Safe work in confined spaces

This leaflet is aimed at employers and the self-employed who carry out work in confined spaces, and forms part of HSE's commitment to make simple and practical guidance available for small firms. It will help them take the necessary action to meet the requirements of the Confined Spaces Regulations 1997. It will also be a useful source of information to anyone involved in carrying out work in confined spaces.

Confined spaces can be deadly

On average, work in confined spaces kills 15 people every year in the UK across a wide range of industries, from those involving complex plant through to simple storage vessels. In addition, a number of people are seriously injured. Those killed include not only people working in the confined space but those who try to rescue them without proper training and equipment.

What is a confined space?

It can be any space of an enclosed nature where there is a risk of death or serious injury from hazardous substances or dangerous conditions (eg lack of oxygen).

Some confined spaces are fairly easy to identify, eg enclosures with limited openings:

- storage tanks;
- silos;
- reaction vessels;
- enclosed drains;
- sewers.

Others may be less obvious, but can be equally dangerous, for example:

- open-topped chambers;
- vats;
- combustion chambers in furnaces etc;

- ductwork;
- unventilated or poorly ventilated rooms.

It is not possible to provide a comprehensive list of confined spaces. Some places may become confined spaces when work is carried out, or during their construction, fabrication or subsequent modification.

What are the dangers from confined spaces?

Dangers can arise in confined spaces because of:

- A lack of oxygen.

  This can occur:

  - where there is a reaction between some soils and the oxygen in the atmosphere;
  - following the action of groundwater on chalk and limestone which can produce carbon dioxide and displace normal air;
  - in ships'holds, freight containers, lorries etc as a result of the cargo reacting with oxygen inside the space;
  - inside steel tanks and vessels when rust forms.

- Poisonous gas, fume or vapour.

  These can:

  - build-up in sewers and manholes and in pits connected to the system;
  - enter tanks or vessels from connecting pipes;
  - leak into trenches and pits in contaminated land, such as old refuse tips and old gas works.

- Liquids and solids which can suddenly fill the space, or release gases into it, when disturbed. Free flowing solids such

as grain can also partially solidify or ‘bridge’ in silos causing blockages which can collapse unexpectedly.

- Fire and explosions (eg from flammable vapours, excess oxygen etc).

- Residues left in tanks, vessels etc, or remaining on internal surfaces which can give off gas, fume or vapour.

- Dust may be present in high concentrations, eg in flour silos.

- Hot conditions leading to a dangerous increase in body temperature.

Some of the above conditions may already be present in the confined space. However, some may arise through the work being carried out, or because of ineffective isolation of plant nearby, eg leakage from a pipe connected to the confined space. The enclosure and working space may increase other dangers arising through the work being carried out, for example:

- machinery being used may require special precautions, such as provision of dust extraction for a portable grinder, or special precautions against electric shock;

- gas, fume or vapour can arise from welding, or by use of volatile and often flammable solvents, adhesives etc;

- if access to the space is through a restricted entrance, such as a manhole, escape or rescue in an emergency will be more difficult (see *Emergency procedures*).

What the law says

You must carry out a suitable and sufficient assessment of the risks for all work activities for the purpose of deciding what measures are necessary for safety (**The Management of Health and Safety at**

Work Regulations 1999). For work in confined spaces this means identifying the hazards present, assessing the risks and determining what precautions to take. In most cases the assessment will include consideration of:

- the task;
- the working environment;
- working materials and tools;
- the suitability of those carrying out the task;
- arrangements for emergency rescue.

HSE's free leaflet *5 steps to risk assessment* will help you further. You may need to appoint competent people to help manage the risks and ensure that employees are adequately trained and instructed (**The Management of Health and Safety at Work Regulations 1999**). Of course, you may be the best person to do this, however, you may need to train someone else or engage the services of a competent person for additional help.

If your assessment identifies risks of serious injury from work in confined spaces, such as the dangers highlighted above, the **Confined Spaces Regulations 1997** apply. These regulations contain the following key duties:

- avoid entry to confined spaces, eg by doing the work from outside;

- if entry to a confined space is unavoidable, follow a safe system of work; and

- put in place adequate emergency arrangements before the work starts.

These duties, and what you need to do, are further described in this leaflet.

Avoid entering confined spaces

You need to check if the work can be done another way so that entry or work in confined spaces is avoided. Better work-planning or a different approach can reduce the need for confined space working.

Ask yourself if the intended work is really necessary, or could you:

- modify the confined space itself so that entry is not necessary;
- have the work done from outside, for example:
  - blockages can be cleared in silos by use of remotely operated rotating flail devices, vibrators or air purgers;
  - inspection, sampling and cleaning operations can often be done from outside the space using appropriate equipment and tools;
  - remote cameras can be used for internal inspection of vessels.

Safe systems of work

If you cannot avoid entry into a confined space make sure you have a safe system for working inside the space.

Use the results of your risk assessment to help identify the necessary precautions to reduce the risk of injury. These will depend on the nature of the confined space, the associated risk and the work involved.

Make sure that the safe system of work, including the precautions identified, is developed and put into practice. Everyone involved will need to be properly trained and instructed to make sure they know what to do and how to do it safely.

The following checklist is not intended to be exhaustive but includes many of the essential elements to help prepare a safe system of work.

Appointment of a supervisor

Supervisors should be given responsibility to ensure that the necessary precautions are taken, to check safety at each stage and may need to remain present while work is underway.

Are persons suitable for the work?

Do they have sufficient experience of the type of work to be carried out, and what training have they received? Where risk assessment highlights exceptional constraints as a result of the physical layout, are individuals of suitable build? The competent person may need to consider other factors, eg concerning claustrophobia or fitness to wear breathing apparatus, and medical advice on an individual's suitability may be needed.

Isolation

Mechanical and electrical isolation of equipment is essential if it could otherwise operate, or be operated, inadvertently. If gas, fume or vapour could enter the confined space, physical isolation of pipework etc needs to be made. In all cases a check should be made to ensure isolation is effective.

Cleaning before entry

This may be necessary to ensure fumes do not develop from residues etc while the work is being done.

Check the size of the entrance

Is it big enough to allow workers wearing all the necessary equipment to climb in and out easily, and provide ready access and egress in an emergency? For example, the size of the opening may mean choosing air-line breathing apparatus in place of self-contained equipment which is more bulky and therefore likely to restrict ready passage.

Provision of ventilation

You may be able to increase the number of openings and therefore improve ventilation. Mechanical ventilation may be necessary to ensure an adequate supply of fresh air. This is essential where portable gas cylinders and diesel-fuelled equipment are used inside the space because of the dangers from build-up of engine exhaust. **Warning: carbon monoxide in the exhaust from petrol-fuelled engines is so dangerous that use of such equipment in confined spaces should never be allowed**.

Testing the air

This may be necessary to check that it is free from both toxic and flammable vapours and that it is fit to breathe. Testing should be carried out by a competent person using a suitable gas detector which is correctly calibrated. Where the risk assessment indicates that conditions may change, or as a further precaution, continuous monitoring of the air may be necessary.

Provision of special tools and lighting

Non-sparking tools and specially protected lighting are essential where flammable or potentially explosive atmospheres are likely. In certain confined spaces (eg inside metal tanks) suitable precautions to prevent electric shock include use of extra low voltage equipment (typically less than 25 V) and, where necessary, residual current devices.

Provision of breathing apparatus

This is essential if the air inside the space cannot be made fit to breathe because of gas, fume or vapour present, or lack of oxygen. Never try to ‘sweeten’the air in a confined space with oxygen as this can greatly increase the risk of a fire or explosion.

Preparation of emergency arrangements

This will need to cover the necessary equipment, training and practice drills.

Provision of rescue harnesses

Lifelines attached to harnesses should run back to a point outside the confined space.

Communications

An adequate communications system is needed to enable communication between people inside and outside the confined space and to summon help in an emergency.

Check how the alarm is raised

Is it necessary to station someone outside to keep watch and to communicate with anyone inside, raise the alarm quickly in an emergency, and take charge of the rescue procedures?

Is a 'permit-to-work' necessary?

A permit-to-work ensures a formal check is undertaken to ensure all the elements of a safe system of work are in place before people are allowed to enter or work in the confined space. It is also a means of communication between site management, supervisors, and those carrying out the hazardous work. Essential features of a permit-to-work are:

- clear identification of who may authorise particular jobs (and any limits to their authority) and who is responsible for specifying the necessary precautions (eg isolation, air testing, emergency arrangements etc);
- provision for ensuring that contractors engaged to carry out work are included;
- training and instruction in the issue of permits;
- monitoring and auditing to ensure that the system works as intended.

Emergency procedures

When things go wrong, people may be exposed to serious and immediate danger. Effective arrangements for raising the alarm and carrying out rescue operations in an emergency are essential.

Contingency plans will depend on the nature of the confined space, the risks identified and consequently the likely nature of an emergency rescue.

Emergency arrangements will depend on the risks. You should consider:

Communications

How can an emergency be communicated from inside the confined space to people outside so that rescue procedures can start? Don't forget night and shift work, weekends and times when the premises are closed, eg holidays. Also, consider what might happen and how the alarm can be raised.

Rescue and resuscitation equipment

Provision of suitable rescue and resuscitation equipment will depend on the likely emergencies identified. Where such equipment is provided for use by rescuers, training in correct operation is essential.

Capabilities of rescuers

There need to be properly trained people, sufficiently fit to carry out their task, ready at hand, and capable of using any equipment provided for rescue, eg breathing apparatus, lifelines and fire-fighting equipment. Rescuers also need to be protected against the cause of the emergency.

Shut down

It may be necessary to shut down adjacent plant before attempting emergency rescue.

First-aid procedures

Trained first aiders need to be available to make proper use of any necessary first-aid equipment provided.

Local emergency services

How are the local emergency services (eg, fire brigade) made aware of an incident? What information about the particular dangers in the confined space is given to them on their arrival?

Relevant law

- The Confined Spaces Regulations 1997;
- The Management of Health and Safety at Work Regulations 1999;
- The Control of Substances Hazardous to Health Regulations 1999;
- The Personal Protective Equipment at Work Regulations 1992;
- The Provision and Use of Work Equipment Regulations 1998;
- Electricity at Work Regulations 1989;
- Workplace (Health, Safety and Welfare) Regulations 1992.

Some of the above law is relevant because of the nature of the work to be carried out inside a confined space, eg where there are risks from machinery, electricity or from hazardous substances.

Further guidance

Safe work in confined spaces Confined Spaces Regulations 1997. Approved Code of Practice, Regulations and Guidance L101 HSE Books 1997 ISBN 0 7176 1405 0

Guidance on permit-to-work systems in the petroleum industry (Third edition) HSE Books 1997 ISBN 0 7176 1281 3 The relevance of this guidance is not restricted to the petroleum industry. It will be helpful in any industry or work activity where the preparation and application of permits-to-work are being considered.

5 steps to risk assessment INDG163(rev1) HSE Books 1998

The future availability and accuracy of the references listed in this publication cannot be guaranteed.

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This leaflet is available in priced packs of 20 from HSE Books, ISBN 0 7176 1442 5. Single free copies are also available from HSE Books.

This leaflet contains notes on good practice which are not compulsory but which you may find helpful in considering what you need to do.

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