15 ENTERING DANGEROUS (ENCLOSED) SPACES

15.1 Introduction

15.1.1 An enclosed space is one that:

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- has limited openings for entry and exit;
- has inadequate ventilation; and
- is not designed for continuous worker occupation.

Any enclosed space deprived of regular and constant ventilation may become a 'dangerous space'. The UK 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.'

15.1.2 Some spaces may be a dangerous space only temporarily, perhaps due to the type of cargo carried or work to be undertaken, e.g. a compartment during spray painting.

15.1.3 Any enclosed space is potentially life threatening and every precaution should be taken both prior to entry and while inside. The dangers may not be readily apparent and, despite testing, isolated areas with very low oxygen content or small concentrations of toxic gases may exist. N.B.: A single inhalation with a 5% oxygen content may result in instantaneous loss of consciousness and subsequent death. Similarly, small concentrations of a toxic substance may result in loss of consciousness and subsequent death. Therefore, it is

essential that all necessary precautions are taken including a risk assessment and the completion of a permit to work.

15.1.4 Based on the findings of the risk assessment, appropriate control measures should be put in place to protect anyone who may enter an enclosed space. Procedures (such as systems of work, permits to work and emergency procedures) should be part of a ship's safety management system. This chapter identifies control measures for entry into enclosed spaces.

15.1.5 A dangerous space may not necessarily be enclosed on all sides, e.g. 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 the atmosphere may become dangerous because of a change in the condition inside or in the degree of enclosure or confinement, which may occur intermittently, e.g. in diving bells or saturation chambers. Personnel need to exercise caution before entering any space on board a ship that has not been opened for some time. Examples of such spaces are:

- cargo spaces;
- double bottoms;
- fuel tanks;
- ballast tanks;
- cargo pump rooms;
- cargo compressor rooms;
- cofferdams;
- chain lockers;
- void spaces;
- duct keels;
- inter-barrier spaces;
- boilers;
- engine crankcases;
- engine scavenge air receivers;
- CO_2 rooms;
- battery lockers;
- sewage tanks; and
- adjacent connected spaces, e.g. cargo space access ways.

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

15.1.6 Any dangerous (enclosed) spaces on board ship should be identified using risk assessment and kept under review. It is recommended that an inventory is made of any enclosed spaces that seafarers may enter where there is any likelihood that they might become dangerous. The inventory should record the characteristics of the space, the likely hazard and measures to prevent entry unless safety procedures are followed. Any difficulties inherent in rescue from the space should also be considered, and solutions identified, so that in the event of an emergency, the crew is in the best position to respond quickly. This inventory should be reviewed regularly.

15.1.7 In addition:

- if there is any unexpected reduction in or loss of the means of ventilating spaces that are usually continuously or adequately ventilated, such spaces should also be dealt with as dangerous spaces; and
- 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 dangerous.

15.1.8 Entrances to all unattended dangerous spaces on a ship should be kept locked or secured against entry. Any hatches to readily accessible enclosed spaces should be marked as the entrance to a dangerous space. When the space is open for work to be carried out, an attendant should be posted or a barrier and warning sign put in place. As far as possible, work should be arranged in such a way that no one has to enter the space.

15.1.9 All crew should be given on-board training and familiarisation with the risks of entry into dangerous spaces on board. Training should include as a minimum:

- identification of the hazards likely to be faced during entry into enclosed spaces;
- knowledge of the procedures for assessment of the space;
- knowledge of the procedures for safe entry; and
- recognition of the signs of adverse health effects caused by exposure to hazards during entry.

15.2 Duties and responsibilities of a competent person and an authorised officer

15.2.1 A competent person means a person with sufficient theoretical knowledge and practical experience to make an informed assessment of the likelihood of a dangerous atmosphere being present or subsequently arising in the space, including taking measurements of the atmosphere.

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15.2.2 An authorised officer means a person authorised to permit entry into an enclosed space and with sufficient knowledge of control and elimination of hazards, and of the procedures to be established and complied with on board, to be able to ensure that the space is safe for entry. (International Maritime Organization (IMO) Resolution A.1050(27) refers to this person as the 'responsible officer'.)

15.2.3 On the basis of their risk assessment, the authorised officer should decide the procedures to be followed for entry into a potentially dangerous space. These will depend on whether the assessment shows that:

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

15.2.4 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 15.3 to 15.10 should be taken as appropriate.

15.2.5 Where the risk to health or life is immediate, then the additional requirements specified in section 15.11 are necessary.

15.2.6 On inland waterway vessels, harbour craft and other small ships operating close to shore, seafarers may never be expected to enter a dangerous space, because shore-based companies or personnel may be engaged to carry out any inspection or other work in dangerous spaces. In such cases, some of the requirements of this chapter may not apply, e.g. the requirement to have atmosphere-testing equipment on board the ship at all times, and the requirement for entry drills. However, **all** seafarers should have on-board training to help them recognise the risks from dangerous spaces and to familiarise them with any applicable procedures. When the competent person and authorised officer are shore-based personnel, no

entry into a potentially dangerous space should be permitted until such suitably qualified persons are present.

15.2.7 When shore-side personnel are contracted to enter a dangerous space on a ship in a UK port, the requirements of the Confined Spaces Regulations 1997 apply. While the master retains overall authority for any activity on board their ship, the employer of the shore-side team is responsible to ensure compliance with the Confined Spaces Regulations 1997. The Company should satisfy themselves that the shore-side personnel have sufficient training, equipment and arrangements for rescue in accordance with the Confined Spaces Regulations 1997, Approved Code of Practice, or suitable equivalent arrangements. Once a permit to work has been issued, the shore-side personnel should take responsibility for the operation and for rescue arrangements. It is not sufficient to rely on emergency services for rescue arrangements, although they should still be notified in the event of any such emergency; nor should the ship's crew be designated to provide back-up support.

15.3 Precautions before entering a dangerous space

15.3.1 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.

- A competent person should make an assessment of the space and an authorised officer to take charge of the operation should be appointed, see section 15.3.
- The potential hazards should be identified – see section 15.4.
- The space should be prepared, vented and secured for entry – see section 15.5.
- The atmosphere of the space should be tested – see section 15.6.
- A permit to work system should be used – see section 15.7.
- Procedures for preparation and entry should be agreed– see sections 15.8 and 15.9.
- Emergency procedures should be in place.

15.3.2 When the procedures listed 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 appropriate to the type and size of the space), as specified in section 15.11 should also be followed.

15.3.3 In addition to pre-entry testing of the atmosphere, it is recommended that any person entering a potentially dangerous space should wear a personal atmosphere-monitoring device ('multimeter') capable of detecting oxygen deficiency, carbon monoxide, toxic gases and

explosive atmospheres. It is important to recognise that carrying a personal atmosphere monitor is no substitute for pre-entry testing.

15.4 Identifying potential hazards

15.4.1 In carrying out their assessment, the competent person must take into account any cargo previously carried in the space, ventilation, the coating of the space, the degree of corrosion and any other relevant factors. The factors affecting adjacent spaces may be different from those affecting the space to be entered, but may affect the atmosphere in the space to be entered.

Oxygen deficiency

15.4.2 If an empty tank or other confined space has been closed for a time, the oxygen content may have been reduced for a number of reasons. The following are examples only:

- Rusting may have occurred due to oxygen combining with steel.
- Oxygen-absorbing chemicals may have been present.
- Oxygen-absorbing cargoes may have been carried, including:
  - grain, grain products and residues from grain processing (such as bran, crushed grain, crushed malt or meal) hops, malt husks and spent malt;
  - oilseeds, products from oil seeds (such as seed expellers, seed cake, oil cake and meal);
  - copra;
  - wood in such forms as packaged timber, round wood logs, pulpwood, props (pit props and other prop-wood) woodchips, wood-shavings, wood pellets and sawdust;
  - jute, hemp, flax, sisal, kapok, cotton and other vegetable fibres, empty bags, cotton waste, animal fibres, animal and vegetable fabric, wool waste and rags;
  - fish, fishmeal and fish-scrap;
  - guano;
  - sulphidic ores and ore concentrates;
  - charcoal, coal lignite and coal products;
  - direct reduced iron (DRI);
  - dry ice;
  - metal wastes and chops, iron swarf, steel and other turnings, borings, drillings, shavings, filings and cuttings; and
  - scrap metal.
- Gases from volatile cargoes may have displaced the oxygen in tanks.

- Hydrogen may have been produced in a cathodically protected cargo tank used for ballast.
- 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.
- Nitrogen or another inert gas may have been used to purge tanks.

Oxygen-enriched atmosphere

15.4.3 This may arise from:

- leaks from damaged or poorly maintained hoses, pipes and valves;
- leaks from poor connections;
- opening valves deliberately or accidentally;
- not closing valves properly after use;
- using an excess of oxygen in welding, flame cutting or a similar process; or
- poor ventilation where oxygen is being used.

Because oxygen is odourless, colourless and tasteless, an oxygen-enhanced atmosphere cannot be easily detected by human senses. However, because oxygen aids combustion, even a small increase in the concentration of oxygen in the air produces an increased risk of fire – including spontaneous combustion – or explosion.

Toxicity of oil

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

15.4.5 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.

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

Toxicity of other substances

15.4.7 Some of the cargoes carried in bulk, liquid, gas or packaged form may be toxic or liable to emit toxic gas; appropriate testing for toxic gas should be carried out as per 15.6.11.

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

15.4.9 Inert gas does not support life. In addition, trace components that are often present in the inert gas, such as carbon monoxide, sulphur dioxide, nitric oxide and nitrogen dioxide, are very toxic.

15.4.10 The interaction of vegetable or animal oils, sewage or slops from drilling operations with sea water may lead to the release of hydrogen sulphide, which is very toxic.

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

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

15.4.13 Fumigants may have been used on cargoes in the space (see section 21.7).

Flammability

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

15.4.15 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

15.4.16 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.

15.4.17 Some of the cargoes in bulk, liquid, gas or packaged form are irritants or corrosive if permitted to come into contact with skin; appropriate testing should be carried out as per 15.6.11.

15.4.18 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.

15.5 Preparing and securing the space for entry

15.5.1 When opening the entrance to a potentially dangerous space, precautions should be taken in case pressurised or unpressurised vapour or gases are released from it. The space should be thoroughly ventilated, either by natural or mechanical means, and then tested (see section 15.6) to ensure that all harmful gases have been removed and no pockets of oxygen-deficient atmosphere remain. Any vented gases should be discharged away from the area, thereby not contaminating the immediate area of the entry point to the space or other spaces.

15.5.2 The space should be isolated and secured against the ingress of dangerous substances by blanking off pipelines or other openings and by closing valves, in accordance with the risk assessment and on-board procedures. Valves should then be secured in the closed position, or some other means used to indicate that they are not to be opened. Remote-operated valves should, where practicable, have their remote actuators inhibited with notices placed locally and on the relevant controls. The officer on watch should be informed.

15.5.3 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 section 15.11).

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

15.5.5 When appropriate, pumping operations or cargo movements should be suspended when entry is being made into a dangerous space.

15.6 Testing the atmosphere of the space

15.6.1 From January 2016, ships are required to carry atmosphere-testing equipment. This must be capable of measuring concentrations of oxygen, flammable gases or vapours, hydrogen sulphide and carbon monoxide prior to entry.

15.6.2 Manufacturers' instructions for atmosphere testing equipment should have clearly defined calibration requirements. Where the operation of the ship permits access more frequently than the manufacturer's recommended calibration renewal period (e.g. ferry

services), the calibration equipment may be kept ashore, and arrangements for calibration should be clear from the ship's SMS. Otherwise, calibration equipment should be carried on board.

MSC.1 Circ 1477

15.6.3 Testing should be carried out by remote means before entry and at regular intervals thereafter. Testing of a space should be carried out using properly calibrated and maintained equipment, and only by competent persons trained in the use of the equipment.

15.6.4 If testing by remote means is not possible, e.g. where remote double-bottom tanks have to be entered), it should be assumed that the atmosphere is hazardous until proven otherwise. The person selected to enter the space to test the atmosphere should only do so in accordance with the additional precautions specified in section 15.11, which include the wearing of breathing apparatus. Testing of the space should be carried out at different levels.

15.6.5 Personal monitoring equipment should not be used as a means of determining whether a dangerous space is safe prior to entry. This 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.

Testing for oxygen deficiency

15.6.6 The normal level of oxygen in the atmosphere is 20.8%. Any variation from that may indicate a problem and should be investigated further. For example, when the oxygen reading is 20%, consideration should be given to further testing for toxic gases, where appropriate, because toxic gases may have displaced some oxygen (see section 15.6.11). Once other risks are discounted, a steady reading of at least 20% oxygen by volume should be obtained before entry is permitted.

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

Testing for flammable gases and vapours

15.6.8 The combustible gas element of the detector 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.

15.6.9 The combustible gas element of the detector is 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 and methane be suspected, because high levels may affect the accuracy of the device.

15.6.10 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 the lower flammable limit may be accepted, e.g. for hydrocarbons in conjunction with an oxygen reading of at least 20% by volume.

Testing for toxic gases

15.6.11 The presence of certain gases and vapours on chemical tankers and gas carriers is detected by fixed or portable gas or vapour detection equipment. 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. Where measurement can be carried out, the readings obtained by this equipment should be compared with the workplace exposure limit (WEL) for the contaminant given in the latest edition of the Health and Safety Executive (HSE) Guidance Note EH40, which can be found on the HSE website. (Workplace exposure limits are sometimes known as occupational exposure limits (OELs) and are given in international industry safety guides.) Workplace exposure limits provide guidance for the level of exposure to toxic substances. Entry should not be authorised if the atmosphere measures over 50% of the WEL. 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. Tests for specific toxic contaminants, such as benzene, should be undertaken depending on the nature of the previous contents of the space. The safety data sheets for previous cargoes or fuel carried should be referred to.

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15.6.12 When a toxic chemical is encountered for which there is no means of testing, then the additional requirements specified in section 15.11 should also be followed.

15.6.13 If a separate combustible gas indicator is used, this is not suitable for measuring levels of gas at or around its workplace 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 may not be sufficiently sensitive to give accurate readings.

15.7 Use of control systems

15.7.1 Entry into a dangerous space should be planned in advance and use should be made of a permit to work system. Details of the arrangements to be followed in a permit to work system are described in Chapter 14, Permit to work systems (a sample permit to work can be found in Annex 14.1).

15.7.2 For situations for which a well-established safe system of work exists, a checklist 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.

15.7.3 No person should enter a dangerous space unless authorised to do so by an authorised officer. Only the minimum number of trained personnel required to do the work should be authorised to enter. Those entering must be wearing appropriate clothing. All equipment used must be in good working condition and inspected before use.

15.8 Safety precautions before entry

15.8.1 The space and its access areas should be adequately illuminated.

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

15.8.3 A rescue plan should be in place (see section 15.14). In all cases, rescue and resuscitation equipment should be positioned ready for use at the entrance to the space. A risk assessment should identify what rescue equipment may be required for the particular circumstances but, as a minimum, this should include:

- appropriate breathing apparatus, with fully charged spare cylinders of air;
- lifelines and rescue harnesses;
- torches or a lamp (approved for use in a flammable atmosphere, if appropriate); and
- a means of hoisting an incapacitated person from the confined space, if appropriate.

15.8.4 Breathing equipment may be bulky and limit movement in the space. 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. Risks should be minimised or entry prohibited.

15.8.5 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. They should not be relied upon as the sole means of recovering a casualty from a space.

15.8.6 When necessary, a rescue harness should be worn to make it easier to recover a casualty in the event of an accident.

15.8.7 In addition to rescue harnesses, wherever practicable, hoisting equipment should be used. Hoisting equipment should be attended by personnel stationed at the entrance who have been trained in how to pull an unconscious person from a dangerous space.

15.8.8 At least one competent person, with appropriate equipment, should be posted to remain as an attendant at the entrance to the space whilst it is occupied.

15.8.9 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.

15.9 Procedures and arrangements during entry

15.9.1 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.

15.9.2 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. Testing should be carried out more frequently if there is any possibility of change in the conditions in the space. Should a personal gas detector give an alarm, everybody should leave the space immediately.

15.9.3 If unforeseen difficulties or hazards develop, the work in the space should be stopped and everybody should leave the space 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.

15.9.4 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.

15.9.5 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.

15.9.6 If air is being supplied through an airline to the person in the space, a check should be made immediately that the air supply is being maintained at the correct pressure.

15.10 Procedures on completion

15.10.1 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.

15.11 Additional requirements for entry into a space where the atmosphere is suspect or known to be unsafe

15.11.1 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 section 15.13). The number of persons entering the space should be the minimum compatible with the work to be performed.

15.11.2 Except in the case of an emergency, or where impracticable because movement in the space would be seriously impeded, two air supplies 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.

15.11.3 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.

15.11.4 Where remote testing of the space 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 they can be removed from the space immediately in the case of an emergency.

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

15.11.6 Should there be a risk of chemicals, whether in liquid, gaseous or vapour form, coming into contact with the skin and/or eyes, then protective clothing should be worn.

15.12 Training, instruction and information

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

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

15.12.2 It is recommended that all seafarers whose duties may involve entry into enclosed spaces should attend a dedicated course for entry into enclosed spaces.

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15.13 Breathing apparatus and resuscitation equipment

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

15.13.2 As described in section 15.11.2, 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. Air-

purifying respirators are not suitable because they cannot supply clean air from an independent source.

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

EN 137:2006, BS EN 14593:2005, BS EN 14594, BS 1146:2005

- conventional self-contained breathing apparatus of the open circuit compressed air type that is approved to EN 137:2006 and has been additionally tested for use with an airline connection; or
- compressed airline breathing apparatus incorporating an emergency self-contained supply. The compressed airline breathing apparatus should be of the demand-valve type and approved to BS EN 14593 or BS EN 14594 or, for self-rescue purposes, to BS 1146:2005 (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.

15.13.4 The authorised officer should make sure that the supply of air from outside the space is continuous and available only to those working in the space. Pipelines or hoses supplying air should be placed so that they are not likely to be damaged or distorted so that supply might be interrupted. If the purpose for which such airlines are used is not immediately apparent to personnel not engaged in the entry, then notices should be posted at appropriate positions. When 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 is informed so that the compressor is not shut down until the work is completed.

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

15.13.6 The authorised 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 for the breathing apparatus. In particular, they should check that:

- there will be sufficient clean air at the correct pressure;
- low-pressure alarms are working properly;
- the face mask fits correctly against the user's face so that, combined with pressure of the air coming into the mask, there will be no 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 face mask);
- 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; and
- when work is being undertaken in the space, the wearer should keep the self-contained supply for use if there is a failure of the continuous supply from outside the space.

15.13.7 When in a dangerous space:

- no one should remove their own breathing apparatus; and
- breathing apparatus should not be removed from a person unless it is necessary to save their life.

15.13.8 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

15.13.9 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.

15.13.10 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. Manufacturers' recommendations, which should always be stored with the equipment, should be complied with at all times.

15.14 Preparation for an emergency

15.14.1 On all SOLAS ships, an emergency drill for rescue from an enclosed space should be carried out every two months. Regular drills are recommended on other ships where the crew may be required to enter an enclosed space. Drills should as a minimum include:

- checking and use of personal protective equipment required for entry;
- checking and use of communication equipment and procedures;
- checking and use of instruments for measuring the atmosphere in enclosed spaces;
- checking and use of rescue equipment and procedures; and
- instructions in first-aid and resuscitation techniques.

15.14.2 For every entry to a dangerous space, a rescue plan should be in place. Suitable rescue equipment should be available at the entry to the space, and roles allocated in the event of an emergency arising. Selection of such equipment should take into account the depth and volume of the space, the size of the access way, the potential distance of the casualty from the point of entry and the resources available to assist in the rescue.

Emergency rescue arrangements

15.14.3 In the event of an alarm being raised, no one should enter any dangerous space to attempt a rescue without taking suitable precautions for their own safety. Failure to do so will put the would-be rescuer's life at risk and almost certainly prevent the person they intended to rescue being brought out alive. Many multiple fatalities have occurred as a result of individuals recklessly attempting a rescue without taking adequate precautions.

15.14.4 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.

15.14.5 Once help has arrived, the situation should be evaluated and the rescue plan put into effect. An attendant should remain outside the space at all times to ensure the safety of those entering the space to undertake the rescue.

15.14.6 Once the casualty is reached, the checking of the air supply must be the first priority. Unless they are gravely injured, they should be removed from the dangerous space as quickly as possible.

15.14.7 Self-contained breathing apparatus that is specifically suited for such applications must be worn. If it is found that it is not possible to enter a tank wearing a self-contained breathing apparatus, the bottle harness may be removed and passed through the access but the face mask must always be worn. Care should be taken to ensure that the harness does not drop onto or pull on the supply tube and dislodge the face mask.

15.14.8 An emergency escape breathing device (EEBD) is **not** suitable for rescue. This is a supplied air or oxygen device, designed only to be used for escape from a compartment that has a hazardous atmosphere. It should not be worn by a rescuer to attempt a rescue of persons in any circumstances.