LEAFLET 10

WORK IN CONFINED SPACES

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LEAFLET FOR LINE MANAGERS

INTRODUCTION

1 This leaflet and its associated guidance is intended to enable line managers to meet the requirements of The Confined Space Regulations 1997 (SI 1997 No 1713). These Regulations are backed by an Approved Code of Practice issued with the authority of the Health and Safety Commission.

2 The Defence Estates have issued a Safety Rules and Procedures Document (SRP No 06 Confined Spaces) in relation to the application of The Confined Space Regulations 1997. The procedures in SRP No 06 are to be followed in respect to property and facility management activities unless an Establishment have in place their own confined space working procedures that provide a greater degree of control than that required by SRP No 06.

3 Within MOD there are a number of confined spaces associated with MOD plant and equipment, which are not part of the Defence Estate (e.g. on board ships, aircraft and inside some vehicles). During operations military personnel will have the need to enter confined spaces (e.g. for search purposes). In these situations confined space entry and work should be controlled in accordance with this leaflet and its guidance.

DEFINITIONS

Confined Space

4 Confined Space means any place, including any chamber, tank, vat, silo, pit, trench, pipe, sewer, flue, well or other similar space in which, by virtue of its enclosed nature, there arises a reasonably foreseeable specified risk. Greater detail on, and examples of, confined spaces is at Annex A.

Specified Risk

5 Specified Risk means a risk of:

5.1 Serious injury to any person at work arising from a fire or explosion;

5.2 Or not the result of a fire or explosion but:

5.2.1 The loss of consciousness of any person at work arising from an increase in body temperature;

5.2.2 The loss of consciousness or asphyxiation of any person at work arising from gas, fume, vapour or the lack of oxygen;

5.3 The drowning of any person at work arising from an increase in the level of liquid; or

5.4 The asphyxiation of any person at work arising from a free flowing solid or the inability to reach a respirable environment due to entrapment by a free flowing solid;

Line Manager

6 Line Manager means all MOD staff, both Service and Civilian, who have authority and responsibility for directing and supervising people working for them. The working staff may be either permanent or temporary MOD employed staff, or persons employed on MOD contracts.

Confined Space Risk Assessment

7 A confined space risk assessment means a documented assessment carried out by a person or organisation with the competence necessary in the process to be carried out, the plant and equipment to be used and an understanding of the hazard created by the confined space.

DUTIES

8 Line Managers shall ensure that before allowing entry to, or work to be undertaken in, a confined space:

8.1 They have identified all confined spaces under their control

8.2 They have established which confined spaces may require work to be undertaken inside the confined space.

8.3 Established where possible an alternative method of work to enable the task to be undertaken without the need to enter the confined space.

8.4 Have in place procedures that prevent direct unauthorised entry into the confined space.

9 Line Managers of staff required to work in a confined space shall ensure that:

9.1 A documented confined space risk assessment is to be undertaken by a competent person covering entry, the task to undertaken, and the hazards of the confined space.

9.2 A safe system of work has been produced to cover the confined space activity.

9.3 Where considered appropriate a Permit to Work control procedure is introduced.

9.4 All persons associated with the confined space activity are competent for their roles.

9.5 All persons associated with the confined space activity, have been supplied, the necessary information, instruction and training needed, and that they understand the information.

9.6 Suitable and sufficient emergency arrangements are established, to rescue persons from the confined space.

9.7 Provide appropriate and maintained equipment for the work to be undertaken and the emergency arrangements.

10 Persons employed in a confined space shall

10.1 Follow all instructions given in respect to the task and follow the system of work.

10.2 Not undertake any activity where a permit to work is required, until the Permit has the necessary approval.

10.3 Report to the Line Manager or Permit Authority immediately if they suspect that circumstances surrounding the work may have changed.

11 Person employed as part of the rescue arrangements shall:

11.1 Remain vigilant at all times that workers are inside a confined space.

11.2 Not leave their post, unless a trained replacement is available to take over, and is aware they are now part of the arrangement, all the time the work is being undertaken in the confined space.

GUIDANCE

12 Detail on what is expected of Line Managers to conform to The Confined Space Regulations 1997 and meet the duties indicated above is contained in Annex A to this leaflet.

COMPETENCE

13 To be competent to work safely in confined spaces, adequate training and experience in the particular work involved is essential. Training standards must be appropriate to the task, and to the individual's roles and responsibilities, so that work (including entry and exit) can be carried out safely. Where the risk assessment indicates that properly trained individuals can work for periods without supervision, Line Managers will need to check that they are competent to follow the established safe system of work and have been provided with adequate information and instruction about the work to be done.

RECORDS

14 All records of training given to a confined space worker or emergency team member should be kept on the individuals personnel file and/or local training records

RELATED PUBLICATIONS

15 Related Publications

- Defence Estates Safety Rules and Procedures No 06 Confined Spaces (Available from Defence Estates Technical Library)
- AP106B-0002-1 (Safety Precautions for working in Integral Fuel Tanks)
- BR 2000(20) Safety Considerations and Precautions
- ME Vol 2 Field Engineering Pamphlet 6A

RELATED LEAFLETS

16 Related Leaflets

- Health and Safety Risk Assessment

- Lifting Operations and Lifting Equipment
- Purchase and Safe Use of Work Equipment
- Permit to Work
- Management of Personnel Protective Equipment
- Protection of Persons Using Compressed Air - RPE
- Safety in Excavations

LEAFLET 10 ANNEX A

WORK IN CONFINED SPACES

CONTENTS

GUIDANCE FOR LINE MANAGERS

WHERE DO THE CONFINED SPACE REGULATIONS APPLY?

1 The Confined Spaces Regulations apply in all premises and work situations subject to the HSW Act, with the exception of:

1.1 Diving operations,

NOTE

When entering compression chambers or diving bells provided for the support of diving operations to conduct pre- and post-diving procedures, setting-to work (i.e. commissioning equipment), or maintenance procedures, the confined spaces regulations will apply because these activities are not defined as diving operations

1.2 Below ground in a mine.

1.3 In addition the Regulations do not apply to the master or crew of a sea-going ship or to the employer of such persons in respect of the normal ship-board activities carried out solely by a ship's crew under the direction of the master.

NOTE

Where an operation involves a ship's crew and shoreside workers working together aboard ship, the provisions will apply, thereby imposing duties on masters, crew.

WHAT IS A CONFINED SPACE?

2 A confined space has two defining features. Firstly, it is a place which is substantially (though not always entirely) enclosed and, secondly, there will be a reasonably foreseeable risk of serious injury from hazardous substances or conditions within the space or nearby.

3 Some confined spaces are fairly easy to identify, for example, closed tanks, vessels and sewers. Others are less obvious but may be equally dangerous, for example, open-topped tanks and vats, closed and unventilated or inadequately ventilated rooms and silos, or constructions that become confined spaces during their manufacture.

4 Some places which fall within the definition of a confined space may be so only occasionally, perhaps due to the type of work to be undertaken, for example, a room during spray painting. Also, a confined space may not necessarily be enclosed on all sides. Some confined spaces, for example vats, silos and ships' holds, may have open tops. Places not usually considered to be confined spaces may become confined spaces because of a change in the condition inside or a change in the degree of enclosure or confinement, which may occur intermittently.

5 In addition to the places referred to above, the expression 'confined space' may also refer to the following examples and other similar places: ducts, vessels, culverts, tunnels, boreholes, bored piles, manholes, shafts, excavations, sumps, inspection pits, cofferdams, freight containers, ship cargo holds/tanks, ballast tanks, double bottoms, ships' engine rooms, buildings, building voids, some enclosed rooms (particularly plant rooms) and compartments within them, including some cellars, enclosures for the purpose of asbestos removal, and interiors of machines, plant or vehicles. However, application of the Confined Space Regulations in any of these places will depend on the presence of a reasonably foreseeable risk of serious injury. (See Specified risk definition in this leaflet)

THE HAZARDS OF CONFINED SPACES

6 The hazards that the Confined Spaces Regulations address arise through the combination of the confined nature of the place of work and the possible presence of substances or conditions which, taken together, could increase the risk to the safety or health of people. Remember that a hazard can be introduced to a substantially enclosed space that otherwise would be safe. The most likely hazards are as follows:

Flammable Substances and Oxygen Enrichment

7 A risk of fire or an explosion can arise from the presence of flammable substances. There can also be a risk of fire and explosion from an excess of oxygen in the atmosphere, for example, caused by a leak from an oxygen cylinder forming part of welding equipment. There is also a risk of explosion from the ignition of airborne flammable contaminants. A fire or explosion can also be caused by leaks from adjoining plant or processes that have not been effectively isolated.

Toxic Gas, Fume or Vapour

8 Vapour may remain from previous processing or as a result of previous storage, or arise from sludge or other deposits disturbed, for example during cleaning. Hydrocarbon vapour may also be present under scale even after cleaning. Vapour may also enter the space from adjoining plant that has not been effectively isolated. Gas and vapour can build up in sewers, manholes, contaminated ground or leak from behind vessel linings, rubber, lead, brick etc. Fume and vapour can also be produced by work inside the confined space, for example, welding, flame cutting, lead lining, brush and spray painting, or moulding using glass reinforced plastics, use of adhesives or solvents, or from the products of combustion. They can also occur inside a compartment or space by hot work taking place on the exterior surfaces or enter the space from equipment in use outside the space, such as exhaust fume from mobile plant, especially on construction sites. Plant failure can also cause problems, for example, by the build-up of ammonia if refrigeration plant fails or the potential for accumulation of carbon dioxide in pub cellars following leaks from compressed gas cylinders.

Oxygen Deficiency

9 Oxygen deficiency may result from, for example: purging of the confined space with an inert gas to remove flammable or toxic gas, fume, vapour or aerosols; It may also occur naturally by a biological processes consuming oxygen, which can occur in sewers, storage tanks, storm water drains, wells etc. Similarly gases can be produced as a result of fermentation in sealed silos where crops have been or are being stored; in fermentation vessels in brewing; or in cargo holds caused by the carriage of timber or timber products, steel turnings or swarf, vegetable products, grain, coal etc.

10 Leaving a vessel completely closed for some time (particularly one constructed of steel) since the process of rust formation on the inside surface consumes oxygen. Newly fabricated or shot blasted carbon steel vessels are especially vulnerable to rusting, particularly those with a large surface area, for example, heat exchangers, separators, filters etc;

11 Other circumstances that can effect the level of oxygen are the risk of increased levels of carbon dioxide from limestone chippings associated with drainage operations when they get wet; burning operations and work such as welding and grinding which consume oxygen; displacement of air during pipe freezing, for example, with liquid nitrogen; a gradual depletion of oxygen as workers breathe in confined spaces and where provision of replacement air is inadequate.

The Ingress or Presence of Liquids

12 Liquids can flow into the confined space and lead to drowning and other serious injury depending on the nature of the liquids such as their corrosivity or toxicity.

Solid Materials Which Can Flow

13 Free flowing solids can submerge or entrap a person, preventing breathing. Materials, which create this hazard, include grain, sugar, flour, sand, coal-dust and other substances in granular or powder form.

Presence of Excessive Heat

14 This can lead to a dangerous rise in core body temperature and can be made worse as a result of personal protective equipment being worn. In extreme cases heat stroke and unconsciousness can result. A slower heat build-up in the body can cause heat stress, and if action is not taken to cool the body there is also a risk of heat stroke and unconsciousness. This can occur where work in hot conditions is being undertaken in a confined space or where, for example, boilers or furnaces have not been allowed sufficient time to cool before people are allowed to enter to undertake maintenance work, or where equipment has been steam cleaned to remove hydrocarbons.

Other Hazards

15 Other hazards can be found when entering or working in confined spaces, but these hazards are not unique to confined spaces working, such as electricity; mechanical equipment; noise; dust. Where these hazards are present in a confined space the precautions will almost always be more extensive than where they appear outside the confined space simply because of the enclosed nature of the space.

FIRST CONSIDERATION PREVENTING ENTRY

16 MOD line managers have a duty to prevent employees, or others who are to any extent within their control, such as contractors, from entering or working inside a confined space where it is reasonably practicable to undertake the work without entering the space. In every situation, consideration must be given to what measures can be taken to enable the work to be carried out without the need to enter the confined space. The measures might involve modifying the confined space itself to avoid the need for entry, or to enable the work to be undertaken from outside the space.

IF ENTRY IS NECESSARY

17 If it is not reasonably practicable to prevent work in a confined space the Line Manager will need to ensure that a documented confined space risks assessment is carried out connected with entering or working in the space. The assessment will need to identify the risks to those entering or working there, and also any others, for example, other workers including contractors and the general public in the vicinity who could be affected by the work to be undertaken. The assessment, upon which a safe system of work is to be based, must be carried out by those competent to do so.

18 A competent person for these purposes will be someone with sufficient experience of, and familiarity with, the relevant processes, plant and equipment so that they understand the risks involved, have knowledge of confined space entry procedures, and can devise necessary precautions to meet the requirements of the confined space regulations. In complex cases more than one person may be needed to conduct assessment of risks with each person relating to their specific areas of expertise.

RISK ASSESSMENT

19 Where a number of confined spaces (e.g. sewers or manholes, ships tanks) are broadly the same, in terms of the conditions and the activities being carried out, and if the risks and measures to deal with them are the same, it may be possible to devise a 'model' or generic risk assessment covering them all. Differences in particular cases that would alter the conclusions of the model risk assessment must be identified. Failure to include relevant information in the risk assessment could lead to inadequate precautions in the subsequent system of work.

Factors to be assessed

20 Line managers should assess the general condition of the confined space to identify what might be present or not present, and cause a problem: for example, is the concentration of oxygen normal? Any records relating to the confined space should be checked for relevant information. Consideration should be given to:

21 Previous contents: Information about any substances previously held, however briefly, in the confined space, will give an indication of what kind of hazard may be expected, for example, toxic or flammable gases, etc. Fires and explosions have been caused by ignition of substances thought to have been 'removed' some considerable time before, but which were, in fact, still present.

22 Residues: Dangers may arise from chemical residues or scale, rust, sludge or other residues in a confined space. For example, dangerous gas, fume or vapour can be released when scale, sludge or animal slurry is disturbed. Where there are residues, safe working procedures should assume that disturbance of the residue will release gas, fume or vapour.

23 Contamination: This may arise from adjacent plant, processes. Gasses and liquids may leak of may have leaked into the confined space from the adjacent plant If open to the elements the possibility of a sudden heavy downpour may need to be considered.

24 Oxygen deficiency and oxygen enrichment: There are substantial risks if the concentration of oxygen in the atmosphere varies significantly from normal (i.e. 20.8%). For example, oxygen enrichment will increase flammability of clothing and other combustible materials. Conversely a relatively small reduction in the oxygen percentage can lead to impaired mental ability. The effects are very rapid and generally there will be no warning to alert the senses. This can happen even in circumstances where only a person's head is inside a confined space. Very low oxygen concentrations (i.e. below 16%) can lead to unconsciousness and death. Any difference in oxygen content from normal should be investigated, the risk assessed, and appropriate measures taken in the light of the risk.

25 Physical dimensions: Line Managers must consider the possible effects of the dimensions and layout of the confined space. Air quality can differ if the space contains remote or low-lying compartments. Account must also be taken of isolated pockets or regions within the space when choosing ventilation methods. The size and shape of the access should be considered in relation to the work and any emergency arrangements. Forced ventilation, breathing apparatus air-lines required by a safe system of work may reduce the dimensions of the access effecting the emergency rescue.

26 Work hazards: Line Managers should assess hazards that arise directly from the work to be undertaken in the confined space. The work itself may produce the hazard. Alternatively, conditions may become hazardous when work is done in conjunction with residues, contamination etc. Work being done on the exterior of the confined space (e.g. external welding) could also generate hazardous conditions within. Hazards that can be introduced into a space that may otherwise be safe include:

26.1 Cleaning chemicals: chemicals that might be used for cleaning purposes could affect the atmosphere directly or interact with residual substances present in the confined space.

26.2 Sources of ignition: welding could act as a source of ignition for flammable gases, vapours (e.g. from residues), dusts, plastics and many other materials which may burn leading to a fire or explosion. Welding on the outside of a confined space can easily ignite materials in contact with the metal on the inside. Tools and equipment, including lighting, may need to be inherently safe or specially protected where they are likely to be used in potentially flammable or explosive atmospheres so that they do not present a source of ignition.

27 Ingress of substances: There may be a risk of substances (liquids, gases, steam, water, raw materials) from nearby processes and services entering the confined space. This could be caused by the inadvertent operation of machinery. Consequently, you should normally disconnect power to such equipment and measures should be taken to ensure that it cannot be reconnected, until it is safe to do so, taking care not to isolate vital services such as sprinkler systems, communications etc. Also, measures are needed to prevent the substance normally held in the confined space from being automatically delivered. There may also be a risk of carbon monoxide, carbon dioxide and nitrogen dioxide present in the exhaust of combustion engines that could enter the confined space.

28 Emergencies: In the initial assessment Line Managers should assess the requirements for emergency rescue arrangements. Possible emergencies should be anticipated and appropriate rescue arrangements made. The likely risks, and therefore the equipment and measures needed for a rescue by nearby employees need to be identified

29 Suitability of staff to work in confined spaces: Each individual who will need to work in the confined space, and the task to be performed, can have implications for the safe system of work. The build of individuals may prevent their use on the work, and other factors, such as claustrophobia or their fitness to wear breathing apparatus may be a restriction. Medical advice on an individuals suitability for the work may be needed. This should also be a consideration for any member of a rescue team who may have to enter the confined space.

SAFE SYSTEM OF WORK

30 Where it is not reasonably practicable to avoid entering a confined space to undertake work, the Line Manager is responsible for ensuring that a safe system of work is used. In designing a safe system of work, they should give priority to eliminating the source of any danger before deciding what precautions are needed for entry.

31 To be effective a safe system of work needs to be in writing. A safe system of work sets out the work to be done and the precautions to be taken. When written down it is a formal record that all foreseeable hazards and risks have been considered in advance. The safe procedure consists of all appropriate precautions taken in the correct sequence. In practice a safe system of work will only ever be as good as its implementation.

Precautions To Be Included In The Safe System Of Work

32 The precautions required in a safe system of work will depend on the nature of the confined space and the risk assessment. For example, the risks involved and precautions needed for cleaning car interiors with solvents will be relatively straightforward by comparison with those involved when undertaking welding work inside a chemical reactor vessel, or work in a sewer. The main elements to consider when designing a safe system of work, and which may form the basis of a permit-to-work are:

33 Supervision: The degree of supervision should be based on the findings of the risk assessment. In some cases this might simply be to instruct an employee how to do the work and then periodically check that all is well, for example, if the work is routine, the precautions straightforward, and all the arrangements for safety can be properly controlled by the person carrying out the work. It is more likely that the risk assessment will identify a level of risk that requires the appointment of a competent to supervise the work and who may need to remain present while the work is being undertaken. It will be the supervisor's role to ensure that the permit-to-work system, where applicable, operates properly, the necessary safety precautions are taken, and that anyone in the vicinity of the confined space is informed of the work being done.

34 Competence for confined spaces working: To be competent to work safely in confined spaces, adequate training and experience in the particular work involved is essential. Training standards must be appropriate to the task, and to the individual's roles and responsibilities, so that work can be carried out safely. Where the risk assessment indicates that properly trained individuals can work for periods without supervision, you will need to check that they are competent to follow the established safe system of work and have been provided with adequate information and instruction about the work to be done.

35 Communications: An adequate tried and tested communication system will be needed and should enable communication:

35.1 Between those inside the confined space; (Worker to Worker)

35.2 Between those inside the confined space and those outside; (Worker to Top man) and

35.3 To summon help in case of emergency. (Top man to Emergency Services)

36 Whatever system is used, and it can be based on speech, tugs on a rope, the telephone, radio etc, it is important that all messages can be communicated easily, rapidly and unambiguously between relevant people. Consider whether the communication methods are appropriate for any workers wearing breathing apparatus. The communication system should also cover the need for those outside the space to raise the alarm and set in motion emergency rescue procedures. Equipment such as telephones and radios should be specially protected so that they do not present a source of ignition where there is a risk of flammable or potentially explosive atmospheres.

37 Testing/monitoring the atmosphere: The atmosphere within a confined space may need testing for hazardous gas, fume or vapour or to check the concentration of oxygen prior to entry. Testing will be needed where knowledge of the confined space, for example, from information about its previous contents or chemicals used in a previous activity in the space, indicates that the atmosphere might be contaminated or to any extent unsafe to breathe, or where any doubt exists as to the condition of the atmosphere. It will also be needed where the atmosphere was known to be contaminated previously, was ventilated as a consequence, and needs to be tested to check the result.

38 Where the atmosphere in the space may not be safe to breathe and requires testing, the findings of the risk assessment may indicate that testing should be carried out on each occasion that the confined space is re-entered, even where the atmosphere initially was found to be safe to breathe. Regular monitoring of the atmosphere may also be necessary to check that there is no change in the atmosphere while the work is being carried out, particularly where there is a known possibility of adverse changes in the atmosphere during the work. The conditions should be continuously monitored when, for example, forced ventilation is being used, and where the work activity could give rise to changes in the atmosphere. The exact testing, retesting and monitoring requirements should be defined by a competent person within the safe system of work.

39 Local emergency services attending an emergency incident may necessarily require the immediate use of self-contained breathing apparatus, under controlled and monitored entry conditions, without following the testing procedures. This is due to the constraints on effecting an immediate rescue.

40 The choice of testing equipment will depend on the circumstances and knowledge of possible contaminants. For example, when testing for toxic or asphyxiating atmospheres suitably calibrated chemical detector tubes or portable atmospheric monitoring equipment may be appropriate. However, in some cases equipment specifically designed to measure for flammable or explosive atmospheres will be required. All such equipment should be specially suited for use in these atmospheres. Testing equipment should also be in good working order and where necessary calibrated and checked in accordance with the intervals and recommendations accompanying the equipment, or at other suitable intervals. Explosimeters will need to be calibrated for different gases or vapours.

41 Testing to measure the oxygen content should be carried out before testing for concentration of flammable gases, followed by any further tests for toxic gases, vapours and dusts. Additional tests may be required for the presence of contaminants in liquid or solid form when the risk assessment indicates that they may be present. It is important not to overlook the flammable properties of substances that also have toxic properties, even if they are only slightly toxic.

42 Testing should be carried out by persons who are not only competent in the practice and aware of the existing standards for the relevant airborne contaminates being measured but are also instructed and trained in the risks involved. Those carrying out the testing should also be capable of interpreting the results and taking any necessary action. Records should be kept of the results and findings.

43 The atmosphere in a confined space can often be tested from the outside, without the need for entry, drawing samples through a long probe. Where flexible sample tubing is used, ensure that it is not impeded by kinks, blockages, blocked or restricted nozzles and that sufficient time is allowed for samples of the atmosphere to displace the normal air in the probe. It is important that the atmosphere in sufficiently representative samples of the space is tested to check for pockets of poor air quality, especially if there is any doubt about the thoroughness of ventilation

44 Gas Purging: Where the risk assessment has identified the presence or possible presence of flammable or toxic gases or vapours there may be a need to purge the gas or vapour from the confined space. This can be done with air or an inert gas where toxic contaminants are present, but with inert gas only where there are flammable contaminants. Only use inert gas for purging flammable gas or vapour because any purging with air could produce a flammable mixture within the confined space. Where purging has been carried out, the atmosphere will need to be tested to check that purging has been effective, and that it is safe to breathe before allowing people to enter.

45 In circumstances where the safest method of removing a flammable or explosive hazard is by purging with inert gas, for instance using nitrogen displacement, and the work cannot be carried out from a safe position outside the confined space. Line Managers will need to put in place a permit-to-work system that identifies the standard of protection of all exposed persons. This would include use of full breathing apparatus.

46 Take account of the possibility of exposure both to employees and non-employees from vented gases as a result of purging. When carrying out purging, take precautions to protect those outside the confined space from toxic, flammable, irritating gases and vapours etc.

47 Good ventilation and a supply of breathable air are essential. Inhaling an atmosphere that contains no oxygen can cause loss of consciousness in a matter of seconds because such an atmosphere not only fails to provide oxygen but may also displace oxygen in the bloodstream. When the atmosphere inhaled contains some oxygen, the loss of oxygen from the bloodstream takes place more slowly. Nevertheless victims will feel very fatigued and will find it difficult to help themselves because of the irrationality induced by lack of oxygen. Prolonged exposure to such an atmosphere can result in loss of consciousness. The speed at which unconsciousness can result after exposure to an inert atmosphere is seldom appreciated and may have been a factor in some fatalities where rescue without proper breathing apparatus or respiratory protection has been attempted in such atmospheres.

48 Ventilation: Some confined spaces are enclosed to the extent that they require mechanical ventilation to provide sufficient fresh air to replace the oxygen that is being used up by people working in the space, and to dilute and remove gas, fume or vapour produced by the work. This can be done by using a blower fan and trunking and/or an exhaust fan or ejector and trunking (provided that there is an adequate supply of fresh air to replace the used air). Fresh air should be drawn from a point where it is not contaminated either by used air or other pollutants. Never introduce additional oxygen into a confined space to 'sweeten' the air as this can lead to oxygen enrichment in the atmosphere that can render certain substances (e.g. grease) liable to spontaneous combustion, and will greatly increase the combustibility of other materials. Oxygen above the normal concentration in air may also have a toxic effect if inhaled.

49 When considering the ventilation method, take account of the layout of the space, the position of openings etc and the properties of the pollutants, so that circulation of air for ventilation is effective. Natural ventilation may suffice if there is sufficient top and bottom openings in a vessel. For example, if a small tank containing heavy vapour has a single top manhole it may be sufficient to exhaust from the bottom of the tank with a ventilation duct whilst allowing 'make-up' air to enter through the manhole. For complicated spaces where several pockets of gas or vapour might collect, a more complex ventilation system will be needed to ensure thorough ventilation. Forced ventilation is normally preferable to exhaust ventilation (which has only a local benefit). It is essential to ensure that extract ventilation is routed away from possible sources of re-entry. In all cases it is important that an airline or trunking should be introduced at, or extend to, the bottom of the vessel to ensure removal of heavy gas or vapour and effective circulation of air.

50 Removal of Residues: Cleaning or removal of residues is often the purpose of confined space work. In some cases residues will need to be removed to allow other work to be undertaken safely. Appropriate measures should be taken where risks from the residues are identified. For example, dangerous substances (such as hazardous gas, fume or vapour) can be released when residues are disturbed or, particularly, when heat is applied to them. The measures might include the use of powered ventilation equipment, specially protected electrical equipment for use in hazardous atmospheres, respiratory protective equipment and atmospheric monitoring. The cleaning or removal process might need to be repeated to ensure that all residues have been removed, and in some cases might need to deal with residues trapped in sludge, scale or other deposits, brickwork, or behind loose linings, in liquid traps, joints in vessels, in pipe bends, or in other places where removal is difficult.

51 Isolation From Gases, Liquids And Other Flowing Materials: Confined spaces will often need to be isolated from ingress of substances that could pose a risk to those working within the space. An effective method is to disconnect the confined space completely from every item of plant either removing a section of pipe or duct or by inserting blanks. If blanks are used, the spectacle type with one lens solid and the other a ring, makes checking easier. When disconnection in this way cannot be done one alternative is a suitable, reliable valve that is locked shut, providing there is no possibility of it allowing anything to pass through when locked, or of being unlocked when people are inside the confined space.

52 Barriers such as a single brick wall, a water seal, or shut-off valves or those sealed with sand or loam to separate one section of plant from another, are sometimes present at a confined space and offer some degree of isolation of the space. However, these barriers are usually provided for normal working and may not provide the level of safety protection necessary for the high risks often found in confined spaces. A more substantial means of isolation may therefore be needed. Whatever means of isolation is used it needs to be tested to ensure it is sufficiently reliable by checking for substances to see if isolation has been effective.

53 Isolation from Mechanical and Electrical Equipment: Some confined spaces contain electrical and mechanical equipment with power supplied from outside the space. Unless the risk assessment specifically enables the system of work to allow power to remain on, either for the purposes of the task being undertaken or as vital services (i.e. lighting, vital communications, fire-fighting, pumping where flooding is a risk, or cables distributing power to other areas), the power should be disconnected, separated from the equipment. A check made to ensure isolation has been effective. This could include locking off the switch and formally securing the key in accordance with a permit-to-work, until it is no longer necessary to control access. Lock and tag systems can be useful here, where each operator has their own lock and key giving self-assurance of the inactivated mechanism or system. Check there is no stored energy of any kind left in the system that could activate the equipment inadvertently.

54 Selection and Use of Suitable Equipment: Any equipment provided for use in a confined space needs to be suitable for the purpose. Where there is a risk of a flammable gas seeping into a confined space and which could be ignited by electrical sources (eg a portable hand lamp), specially protected electrical equipment (i.e. intrinsically safe) needs to be used, for example, a lamp certified for use in explosive atmospheres.

NOTE

Specially designed low voltage portable lights, while offering protection against electrocution, could nevertheless still present ignition sources and are not in themselves safer in flammable or potentially explosive atmospheres.

55 All equipment should be carefully selected bearing in mind the conditions and risks where it will be used. Earthing should be considered to prevent static charge build-up. In addition to isolation, mechanical equipment may need to be secured against free rotation, as people may tread or lean on it, and risk trapping or falling.

56 Personal Protective Equipment And Respiratory Protective Equipment: So far as is reasonably practicable you should ensure that a confined space is safe to work in without the need for Personal Protective Equipment (PPE) and Respiratory Protective Equipment (RPE) which should be a last resort, except for rescue work (including the work of the emergency services). Use of PPE and RPE may be identified as necessary in your risk assessment, in which case it needs to be suitable and should be provided and used by those entering and working in confined spaces. Such equipment is in addition to engineering controls and safe systems of work. The type of PPE provided will depend on the hazards identified but, for example, might include safety lines and harnesses, and suitable breathing apparatus. Take account of foreseeable hazards that might arise, and the need for emergency evacuation.

57 Wearing respiratory protective equipment and personal protective equipment can contribute to heat stress. In extreme situations cooling air may be required for protective suits. Footwear and clothing may also require insulating properties, for example, to prevent softening of plastics that could lead to distortion of components such as visors, air-hoses and crimped connections.

58 Portable Gas Cylinders and Internal Combustion Engines: never use petrol-fuelled internal combustion engines in confined spaces. Gas cylinders should not normally be used within a confined space unless special precautions are taken. Portable gas cylinders for heat, power or light, and diesel-fuelled internal combustion engines are nearly as dangerous as petrol-fuelled engines, and are inappropriate unless exceptional precautions are taken. Where their use cannot be avoided, adequate ventilation needs to be provided to prevent a build up of harmful gas, and to allow internal combustion engines to operate properly. The exhaust from engines should be vented to a safe place well away from the confined space, downwind of any ventilator intakes for the confined space, and the means checked for leakage within the confined space. In tunnelling, normal practice is to provide a high level of ventilation and additional precautions to minimise emissions. Fuelling of portable engine-driven equipment should be conducted outside the confined space except in rare cases where it is not reasonably practicable, such as in some tunnelling work. Using such equipment within the space requires constant atmospheric monitoring of the space.

59 Check gas equipment and gas pipelines for gas leaks before entry into the confined space. At the end of every work period remove gas cylinders, including those forming welding sets, from the confined space in case a slow leak contaminates the atmosphere within the space.

60 Gas Supplied by Pipes and Hoses: The use of pipes and hoses for conveying oxygen or flammable gases into a confined space should be controlled to minimise the risks. It is important that at the end of every working period, other than during short interruptions, the supply valves for pipes and hoses are securely closed before the pipes and hoses are withdrawn from the confined space to a place that is well ventilated. Where pipes and hoses cannot be removed, they should be disconnected from the gas supply at a point outside the confined space and their contents safely vented.

61 Access And Egress: Line Managers should provide a safe way in and out of the confined space. Wherever possible allow quick, unobstructed and ready access. The means of escape must be suitable for use by the individual who enters the confined space so that they can quickly escape in an emergency. Suitable means to prevent access should be in place when there is no need for anybody to work in the confined space. The safe system of work should ensure that everyone has left the confined space during 'boxing-up' operations particularly when the space is complicated and extensive, for example in boilers, cable-ways and culverts where there can be numerous entry/exit points.

62 The size of openings to confined spaces needs to be adequate. Openings affording safe access to confined spaces, and through divisions, partitions or obstructions within such spaces, need to be sufficiently large and free from obstruction to allow the passage of persons wearing the necessary protective clothing and equipment, and to allow adequate access for rescue purposes.

63 There should be a safety sign that is clear and conspicuous to prohibit unauthorised entry alongside openings that allow for safe access.

64 Fire Prevention: Wherever possible flammable and combustible materials should not be stored in confined spaces that have not been specifically created or allocated for that purpose. If they accumulate as a result of work they should be removed as soon as possible and before they begin to create a risk. Where flammable materials need to be located in a confined space the quantity of the material should be kept to a minimum. In most cases flammable materials should not be stored in confined spaces; however there may be special cases where this is necessary for example, in tunnelling. In these cases they should be stored in suitable fire-resistant containers. If there is a risk of flammable or potentially explosive atmospheres, take precautions to eliminate the risk such as removal by cleaning, effective use of thorough ventilation, and control of the sources of ignition.

65 Lighting: Adequate and suitable lighting, including emergency lighting, should be provided. For example, the lighting will need to be specially protected if used where flammable or potentially explosive atmospheres are likely to occur. Other gases may be present that could break down thermally on the unprotected hot surfaces of a lighting system and produce other toxic products. Lighting may need to be protected against knocks (e.g. by a wire cage), and/or be waterproof. Where water is present in the space, suitable plug/socket connectors capable of withstanding wet or damp conditions should be used and protected by Residual Current Devices (RCDs) suitable for protection against electric shock. The position of lighting may also be important, for example to give ample clearance for work or rescue to be carried out unobstructed.

66 Static Electricity: Exclude static discharges, and all sources of ignition if there is a risk of a flammable or explosive atmosphere in the confined space. All conducting items such as steel trunking and airlines should be bonded and effectively earthed. If cleaning operations are to be carried out assess the risks posed by the use or presence of high resistivity materials (such as synthetic plastics) in and adjacent to the confined space.

67 Some equipment is prone to static build-up due to its insulating characteristics, for example, most plastics. There is also a high risk of electrostatic discharge from some equipment used for steam or water jetting. Static discharges can also arise from clothing containing cotton or wool. Consider selecting safer alternative equipment and antistatic footwear and clothing.

68 Smoking: Smoking should be prohibited in confined spaces. The results of the risk assessment may indicate that it would be necessary to extend the exclusion area to a distance beyond the confined space, for example, 5-10 m.

69 Emergencies And Rescue: The arrangements for the rescue of persons in the event of an emergency, required under the confined spaces regulations, need to be suitable and sufficient and, where appropriate, there will also be a need for the necessary equipment to enable resuscitation procedures to be carried out. The arrangements should be in place before any person enters or works in a confined space.

PERMIT TO WORK PROCEDURES

70 A permit-to-work system is a formal written system and is usually required where there is a reasonably foreseeable risk of serious injury in entering or working in the confined space. The permit-to-work procedure is an extension of the safe system to work, not a replacement for it. The use of a permit-to-work system does not, by itself, make the job safe. It supports the safe system, providing a ready means of recording findings and authorisations required to proceed with the entry. It also contains information, for example, time limits on entry, results of the gas testing, and other information that may be required during an emergency and which, when the job is completed, can also provide historical information on original entry conditions. A permit-to-work system is appropriate, for example:

70.1 To ensure that the people working in the confined space are aware of the hazards involved and the identity, nature and extent of the work to be carried out;

70.2 To ensure there is a formal check undertaken confirming elements of a safe system of work are in place. This needs to take place before people are allowed to enter or work in the confined space;

70.3 Where there is a need to co-ordinate or exclude, using controlled and formal procedures, other people and their activities where they could affect work or conditions in the confined space;

70.4 If the work requires the authorisation of more than one person, or there is a time-limit on entry. It may also be needed if communications with the outside are other than by direct speech, or if particular respiratory protective and/or personal protective equipment is required.

71 A permit-to-work should be cancelled once the operations to which it applies have finished.

72 The nature of permit-to-work procedures will vary in their scope depending on the job, and the risks. A permit-to-work system is unlikely to be needed where, for example:

72.1 The assessed risks are low and can be controlled easily; and

72.2 The system of work is very simple; and

72.3 You know that other work activities being carried out cannot affect safe working in the confined space.

73 If an assessed risk is subsequently eliminated entirely, and there is no foreseeable chance of it recurring, you can consider giving unrestricted entry provided the above conditions apply.

74 The decision not to adopt a permit-to-work system should be taken by a competent person, where necessary following consultation with specialists, and bearing in mind the findings of the risk assessment and the need to ensure a safe system of work.

EMERGENCY PROCEDURES

75 No person at work should be allowed to enter or carry out work in a confined space unless there have been prepared for that confined space suitable and sufficient arrangements for the rescue of persons in the event of an emergency, whether or not arising out of a specified risk (i.e. they become ill or hurt, not through the process or the confined space hazards). Suitable and sufficient means-

75.1 The arrangements reduce, so far as is reasonably practicable, the risks to the health and safety of any person required to put the arrangements for rescue into operation; and

75.2 The arrangements include, where the need for resuscitation of any person is a likely consequence of a relevant specified risk, the provision and maintenance of such equipment as is necessary to enable resuscitation procedures to be carried out.

75.3 The arrangements are able to implemented immediately an emergency arises.

76 Arrangements for emergency rescue will depend on the nature of the confined space, the risks identified and the likely nature of an emergency rescue. Account needs to be taken not only of accidents arising from a specified risk, but also any other accident in which a person needs to be recovered from a confined space, for example, incapacitation following a fall. To be suitable and sufficient the arrangements for rescue and resuscitation should include consideration of:

77 Rescue And Resuscitation Equipment: Rescue equipment provided should be appropriate in view of the likely emergencies identified in the risk assessment, and should be properly maintained. If resuscitation has been identified as a likely consequence, provision will need to be made for appropriate training to enable resuscitation procedures to be carried out, and this may include use of appropriate resuscitation equipment. In determining if resuscitation is likely to be needed, consideration should be given to experience gained from knowledge of previous incidents.

78 Rescue equipment will often include lifelines and lifting equipment (since even the strongest person is unlikely to be able to lift or handle an unconscious person on their own using only a rope), additional sets of breathing apparatus and first aid equipment.

79 Self-rescue' equipment, may be appropriate for use in situations where there will be time to react to an anticipated emergency situation, for example, smoke logging in tunnels or reacting to atmospheric monitoring devices. They should be made available only where the type provided is suitable for the hazard expected in the emergency situation. They are not a substitute for respiratory protective equipment.

80 Resuscitation procedures include respiratory and circulatory resuscitation procedures. These are simple procedures that most people would be capable of carrying out provided they have been trained. Training and refresher training are essential since the speed with which resuscitation is started is often as important as how well it is done. Ancillary equipment may be needed for oral resuscitation: these avoid direct contact between the mouths of the victim and rescuer, for example, by using special tubes and mouthpieces. However, if resuscitation is needed as a result of exposure to toxic gases, oral methods are not appropriate since they could put the rescuer at risk. In some cases equipment for artificial respiration as a follow-up to, or in place of, oral resuscitation is appropriate. This equipment should only be operated by someone with the necessary specialist training, or it can be kept available, properly maintained, on site for use by a person providing professional medical help.

81 Raising The Alarm And Rescue: There should be measures to enable those in the confined space to communicate to others outside t he space who can initiate rescue procedures or summon help in an emergency. The emergency can be communicated in a number of ways, for example by the tug of a rope, by radio or by means of a 'lone worker' alarm. Whatever the system it should be reliable and tested frequently. Exceptionally, if justified on grounds of risk or from knowledge of previous incidents involving similar work, one or more people dedicated to the rescue role, and outside the confined space will be required to keep those inside in constant direct visual sight in case of emergency.

82 Safeguarding the Rescuers: Multiple fatalities have occurred when rescuers have been overcome by the same conditions that have affected the people they have tried to rescue. To prevent this, it is essential that those who have been assigned a rescue role, for example, members of an in-house or works rescue team are themselves protected against the cause of the emergency. The precautions necessary to protect the rescuers should be considered during the risk assessment, and adequate provisions made when preparing suitable and sufficient emergency arrangements.

83 Fire Safety: Advice on fire safety precautions and measures may be obtained from the local fire service or advisor. Inert gas flooding of the confined space must not take place when people are within the space.

84 Training: Those likely to be involved in any emergency rescue should be trained for that purpose. The training needs for each individual will vary according to their designated role. It is important that refresher training is organised and available on a regular basis, for example annually. Training should include the following, where appropriate:

84.1 The likely causes of an emergency;

84.2 Use of rescue equipment, e.g. breathing apparatus, lifelines, and where necessary a knowledge of its construction and working;

84.3 The check procedures to be followed when donning and using apparatus;

84.4 Checking of correct functioning and/or testing of emergency equipment (for immediate use and to enable specific periodic maintenance checks);

84.5 Identifying defects and dealing with malfunctions and failures of equipment during use;

84.6 Works, site or other local emergency procedures including the initiation of an emergency response;

84.7 Instruction on how to shut down relevant process plant as appropriate (this knowledge would be required by anyone likely to perform a rescue);

84.8 Resuscitation procedures and, where appropriate, the correct use of relevant ancillary equipment and any resuscitation equipment provided (if intended to be operated by those receiving emergency rescue training);

84.9 Emergency first aid and the use of the first aid equipment provided;

84.10 Use of fire-fighting equipment;

84.11 Liaison with local emergency services in the event of an incident, providing relevant information about conditions and risks, and providing appropriate space and facilities to enable the emergency services to carry out their tasks; and

84.12 Rescue techniques including regular and periodic rehearsals/exercises. This could include the use of a full-weight dummy. Training should be realistic and not just drill based, and should relate to practice and familiarity with equipment.

RESPIRATORY PROTECTIVE EQUIPMENT

85 Where Respiratory Protective Equipment (RPE) is provided or used in connection with confined space entry or for emergency or rescue, it should be suitable for the purpose for which it is intended, i.e. correctly selected and matched both to the job and the wearer. RPE will not normally be suitable unless it is breathing apparatus. For most cases breathing apparatus would provide the standard of protection for entry into confined spaces. Any RPE should comply with the Personal Protective Equipment Regulations 1992 (display a 'CE mark'), or, where these provisions are not appropriate, be of a standard or to a type approved by HSE.

OTHER EQUIPMENT

86 Ropes, winches, harnesses, fall arrest gear, lifelines, first aid equipment, protective clothing and other special equipment provided or used for, or in connection with, confined space entry, rescue or resuscitation, should be suitable for the purposes for which they are intended, and account taken of appropriate recognised standards where these exist.

87 When a safety harness and line are used, it is essential that the free end of the line is secured so that it can be used as part of the rescue procedure. In most cases the line should be secured outside the entry to the confined space. The harness and line should be adjusted and worn so that the wearer can be safely drawn through any manhole or opening. Lifting equipment may be necessary for this purpose. An appropriate harness fitted to the line should be of suitable construction, and made of suitable material to recognised standards capable of withstanding both the strain likely to be imposed, and attack from chemicals.

MAINTENANCE OF EQUIPMENT

88 All equipment provided or used for the purposes of securing the health and safety of people in connection with confined space entry or for emergency or rescue, should be maintained in an efficient state, in efficient working order and in good repair. This should include periodic examination and testing as necessary. Some types of equipment, for example breathing apparatus, should be inspected each time before use. The manufacturer or supplier's instructions will often provide advice on the frequency and type of examination.

89 Examination Of Equipment: The examination of RPE and resuscitating apparatus normally will comprise a thorough visual examination of all parts of the respirator, breathing or resuscitating apparatus, looking particularly at the integrity of the straps, face-pieces, filters and valves. Any defects discovered by the examination, and which would undermine safe operation, should be remedied before further use.

90 The examination of ropes, harnesses, lifelines, protective clothing, and other special equipment normally will consist of a thorough visual examination of all their parts for deterioration or damage, in particular of those parts that are load-bearing. Examinations should be carried out regularly. In the case of protective clothing that is used only occasionally or where the conditions of use are unlikely to damage it, the interval between examinations may be greater.

91 Atmospheric monitoring equipment and special ventilating or other equipment provided or used in connection with confined space entry needs to be properly maintained. It should be examined thoroughly, and where necessary calibrated.

TRAINING

92 Line Managers should ensure that such information, instruction, training and supervision as is necessary to ensure the health and safety at work of employees. Specific training for work in confined spaces will depend on an individual's previous experience and the type of work they will be doing. It is likely that this training will need to cover:

92.1 An awareness of the confined spaces regulations and in particular the need to avoid entry to a confined space, unless it is not reasonably practicable to do so;

92.2 An understanding of the work to be undertaken, the hazards, and the necessary precautions;

92.3 An understanding of safe systems of work, with particular reference to 'permits-to-work' where appropriate;

92.4 How emergencies arise, the need to follow prepared emergency arrangements and the dangers of not doing so.

93 Training will also take into account the practical use of safety features and equipment, the identification of defects and, where appropriate, it should involve demonstrations and practical exercises. It is important that trainees are familiar with both equipment and procedures before working for the first time in confined spaces.

94 Practical refresher training should be organised and available. The frequency with which refresher training is provided will depend upon how long since the type of work was last done, or if there have been changes to methods of work, safety procedures or equipment.

95 Training in specific safety features may include any or all of the following:

95.1 Use of atmospheric testing equipment, and the action to take depending on the readings;

95.2 Use of breathing apparatus and escape sets (self-rescuers), their maintenance, cleaning and storage;

95.3 Use of other items of personal protective equipment;

95.4 Instruction in the communication methods to be used whilst in the confined space.

95.5 Training in emergency rescue procedures.