are being carried out. Here is a list of some of the more common confined spaces:

- *Storage tanks*
- *Enclosed drains and sewers*
- *Silos*
- *Ductwork*
- *Vats*
- *Reaction vessels*
- *Combustion chambers in furnaces*
- *Unventilated or poorly ventilated rooms*
- *Open-topped chambers*

What are the dangers that may arise?

A lack of oxygen which can suddenly occur for several reasons, for example where there is a reaction between some soils and the oxygen in the atmosphere.

Action of groundwater on chalk and limestone can produce carbon dioxide and displace normal air.

Poisonous gases and liquids can build up in underground work areas or can enter via connecting pipe work or through leaks in things like pits and trenches.

Freeflowing Solids can dislodge when disturbed, bringing a multitude of possible problems such as crushing or trapping personnel, as well as cutting off oxygen supplies or leading to flooding of the area. The obvious risks of fire and explosion also have to be considered.

Consider the effect of Confined Spaces on workers

Working in excessively hot (or sometimes excessively cold) temperatures can cause physical and mental stress, as well as dangerous changes in body temperature, and so requires a strict health and safety provision.

The working temperatures need to be monitored at all times with adequate thermometers to ensure safe working environments. The management must make sure that all staff wear any necessary safety protection when it comes to clothing and equipment, such as breathing apparatus, for example. The length of time a worker can continually work within the confined space must also be managed properly, so in order to prevent problems like heat exhaustion, job rotation may be required.

Duty of an employer

When it comes to working in confined spaces, the management must identify any hazards present, assess the risks posed by them, put procedures in place and take any necessary precautionary measures to protect the workforce. All of these considerations will usually be determined by the following:

> "identification of precautions to be taken is one thing, but putting it into practice is another - which must be done through training, assessment and communication"

- *What the work entails*
- *The environment in which it is carried out*
- *The materials and tools that are to be used alongside the appropriate equipment such as gas detection equipment and specific PPE, such as breathing apparatus, protective clothing such as boots, chemical suits, glasses*
- *All of this equipment will need to conform to internationally recognised standards e.g. CE, ANSI, ATEX*
- *The competency and suitability of those employed to carry out the work will include their mental and physical suitability, as well as specific training in PTW, PPE to be used, gas monitors plus any escape and resuscitation equipment*
- *Procedures for emergency rescue*

If the results of the risk assessment identify any possibility of serious injury or stress from working in the confined space, then confined spaces precautions must be taken. Let us look at best practice requirements:

Avoid entry to confined spaces, for example by doing the work from outside: You need to check if the work can be done another way. Better planning could reduce the need for confined space working and the duration of work and number of workers exposed.

Also, ask yourself if the work is really necessary. Perhaps you could modify the confined space itself, so that entry is not necessary. Failing that, the work could be done from outside, for example blockages in silos could be cleaned by use of remotely operated rotating flail devices, vibrators or air purgers.

Safe systems of work

If, after full consideration of the above, entry into a confined space cannot be avoided, make sure a safe system has been put in place before sending any workers inside the space. The results of your risk assessment will identify the necessary precautions to be taken. Identification of precautions to be taken is one thing, but putting it into practice is another - which must be done through training, assessment and communication.

Try the following checklist to help prepare a safe system:

- *Appoint a supervisor: Supervisors should be given responsibility to ensure that the necessary precautions are taken and to check safety at each stage. They, or a suitably competent stand-by person, will need to remain present while the work in the confined space is underway in case of emergency*
- *Those involved: Check the person is suitable for the work. Do they have sufficient experience of the type of work to be carried out - and have they received proper training, as well as being physically fit enough?*
- *Isolation of equipment: Isolation of mechanical and electrical equipment is essential, otherwise it could operate or be operated inadvertently. The other source of danger could come from gas or fumes entering the space, so isolation of pipework needs to be made and checked* ▸

- *Cleaning before entry: Sometimes fumes can develop from residues of substance while the essential work is being done*
- *Check the size of the entrance: Bear in mind that workers wearing all the necessary protective equipment will need to be able to get through into the confined workspace - and also get out in case of emergency*
- *Provide ventilation: Mechanical ventilation may be necessary if you are unable to increase the number of openings to the confined space to improve airflow. An adequate supply of fresh air is essential, especially where portable gas cylinders and diesel-fuelled equipment are used inside the space. Best practice requires that where mechanical ventilation is provided, a suitable audio and visual warning system must be in place, which warns those present of any failure. Petrol-fuelled engines in confined spaces should never be allowed, due to carbon monoxide emissions*
- *Air testing: Where the risk assessment indicates that conditions may change, or as a further precaution, continuous monitoring of the air may be necessary. Such monitoring equipment might be a single or multiple gas detector, depending upon the circumstances identified by the risk assessment. Where there are multiple personnel working in the area, an advanced wireless integrated system can provide immediate notification of personnel in distress AND provide a means to send an evacuation signal to all personnel*
- *Special tools and lighting: Provision of non-sparking tools and specially protected lighting, for example reduced voltage or in extreme cases intrinsically safe equipment, is essential in confined spaces where potentially explosive atmospheres are possible. Precautions need to be taken to prevent electric shock, especially in metal tanks where the danger is even greater. To avoid the risk of trailing cables becoming entangled, battery operated lamps of a type approved for the environment likely to be present are preferred for inspection purposes, and for temporary general illumination. Where the work is of longer duration, then portable lamps and the trailing cables should operate at low voltage and be of a type approved for the environment. Any other electrically driven power tools should be supplied from a 110 volt CTE transformer with a high sensitivity (30 mA or less) residual current device. Likewise, all metal tools will need to be sparkproof*
- *Breathing apparatus provision: If the air inside the space can't be made fit to breathe due to gas, fume or vapour, NEVER try to 'sweeten' the air with oxygen as this can greatly increase the risk of a fire or explosion. There are two main types of breathing apparatus; line fed and self contained breathing apparatus*

  i) Compressed Air Line or Line Fed breathing apparatus consists of an air line from a compressed air source to a breathing tube attached to a facepiece on the operative. The breathing tube normally connects with either a half facepiece, a full facepiece, hood or helmet. The choice is dictated by the possible routes of entry of the hazard and the extent of the hazard. For example, a half piece mask is no good if there is another potential route of entry due to absorption via the eyes. The flow of air to the half and full face piece types may be either continuous or controlled by a demand valve. Where the air supply is also used in the industry process, the compressor should be capable of supplying 170 litres/minute. The continuous flow of air creates a positive pressure inside the facepiece or helmet, which gives greater protection than a demand-type respirator. It also reduces fogging and cools the wearer's face. The flow rate can be adjusted by a belt-mounted regulator

  ii) Self-Contained Breathing Apparatus (SCBA) lets the wearer work without the restriction of a hose or air line in an atmosphere that is contaminated and/or deficient in oxygen. This type of breathing apparatus is suitable for short-term routine work and emergency use. These devices provide air from a source carried by the wearer without unduly impeding the wearer, and can be used in extremes of temperature. The most widely used SCBA is a compressed air open circuit device with a compressed air cylinder, an air line to a demand regulator, and a facepiece. ▸

These can be supplied in a positive or negative-pressure mode. For routine work, the air supply may last in excess of 15 minutes, although for escape use it may be less depending on cylinder size. Within the Eurpean Union (EU) SCBA must comply with the requirements of the European Standard EN 137 : 2006

Preparing emergency arrangements

Workers with emergency rescue responsibilities will need additional specialised training. All confined space training should include some hands-on training with the safety equipment. Rescue procedures should be practiced frequently so there is a high level of proficiency. Employers should keep records of all confined spaces training including refresher courses.

It is recommended that the retrieval system be capable of rescuing the victim without the need for other persons to enter the confined space. Safe access and egress must be provided, in other words, appropriate fall protection and rescue equipment should be used from the time the person enters the space until exiting the space.

Ropes, harnesses, fall arrest gear, lifelines and winches used in connection with confined space entry or, emergency rescue, should be suitable for the purposes for which they are intended, and account taken of appropriate recognised standards where these exist.

Equipment used for lifting, such as ropes, harnesses, lifelines, rings, shackles and carabiners, will have a test certificate and safe working load when purchased. It is important to ensure they are not further tested (as this could weaken them). If they become damaged, they should be scrapped.

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Keeping records

The record of each thorough examination and test of equipment will normally include:

- *The name and address of employer or other person responsible for that equipment*
- *Particulars of the equipment and its distinguishing number or mark, together with a description and the name of the maker*
- *The date of the examination and the name and signature of the person carrying out the examination*
- *The condition of the equipment and any defects found*
- *A brief description of any remedial action*

Records of the examination and equipment testing should be kept for a minimum of five years. Man-riding winches and fall arrest systems should be tested every six months.

European CEN standards

In the European Union there are specific codes (standards) for fall arrest and rescue equipment:

- *EN 341 Descender devices*
- *EN 353 Guided type fall arresters*
- *EN 354 Restraint Lanyards*
- *EN 355 Energy absorbers*
- *EN 358 Belts for work positioning and restraint and lanyards for work positioning*
- *EN 360 Retractable type fall arresters (Self Retracting Lifelines)*
- *EN 361 Full body harnesses*
- *EN 362 Connectors*
- *EN 363 Fall arrest systems*
- *EN 364 Test methods*
- *EN 365 General requirements for instructions for use, maintenance, periodic examination, repairs, labelling and packaging*
- *EN 795 Anchor devices. Requirements and testing*
- *EN 813 Sit harnesses*
- *EN 1496 Rescue lifting devices*
- *EN 1497 Rescue harnesses*
- *EN 1498 Rescue loops*

There are other recognised international standards. For example, in Australia, the selection of the type of safety harness or safety line or rescue line should be in accordance with Australian Standard AS 2626.

Rescue harnesses: Lifelines attached to harnesses should be able to run back to a point outside the confined space, which in turn is affixed to a suitable tripod/lifting device to allow safe and speedy evacuation should it be required. There are lots of different types of harnesses, and it is important to understand that they are not all ▸

suitable for confined space rescue. Waist belts or chest harnesses should on no account be used for confined space access or rescue situations. They may be used for restraint purposes to prevent a person from reaching a place where the risk of fall exists.

Communications: An adequate communications system is essential between people inside and outside the space. This will also be used to summon help in case of emergency, obviously taking into account such things as the risk of explosion. Portable communications equipment for confined space work falls into two categories; 'wireless' and 'wired'. For confined space and tunnel working there are four main options:

1 *Mobile radio using free space propagation, possibly with repeaters*

2 *Mobile radio using leaky feeder guided propagation*

3 *Hard-wired point to point intercom systems*

4 *Low frequency wire-guided inductive communication systems*

A further factor is the use of voice operated transmission switching (VOX). In many noisy environments this may either require continuous adjustment or, worse still, may cause channel lock-out in a single channel system. Often, the most reliable solution under these circumstances is to adopt press-to-talk only operation.

Raising the alarm: Place a trained person outside in order to keep watch, communicate, raise the alarm and take charge of rescue procedures.

Work permit: Some sort of control system, such as a permit to work, (PTW), will be required to ensure a formal check is undertaken to ensure all elements are in place before people are allowed to enter or work in the confined space. It would include features such as clear identification, provision for ensuring contractors and others concerned are trained, instructed, monitored and audited, in order to ensure that the system works as intended.

Shut down: In order to prevent additional harm to both the rescuer and those in need of rescue, it may be necessary to shut down adjacent plant before attempting emergency rescue.

First aid procedures: Suitable first aid equipment and facilities must be available for the hazards identified in the risk assessment and a suitable number of competent and trained first-aiders need to be available. If resuscitation has been identified as a likely requirement by the risk assessment, then provision will need to be made for training in use of resuscitation equipment which might include defibrillation and oxygen.

Local emergency services: Ask yourselves exactly how the local emergency services (fire brigade for example) are made aware of what you are doing in advance of any work and therefore, should there be an incident, how will you and they react most efficiently to effect any rescue on their arrival?

Importance of Training

There is so much more contained within Confined Spaces best practice than can be covered here, hence the importance of proper training and assessment in this field. Many organisations like British Safety Services offer professional and management level training from recognised awarding bodies including the National Examinations Board in Occupational Safety and Health (NEBOSH). The NEBOSH National General Certificate and National Diploma provide an excellent qualification in health and safety, however many companies would benefit from a bespoke in-house training course relevant to their own organisation. This would allow the training to cover specific hazard identification, risk assessments, how to carry out the work activities in a safe manner, developing communications strategies and emergency procedures. People trained and prepared for working in confined spaces will help reduce the level of risk in this hazardous environment. ■

Author Details:

British Safety Services (BSS) is an international consultancy offering advice and training on health and safety issues. Established in 1990, BSS has gained an international reputation as a major provider of high quality safety training that gets results. The team at BSS also provides guidance on all aspects of public safety, specialising in workplace legislation and best practice.

BSS advise clients on their health and safety strategy and policy and assist in implementing procedures as required. By conducting training needs analysis, BSS help clients identify skills gaps in their workforce and then develop and deliver bespoke training programmes to meet these gaps, to improve safety awareness and performance in the workplace. BSS have been successfully providing these services to companies throughout the world for almost 20 years.

BSS now have offices in Qatar, Dubai, Yemen, China, Libya and Algeria. With a team of specialist staff grounded in a detailed understanding of each country's cultural issues as well as specific industry and country safety requirements. Instructors are all qualified to NEBOSH standards and have a minimum of 15 years experience.

Most clients are in high-risk sectors such as construction, the nuclear industry, oil and gas, together with many service industries including schools and food. Clients include, Qatar Petroleum, Al Futtaim Carillion, Readymix Qatar, PDO, Sabic, Conoco Phillips, Canadian Nexan, Weatherford, Inpex Libya, Al Mansoori, Petro Bras and Misco Libya.

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