

ENTERING ENCLOSED OR CONFINED SPACES

17.1 Introduction

17.1.1 Based on the findings of the risk assessment, appropriate control measures should be put into place to protect those who may be affected. This Chapter highlights suggested control measures for entry into enclosed or confined spaces.

17.1.2 The Regulations define a “Dangerous Space” as: “Any enclosed or confined space in which it is foreseeable that the atmosphere may at some stage contain toxic or flammable gases or vapours, or be deficient in oxygen, to the extent that it may endanger the life or health of any person entering that space”. **The atmosphere of any enclosed or confined space is potentially dangerous.** The space may be deficient in oxygen and/or contain flammable or toxic fumes, gases or vapours. Where possible, alternative means of working which avoid entering the space should be found.

17.1.3 The Regulations say that “Except when necessary for entry thereto, the master of a ship shall ensure that all entrances to unattended dangerous spaces on the ship are either kept closed or otherwise secured against entry”. When determining whether a space can be regarded as dangerous it should be remembered that **any space** deprived of regular and constant ventilation can become “dangerous”. This could include spaces which would not normally be regarded as such. Some places which fall within the definition of a “Dangerous Space” may be so only occasionally, perhaps due to the type of work to be undertaken, for example, a compartment during spray painting. A “Dangerous Space” may not necessarily be enclosed on all sides, for example ships’ holds may have open

tops, but the nature of the cargo makes the atmosphere in the lower hold dangerous. Such places are not usually considered to be Dangerous Spaces but may become so because of a change in the condition inside or a change in the degree of enclosure or confinement, which may occur intermittently. Personnel need to be aware of any space onboard a ship that has not been opened for some time. Examples of such spaces:

Cargo pump rooms

Some machinery spaces

Holds

This is not an exhaustive list and awareness of potential risks is necessary for all spaces onboard ship. **If in any doubt, such a space should be regarded as dangerous and appropriate action taken.**

17.1.4 Should there be any unexpected reduction in or loss of the means of ventilation of those spaces that are usually continuously or adequately ventilated then such spaces should also be dealt with as dangerous spaces.

17.1.5 When it is suspected that there could be a deficiency of oxygen in any space, or that toxic gases, vapours or fumes could be present, then such a space should be considered to be a dangerous space.

17.2 Precautions on Entering Dangerous Enclosed or Confined Spaces

17.2.1 The following precautions should be taken as appropriate before a potentially dangerous space is entered so as to make the space safe for entry without breathing apparatus and to ensure it remains safe whilst persons are within the space.

1. A competent person should make an assessment of the space and a responsible officer to take charge of the operation should be appointed - see 17.3
2. The potential hazards should be identified - see 17.4
3. The space should be prepared and secured for entry - see 17.5

4. The atmosphere of the space should be tested - see 17.6
5. **A “permit-to-work” system should be used** - see 17.7
6. Procedures before and during the entry should be instituted - see 17.8 and 17.9

17.2.2 Where the procedures listed at 1 to 4 in the previous paragraph have been followed and it has been established that the atmosphere in the space is or could be unsafe then the additional requirements including the use of breathing apparatus specified in 17.11 should also be followed.

17.2.3 No one should enter any dangerous space to attempt a rescue without taking suitable precautions for his own safety since not doing so would put his own life at risk and almost certainly prevent the person he intended to rescue being brought out alive.

17.2.4 An Emergency Escape Breathing Device (EEBD) is a supplied air or oxygen device , only to be used for escape from a compartment that has a hazardous atmosphere, they should not be worn by a rescuer to attempt a rescue of persons in any circumstances.

17.2.5 EEBDs shall not be used to fight fires, entering oxygen deficient voids or tanks, or worn by fire fighters. In these events, a self-contained breathing apparatus, which is specifically suited for such applications, should be used. If it is found that it is not possible to enter a tank wearing a self-contained breathing apparatus the bottle harness can be removed and passed through the access but the face mask must always be worn.

17.2.6 It is recommended that any person entering a potentially dangerous space should wear a personal gas detection meter capable of detecting oxygen deficiency, toxic gases and explosive atmospheres.

17.3 Duties and Responsibilities of a Competent Person and of a Responsible Officer

17.3.1 A competent person is a person capable of making an informed assessment of the likelihood of a dangerous atmosphere being present or arising subsequently in the space. This person should have sufficient theoretical knowledge and practical experience of the hazards that might be met in order to be able to assess whether precautions are necessary. This assessment should include consideration of any potential hazards associated with the particular space to be entered. It should also take into consideration dangers from neighbouring or connected spaces as well as the work that has to be done within the space.

17.3.2 A responsible officer is a person appointed to take charge of every operation where entry into a dangerous space is necessary. This officer may be the same as the competent person (see 17.3.1 above) or another officer. Both the competent person and/or the responsible officer may be a shore-side person.

17.3.3 It is for the responsible officer to decide on the basis of the risk assessment the procedures to be followed for entry into a potentially dangerous space. These will depend on whether the assessment shows:

- (a) there is a minimal risk to the life or health of a person entering the space then or at any future time;
- (b) there is no immediate risk to health and life but a risk could arise during the course of work in the space; or
- (c) the risk to life or health is immediate.

17.3.4 Where the assessment shows that there is no immediate risk to health or life but that a risk could arise during the course of the work in the space the precautions described in sections 17.4 to 17.9 should be taken as appropriate.

17.3.5 Where the risk to health or life is immediate then the additional requirements specified in section 17.11 are necessary.

17.3.6 For inland water vessels such as harbour craft either or both the competent person and the responsible officer may only be available from shore-based personnel. No entry into a potentially dangerous space should be made in these circumstances until such suitably qualified persons are available.

17.4 Identifying Potential Hazards

Oxygen Deficiency

17.4.1 If an empty tank or other confined space has been closed for a time the oxygen content may have been reduced owing to a number of reasons:

- (a) Rusting may have occurred due to oxygen combining with steel.
- (b) Oxygen absorbing chemicals may have been present.
- (c) Oxygen absorbing cargoes may have been carried or gases from volatile cargoes may have displaced the oxygen in tanks.
- (d) Hydrogen may have been produced in a cathodically-protected cargo tank used for ballast.
- (e) Oxygen may have been displaced by the use of carbon dioxide or other fire-extinguishing or -preventing media, or inert gas in the tanks or inter-barrier spaces of tankers or gas carriers.

Toxicity of Oil Cargoes

17.4.2 Hydrocarbon gases are flammable as well as toxic and may be present in fuel or cargo tanks which have contained crude oil or its products.

17.4.3 Hydrocarbon gases or vapours may also be present in pump rooms and cofferdams, duct keels or other spaces adjacent to cargo tanks due to the leakage of cargo.

17.4.4 The components in the vapour of some oil cargoes, such as benzene and hydrogen sulphide are very toxic.

Toxicity of Other Substances

17.4.5 Cargoes carried in chemical tankers or gas carriers may be toxic.

17.4.6 There is the possibility of leakage from drums of chemicals or other packages of dangerous goods where there has been mishandling or incorrect stowage or damage due to heavy weather.

17.4.7 The trace components in inert gas such as carbon monoxide, sulphur dioxide, nitric oxide and nitrogen dioxide are very toxic.

17.4.8 The interaction of vegetable or animal oils or sewage with sea water may lead to the release of hydrogen sulphide which is very toxic.

17.4.9 Hydrogen sulphide or other toxic gases may be generated where the residue of grain or similar cargoes permeates into or chokes bilge pumping systems.

17.4.10 The chemical cleaning, painting or the repair of tank coatings may involve the release of solvent vapours.

Flammability

17.4.11 Flammable vapours may still be present in cargo or other tanks that have contained oil products or chemical or gas cargoes.

17.4.12 Cofferdams and other spaces that are adjacent to cargo and other tanks may contain flammable vapours should there have been leakage into the space.

Other Hazards

17.4.13 Although the inhalation of contaminated air is the most likely route through which harmful substances enter the body, some chemicals can be absorbed through the skin.

17.4.14 Some of the cargoes carried in chemical tankers and gas carriers are irritant or corrosive if permitted to come into contact with the skin.

17.4.15 The disturbance of rust, scale or sludge residues of cargoes of animal, vegetable or mineral origin, or of water that could be covering such substances may lead to the release of toxic or flammable gases.

17.5 Preparing and Securing the Space for Entry

17.5.1 When opening the entrance to a potentially dangerous space, precautions should be taken in case pressurised or unpressurised vapour or gases are released from the space.

17.5.2 The space should be isolated and secured against the ingress of dangerous substances by blanking off pipe-lines or other openings and by closing valves.

Valves should then be lashed or some other means used to indicate that they are not to be opened and notices placed on the relevant controls. The officer on watch should be informed.



17.5.3 Where necessary, any sludge or other deposit liable to give off fumes should be cleaned out. This may in itself lead to the release of gases, and precautions should be taken (see 17.11).

17.5.4 The space should be thoroughly ventilated either by natural or mechanical means and then tested (see 17.6) to ensure that all harmful gases are removed and no pockets of oxygen deficient atmosphere remain.

17.5.5 Compressed oxygen should not be used to ventilate any space.



17.5.6 Where necessary pumping operations or cargo movements should be suspended when entry is being made into a dangerous space.

17.6 Testing the Atmosphere of the Space

17.6.1 Testing of a space should be carried out only by persons trained in the use of the equipment.

17.6.2 Testing should be carried out before entry and at regular intervals thereafter.

17.6.3 If possible, the testing of the atmosphere before entry should be made by remote means. If this is not possible, the person selected to enter the space to test the atmosphere should only do so in accordance with the additional precautions specified in 17.11, which include the wearing of breathing apparatus.

17.6.4 Where appropriate, the testing of the space should be carried out at different levels.

17.6.5 Personal monitoring equipment is designed for personal use only, to provide a warning against oxygen deficiency, toxic gases and explosive atmospheres whilst the wearer is in the space. This should not be used as a means of determining whether a dangerous space is safe prior to entry.

Testing for Oxygen Deficiency

17.6.6 A steady reading of at least 20% oxygen by volume on an oxygen content meter should be obtained before entry is permitted.

17.6.7 A combustible gas indicator cannot be used to detect oxygen deficiency.

Testing for Flammable Gases and Vapours

17.6.8 The combustible gas indicator (sometimes called an explosimeter) detects the amount of flammable gas or vapour in the air. An instrument capable of providing an accurate reading at low concentrations should be used to judge whether the atmosphere is safe for entry.

17.6.9 Combustible gas detectors are calibrated on a standard gas. When testing for other gases and vapours reference should be made to the calibration curves supplied with the instrument. Particular care is required should accumulations of hydrogen be suspected.

17.6.10 In deciding whether the atmosphere is safe to work in, a 'nil' reading on a suitably sensitive combustible gas indicator is desirable but, where the readings have been steady for some time, up to 1% of lower flammable limit may be accepted, eg for hydrocarbons in conjunction with an oxygen reading of at least 20% by volume.

17.6.11 Direct measurement of trace components of inert gas (see 17.4.7) is not required when the gas freeing of the atmosphere of a tank reduces the hydrocarbon concentration from about 2% by volume to 1% of lower flammable limit or less in conjunction with a steady oxygen reading of at least 20% by volume, because this is sufficient to dilute the components to a safe concentration. If, before the commencement of gas freeing, the hydrocarbon concentration of a tank containing inert gas is below 2% by volume due to excessive purging by inert gas, then additional gas freeing is necessary to remove toxic products introduced with the inert gas. It is difficult to measure

the quantities of these toxic products at the safe level without specialised equipment and trained personnel. If this equipment is not available for use, the period of gas freeing should be considerably extended.

Testing for Toxic Gases

17.6.12 The presence of certain gases and vapours on chemical tankers and gas carriers is detected by fixed or portable gas or vapour detection equipment. The readings obtained by this equipment should be compared with the occupational exposure limits for the contaminant given in international industry safety guides or the latest edition of the Health and Safety Executive Guidance Note EH-40 Occupational Exposure Limits. These occupational exposure limits provide guidance for the level of exposure to toxic substances which should not be exceeded if the health of persons is to be protected. However, it is necessary to know for which chemical a test is being made in order to use the equipment correctly and it is important to note that not all chemicals may be tested by these means.

17.6.13 When a toxic chemical is encountered for which there is no means of testing then the additional requirements specified in 17.11 should also be followed.

17.6.14 A combustible gas indicator will probably not be suitable for measuring levels of gas at or around its occupational exposure limit, where there is solely a toxic, rather than a flammable, risk. This level will be much lower than the flammable limit, and the indicator will probably not be sufficiently sensitive to give accurate readings.

17.7 Use of Control systems

17.7.1 Entry into a dangerous space should be planned in advance and use should preferably be made of a 'permit-to-work' system. Details of the arrangements to be followed in a 'permit-to-work' system are described in section 16.2. A sample "permit to work" is at Annex 1 of Chapter 16.

17.7.2 For situations for which a well established safe system of work exists a check-list may exceptionally be accepted as an alternative to a full 'permit-to-work' provided that the principles of the 'permit-to-work' system are covered and the risks arising in the dangerous space are low.

17.8 Procedures and Arrangements Before Entry

17.8.1 Access to and within the space should be adequate and well illuminated.

17.8.2 No source of ignition should be taken or put into the space unless the master or responsible officer is satisfied that it is safe to do so.

17.8.3 In all cases rescue and available resuscitation equipment should be positioned ready for use at the entrance to the space. Rescue equipment means breathing apparatus together with fully charged spare cylinders of air, life lines and rescue harnesses, and torches or lamp, approved for use in a flammable atmosphere, if appropriate. A means of hoisting an incapacitated person from the confined space may be required.

17.8.4 The number of personnel entering the space should be limited to those who actually need to work in the space. When necessary a rescue harness should be worn to facilitate recovery in the event of an accident.

17.8.5 At least one attendant should be detailed to remain at the entrance to the space whilst it is occupied.

17.8.6 An agreed and tested system of communication should be established between any person entering the space and the attendant at the entrance, and between the attendant at the entrance to the space and the officer on watch.

17.8.7 Before entry is permitted it should be established that entry with

breathing apparatus is possible. Any difficulty of movement within any part of the space, or any problems if any incapacitated person had to be removed from the space, as a result of breathing apparatus or lifelines or rescue harnesses being used, should be considered and any risks minimised.

17.8.8 Lifelines should be long enough for the purpose and capable of being firmly attached to the harness, but the wearer should be able to detach them easily should they become tangled.

17.9 Procedures and Arrangements During Entry

17.9.1 Ventilation should continue during the period that the space is occupied and during temporary breaks. In the event of a failure of the ventilation system any personnel in the space should leave immediately.

17.9.2 The atmosphere should be tested periodically whilst the space is occupied and personnel should be instructed to leave the space should there be any deterioration of the conditions. Should a personal gas detector alarm, the space should be vacated by all persons immediately.

17.9.3 If unforeseen difficulties or hazards develop, the work in the space should be stopped and the space evacuated so that the situation can be re-assessed. Permits should be withdrawn and only re-issued, with any appropriate revisions, after the situation has been re-assessed.

17.9.4 If any personnel in a space feel in any way adversely affected they should give the pre-arranged signal to the attendant standing by the entrance and immediately leave the space.

17.9.5 Should an emergency occur the general (or crew) alarm should be sounded so that back-up is immediately available to the rescue team. Under no circumstances should the attendant enter the space before help has arrived and the situation has been evaluated to ensure the safety of those entering the space to undertake the rescue.

17.9.6 If air is being supplied through an air line to the person who is unwell, a check should be made immediately that the air supply is being maintained at the correct pressure.

17.9.7 Once the casualty is reached, the checking of the air supply must be the first priority. Unless he is gravely injured, eg a broken back, he should be removed from the dangerous space as quickly as possible.

17.10 Procedures on completion

17.10.1 On expiry of the 'permit-to-work', everyone should leave the space and the entrance to the space should be closed or otherwise secured against entry or alternatively, where the space is no longer a dangerous space, declared safe for normal entry.

17.11 Additional Requirements for Entry into a Space where the Atmosphere is Suspect or Known to be Unsafe

17.11.1 If the atmosphere is considered to be suspect or unsafe to enter, then the space should only be entered if it is essential for testing purposes, for the safety of life or of the ship, or for the working of the ship. Breathing apparatus should always be worn (see 17.13). The number of persons entering the space should be the minimum compatible with the work to be performed.

17.11.2 Except in the case of an emergency, or where impracticable because movement in the space would be seriously impeded, two air supplies as described in 17.13.2 should be available. While working the wearer should use the continuous supply provided from outside the space. If it becomes necessary to change over to the self-contained supply, the user should immediately exit from the space.

17.11.3 Precautions should be taken against any disruption to the air supply while the individual is inside the enclosed space. Special attention should be given to supplies originating from the engine room.

17.11.4 Where remote testing of the space (as recommended in 17.6.3) is not reasonably practicable, or where a brief inspection only is required, a single air supply may be acceptable provided that the wearer of breathing apparatus is so situated that he can be hauled out immediately in the case of an emergency.

17.11.5 In addition to rescue harnesses, wherever practicable lifelines should be used. Lifelines should be attended by a person stationed at the entrance who has been trained in how to pull an unconscious person from a dangerous space. If hoisting equipment would be required for any rescue, arrangements should be made to ensure that personnel would be available to operate it as soon as necessary.

17.11.6 When appropriate, portable lights and other electrical equipment should be of a type approved for use in a flammable atmosphere.

17.11.7 Should there be any hazard due to chemicals, whether in liquid, gaseous or vapour form, coming into contact with the skin and/or eyes then protective clothing should be worn.

17.12 Training, Instruction and Information

17.12.1 Employers should provide any necessary training, instruction and information to employees in order to ensure that the requirements of the Entry into Dangerous Spaces Regulations are complied with. This should include:

1. recognition of the circumstances and activities likely to lead to the presence of a dangerous atmosphere,
2. the hazards associated with entry into dangerous spaces, and the precautions to be taken,
3. the use and maintenance of equipment and clothing required for entry into dangerous spaces,
4. instruction and drills in rescue from dangerous spaces.

17.13 Breathing Apparatus and Resuscitation Equipment

17.13.1 No one should enter a space where the atmosphere is unsafe or suspect without wearing breathing apparatus which they are trained to use, even to rescue another person.

17.13.2 As described in 17.11.2, breathing apparatus for those working in a dangerous space will usually comprise a continuous supply from outside the space and a self-contained supply to enable the wearer to escape to a safe atmosphere in the event of difficulty with, or failure of, the continuous supply. It should not be necessary to remove any part of the equipment or any protective clothing to change over to the self-contained supply.

17.13.3 Equipment for use with two air supplies may consist of:

- (a) a conventional self-contained breathing apparatus of the open circuit compressed air type that is approved to EN 137:1993 and has been additionally tested for use with an air line connection; or
- (b) a compressed air line breathing apparatus incorporating an emergency self-contained supply. The compressed air line breathing apparatus should be of the demand valve type and should be approved to EN 139:1995, or for self-rescue purposes, to BS 1146: 1997 (or equivalent Standard). The emergency self-contained supply should comply with the relevant parts of the appropriate Standard.

The capacity of the self-contained supply should be sufficient for the wearer to escape to a safe atmosphere. When determining this capacity it should be recognised that, under stress or in difficult conditions, the wearer's breathing rate may be in excess of the nominal breathing rate of 40 litres per minute.

17.13.4 The responsible officer should make sure that the supply of air from outside the space is continuous and is available only to those working in the space. Pipeline or hoses supplying air should be placed so that they are not likely to be so distorted that supply might be interrupted or damaged. If the purpose for which such air lines are used is not immediately apparent to

personnel not engaged in the entry, then notices should be posted at appropriate positions. Where a mechanical pump is being used it should frequently be checked carefully to ensure that it continues to operate properly. Any air pumped directly into a pipeline or put into reserve bottles must be filtered and should be as fresh as possible. Pipelines or hoses used to supply air should be thoroughly blown through to remove moisture and freshen the air before connection to breathing apparatus and face masks. It is essential that where the air supply is from a compressor sited in a machinery space, the engineer of the watch be informed so that the compressor is not shut-down until the work is completed.

17.13.5 Everyone likely to use breathing apparatus must be instructed by a competent person in its proper use.

17.13.6 The master, or responsible officer, and the person about to enter the space should undertake the full pre-wearing check and donning procedures recommended in the manufacturer's instructions. In particular they should check:-

1. that there will be sufficient clean air at the correct pressure;
2. that low pressure alarms are working properly;
3. that the facemask fits correctly against the user's face so that, combined with pressure of the air coming into the mask, there will not be an ingress of oxygen deficient air or toxic vapours when the user inhales. It should be noted that facial hair or spectacles may prevent the formation of an air-tight seal between a person's face and the facemask;
4. that the wearer of the breathing apparatus understands whether or not their air supply may be shared with another person and if so is also aware that such procedures should only be used in an extreme emergency;
5. that when work is being undertaken in the space the wearer should keep the self-contained supply for use when there is a failure of the continuous supply from outside the space.

17.13.7 When in a dangerous space:-

1. No one should remove their own breathing apparatus.
2. Breathing apparatus should not be removed from a person unless it is necessary to save their life.

17.13.8 It is recommended that resuscitators of an appropriate kind should be provided where any person may be required to enter a dangerous space. Where entry is expected to occur at sea the ship should be provided with appropriate equipment. Otherwise entry should be deferred until the ship has docked and use can be made of shore side equipment.

Maintenance of Equipment for entry into dangerous spaces

17.13.9 All breathing apparatus, rescue harnesses, lifelines, resuscitation equipment and any other equipment provided for use in, or in connection with, entry into dangerous spaces, or for use in emergencies, should be properly maintained, inspected periodically and checked for correct operation by a competent person and a record of the inspections and checks should be kept. All items of breathing apparatus should be inspected for correct operation before and after use.

17.13.10 Equipment for testing the atmosphere of dangerous spaces, including oxygen meters, should be kept in good working order and, where applicable, regularly serviced and calibrated. Due regard should be paid to manufacturers' recommendations which should always be kept with the equipment.

18.1 Introduction

18.1.1 Based on the findings of the risk assessment, appropriate control measures should be put into place to protect those who may be affected. This chapter highlights some areas which may require attention in respect of boarding arrangements.

18.2 Positioning of Boarding Equipment

18.2.1 The angles of inclination of a gangway or accommodation ladder should be kept within the limits for which it was designed. Gangways should not be used at an angle of inclination greater than 30° from the horizontal and accommodation ladders should not be used at an angle greater than 55° from the horizontal, unless specifically designed for greater angles.

18.2.2 When the inboard end of the gangway or accommodation ladder rests on or is flush with the top of the bulwark, a bulwark ladder should be provided. Any gap between the bulwark ladder and the gangway or accommodation ladder should be adequately fenced to a height of at least 1 metre.

18.2.3 Gangways and other access equipment should not be rigged on ships' rails unless the rail has been reinforced for that purpose. They should comply with the guidance in Annex 18.1.

18.2.4 The means of access should be checked to ensure that it is safe to use after rigging. There should be further checks to ensure that adjustments are made when necessary due to tidal movements or change of trim and freeboard. Guard ropes, chains etc should be kept taut at all times and stanchions should be rigidly secured.

18.2.5 Each end of a gangway or accommodation or other ladder should provide safe access to a safe place or to an auxiliary safe access.