Shipowners

Enclosed Space Entry

Contents

Introduction

The Club has recently experienced a number of claims where people have sadly lost their lives due to a direct failure to follow correct procedures for enclosed space entry. For the cases featured within this booklet (Appendix 1) it is important to highlight that the people involved were qualified and experienced in making enclosed space entries and therefore trained in the associated dangers, which unfortunately in many circumstances is not the case.

Enclosed and confined spaces include, but are not limited to cargo holds, tanks (including ballast, fore and aft peaks, fresh water, slop / waste and bunker), void spaces, pump rooms, cofferdams, duct keels, pipe tunnels, main engines, chain lockers and any other spaces which may normally be kept closed or sealed. This is also relevant to spaces that are not regularly worked in or have a restricted air flow and hence are not subject to continuous ventilation.

When seeing a colleague collapsed within an enclosed space it is a natural impulsive reaction to rush in and assist. Unfortunately this is one of the main causes of fatalities as over 50% of the workers who die in confined spaces are attempting to rescue other workers who have found themselves in difficulty. Although this is not the case in the included examples, it is a common factor and it should be borne in mind that if the correct procedures are followed and the relevant safety equipment prepared prior to carrying out the entry, then these deaths could have been avoided.

It is essential to remember that when faced with such a serious dilemma, it is often difficult to think rationally. Therefore correct preparation resulting from a thorough risk assessment and evaluation enables the shipboard emergency contingency plans to be implemented in an expedient fashion.

However, prevention is better than cure. To reduce the possibility of an incident, notwithstanding the type of vessel or the relevance of the ISM Code, written procedures for entry into enclosed spaces should be established, therefore giving all persons making an enclosed space entry instructions to adhere to. Once these procedures have been implemented, no entries are to be undertaken without compliance.

Figure 1: Warning notice displayed on the entrance to an enclosed space

Enclosed Space Entry Procedures

The Club has published the following guidelines to assist Members, who do not have their own procedures, to create their own.

When drafting and developing enclosed space entry procedures reference should also be made to:

- The United Kingdom's MCA (or home countries equivalent authority) "Code of Safe Working Practices", Chapter 17.
- United Kingdom's Merchant Shipping (Entry Into Enclosed Spaces) Regulation 1988 SI. 1638.
- IMO Resolution A.864 (20), Recommendations For Entering Enclosed Spaces Aboard Ships.
- Local regulations and any official local guidance.

Figure 2: Entry tag displayed on entrance to enclosed space. This summarises that the space has been passed for entry by a competent / responsible person

Prior to carrying out enclosed space entry, an assessment should be carried out of the space by a competent person [1] and responsible person [2]. It may be the case on smaller types of vessels such as barges and vessels operating specifically in and around the harbour environments, that a competent person and / or the relevant equipment may not be available onboard. In these cases, no attempt should be made to enter into enclosed spaces until an appropriate person is present. If the person carrying out the entry is from a third party e.g. surveyor, the competent person must ensure that they are fully aware of the vessel's characteristics or special circumstances which may be a relevant factor to the safety of the entry.

It should always be borne in mind that everyone has the right to refuse to enter any compartment that they question the safety of.

Prior to entering an enclosed space a "Permit to Work" system should be in place (see point 10 – Is a "Permit to Work" in place?). The following are a number of basic checklist criteria to be used in conjunction with a "Permit to Work" form for entry into enclosed spaces. All Members, even if entries into enclosed spaces are infrequently carried out onboard their vessels, should have such a checklist forming part of their laid down procedures. It should be noted that these recommendations may not be applicable to all vessels and circumstances but are intended to be used as a guide to demonstrate good practice from which specific guidelines / procedures can be drawn up.

[1] 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.

[2] Responsible person means a person authorized to permit entry into an enclosed space and having sufficient knowledge of the procedures to be followed.

Definitions provided by IMO Resolution A.864(20).

1) Is the space thoroughly ventilated?

Where possible, prior to the space being entered, all accesses should be opened with at least one entrance opened at each end of the relevant space. Ventilation should be commenced for a minimum of 24 hours prior to entry.

Ventilation can be carried out in the following ways, although it is preferable to use mechanical forms:

a) At sea / in port – This would normally involve natural ventilation unless the vessel is equipped with portable mechanical blowers or fans. Natural ventilation can be assisted by using sails or cowls to direct the air flow into the space.

b) At a shipyard – In normal circumstances this would involve forced ventilation using portable mechanical blowers or fans provided by the shipyard.

It is important to continue ventilation until the enclosed entry is fully completed. If the ventilation system fails, all persons in the enclosed space must evacuate immediately.

2) Has the atmosphere been tested and found safe?

Before entry, the atmosphere of the space must be tested using suitable instruments. Under normal circumstances, this would include an Oxygen Analyser and a Combustible Gas Meter which measures the Lower Explosive Limit (Lower Flammable Limit) of gas in air mixtures. When particularly toxic cargoes have been carried such as Benzene, specific testing should be carried out (refer to IMO Resolution A.864 (20) in Appendix 2).

Testing the atmosphere should only be performed by personnel who are fully trained in the use of the instruments. The manufacturer's instructions should be strictly adhered to. It is important to note that the "IMO Resolution A.864 (20), Recommendations For Entering Enclosed Spaces Aboard Ships" states that for entry purposes, steady readings of 21% oxygen by volume by oxygen content meter is required. It is often assumed that by de-ballasting a tank, a full air change is consequently introduced but this procedure does not guarantee a safe atmosphere and testing is still required. An empty ballast tank could be oxygen deficient due to the rusting process in the structure.

Combustible gas detectors are not usually designed to measure levels of oxygen as they detect the amount of flammable gas in air of an inert atmosphere. Ideally, a “multi-meter” should be used when testing for oxygen, hydrocarbons, carbon monoxide and sulphur dioxide.

The atmosphere analysing equipment should be tested first and calibrated in accordance with manufacturer’s recommendations. Whilst the enclosed space entry is taking place, oxygen levels should be regularly tested and where appropriate at different height levels to ensure a safe environment in all areas. Forced ventilation must be stopped during testing.

Figure 3: Testing the atmosphere of the enclosed space

3) Is the space prepared for entry?

Prior to operations, the competent person in charge should assess the area for potential hazards. This can include but not be limited to:

- Lack of ventilation – see points 1 and 2 of this section.
- Hazards associated to the nature of the space being entered, e.g. if a cargo space, what was the last cargo? (see Appendix 2 for IMO Resolution A.864(20), Recommendations For Entering Enclosed Spaces Aboard Ships). This details the hazards related to specific types of cargo.
- Temperature of the enclosed space.
- Any machinery or working elements that may present a danger to the person entering the space, such as:
  - Valves which may need to be blanked / secured in the closed position; (e.g. lashed with rope or preferably secured with padlock and chain).
  - Warning notices should be posted on controls that operate machinery / equipment in the relevant space to alert personnel of an ongoing entry (Figures 4 and 5). Machinery should also be temporarily disabled by removing fuses and breakers in order to prevent accidental use.

Figures 4 and 5: Warning signs displayed on a valve and at the control station

4) Is there sufficient rescue and resuscitation equipment available at the enclosed space entrance?

If personnel in an enclosed space come into difficulties and require rescue, this has to be carried out as quickly as possible. Survival times in an oxygen deficient or gaseous atmosphere is very limited.

In particular, on tankers and other vessels carrying flammable products, all equipment should be of an approved type (and where necessary certified spark proof) and to speed up a rescue it is good practice to place the safety equipment at the entrance to the space. This should include:

- SCBA (Self Contained Breathing Apparatus) with a fully charged spare cylinder.
- Lifeline and rescue harness. The lifeline should be of an adequate length and strength and be detachable in case of entanglement.
- Torches.
- Stretcher.
- Gas analysers, oxygen meter.
- Resuscitation equipment (Figure 6).
- Means of hoisting up an incapacitated person, e.g. stretcher (Figure 6).

Figure 6: Emergency equipment placed at the entrance to enclosed space

5) Is there a suitably experienced person in attendance at the entrance?

Both prior to and during the tank inspections it is imperative to ensure that the designated officer and / or member of the crew stands by at the entrance throughout. In no circumstances should the person at the access point move from his station until all persons have exited the space.

Figure 7: Designated person in attendance (regular atmosphere tests are taken to ensure a safe environment)

6) Have communication arrangements been agreed between the person at the entrance and those entering?

The means of communication between the person(s) entering the tank, the designated crew member at the access, the Master / allocated competent / responsible person or any relevant persons in the engine room / bridge should be established prior to entry into the tank and tested. A pre-arranged frequency / time should be agreed between parties to ensure communications are maintained.

Communication is to be carried out using appropriate means, e.g. handheld radios of an approved type (i.e. on tankers intrinsically safe).

7) Is there safe access and sufficient illumination?

Sufficient and suitable lighting should be rigged as far as possible and where practical. All possible accesses should be open to improve ventilation and light. Persons entering an enclosed space where there is a possibility of a potentially explosive atmosphere should be equipped with intrinsically safe torches.

8) What personal protective equipment is to be used?

It is important to assess each "enclosed space entry operation" on a case by case basis as the type of equipment (approved type only) required would be dependent upon the circumstances at the time.

Basic equipment may include:

- Hard hat, with chin strap.
- Gloves.
- Goggles / protective eyewear.
- Ear defenders.
- Intrinsically safe torch.
- Foot protection.
- Overalls (protective clothing).
- An ELSA, EEBD or other emergency escape breathing device.
- Portable oxygen / gas indicator.

The Emergency Escape Breathing Device (EEBD) and emergency escape sets such as an ELSA (Emergency Life Support Apparatus, see Scott Health & Safety Ltd, www.scottsafety.com) should not be considered as a SCBA. They are designed to enable escape from a hazardous environment by providing a limited supply of air delivered via a plastic hood or mask. It should be borne in mind that these devices must not be used as a means to enable the entry into the enclosed space as its intended purpose is to enable the user to exit a space safely, should the atmosphere become oxygen deficient or not gas free.

Figure 8: ELSA sets in use

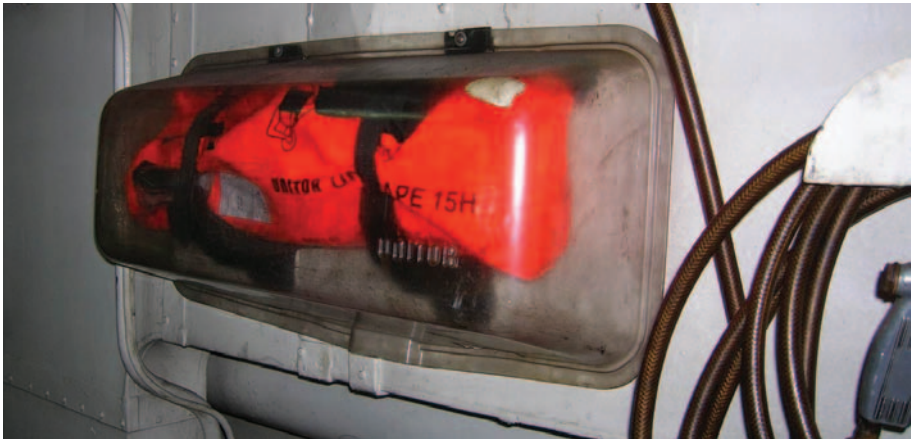

Figure 9: EEBD positioned in the engine room

It is advisable for personnel entering the enclosed space to be provided with a portable oxygen analyser such as the ones manufactured by BW Technologies (www.gasmonitors.com).

These instruments are designed to be used during an enclosed space entry to continuously monitor the oxygen content of the atmosphere. If the oxygen level falls below a preset value, normally 19.5%, a distinct audible, visual and vibration alarm is activated indicating that the space should be evacuated immediately.

The monitor can be clipped onto the user's overalls and because it operates passively no further action is required from the user. If available, this equipment should be utilised throughout the enclosed space entry.

The instruments should be tested and calibrated on a regular basis in accordance with manufacturer's instructions.

Figure 10: Two examples of oxygen / H2S meters

If the person entering the tank is using a personal monitoring device it is important that this is not used to ascertain if the level of oxygen in the space is safe to enter. A separate independent instrument should be used prior to entry for this purpose.

9) Breathing apparatus

I. All crew members should be trained in the use of breathing apparatus (BA). This can be ensured by performing regular safety drills and including it in the onboard training procedures. When the responsible person is allocating personnel for the entry, the proficiency of using equipment should be taken into account. This may mean having a designated emergency team trained fully in the use of relevant equipment to respond to this type of emergency.

II. To ensure the efficient operation of the apparatus, they must be tested regularly.

10) Is a "Permit to Work" in place?

A "Permit to Work" should be completed for each and every enclosed space entry as it serves as both a check and a record that all necessary measures have been properly carried out and are in place for the intended enclosed space entry. When completing the form the responsible person should allocate a time period for which the permit is valid, this should never exceed 24 hours. A copy of the permit must be placed outside the entry point. On expiry of the permit all persons should leave the space and re-entry should not be made until another permit has been issued.

The points below detail general precautions that the "Permit to Work" should cover and which have also been highlighted previously (see Appendix 3 for an example of a "Permit to Work" system). Additional points may be added specific to the space being entered as required:

- Location, type of work, details of participating crew, competent person in charge, validity period of the permit and authorising officer.
- Space ventilated and the confirmation that continuous ventilation is in progress.
- Enclosed space atmosphere tested.
- Potential hazards identified and isolated as appropriate.
- Rescue and resuscitation equipment positioned in case of emergency
  (It should be borne in mind that when using breathing apparatus in stressful emergency situations, the users air consumption is greatly increased and the duration of available air is thus decreased).

- Testing of the equipment, confirmation they are of an approved type and that relevant persons are competent in their use (e.g. breathing apparatus).
- Space and access illuminated as far as possible.
- Suitable communication system set up between all involved parties.
- Designated person positioned at the access.
- All involved persons are wearing correct personal safety equipment of approved types.
- Permit to work has been completed and signed by all appropriate parties concerned.

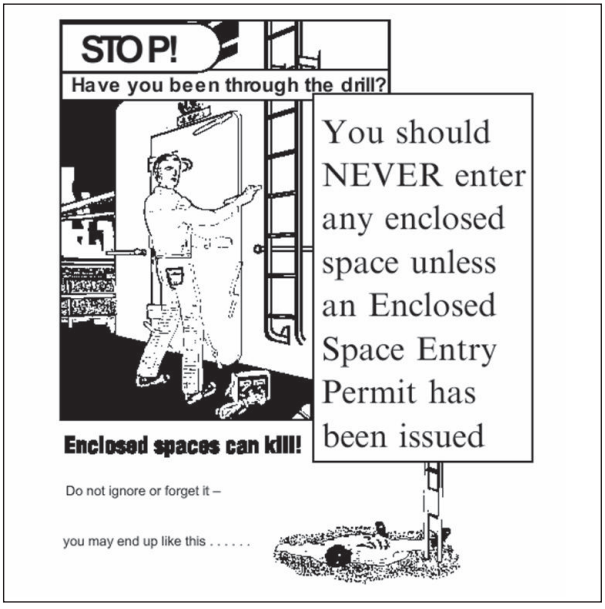

Figure 11: Safety notice from IMO Resolution A.864(20) - 199

Training and Enclosed Entry Emergency Drills

In addition to drills that are carried out to tackle enclosed space entry in an emergency, training should be provided to crew members on identifying the applicable spaces and their associated problems, including the nature of activities, which may cause an unsafe atmosphere to be present.

Emergency drills should be conducted on a regular basis to familiarise the entire vessel's compliment with the procedures and measures required for an enclosed space entry rescue. These drills should be carried out as frequently as possible and particularly onboard vessels for which enclosed space entry is not a regular occurrence. It is important to remember that each vessel may have its own problems or characteristics which may affect the rescue operation and therefore all procedures must be vessel specific.

Figure 12: Enclosed space drill and training in progress to familiarise crew members with associated equipment

These drills will assist in testing pre-defined contingency plans for feasibility and to ascertain how they fare with different scenarios. They should be made as realistic as possible by using appropriate spaces where such incidents are likely to occur. For added effect, a dummy of realistic weight and size should be used as a victim. All drills must be recorded in the vessel's official log book along with any noted comments.

Various industry publications are available to assist with enclosed entry training such as Walport's "Enclosed Space Entry – Safe Entry Procedures" (www.walport.co.uk) and Seamanship International's "Seamanship Training 2006" (www.witherbyseamanship.com).

In the Event of an Emergency

In the event of an emergency the vessel's crew must follow the emergency procedures set down on how to respond to the current situation. The following illustrates some areas to be covered by the vessel's emergency plans, but it should be noted that this is not exhaustive:

- The composition and duties of the persons acting within the emergency plan, e.g. the designated person at the entrance to the space entered must remain in place and not be tempted to enter the space when it is apparent an emergency situation is developing.
- Procedures for the assignment of duties for the emergency teams.
- Procedures for communication between all parties concerned.
- The availability of the equipment required including the vessel's plans and relevant equipment.
- Checklists have been set up to assist the personnel on site to cover all aspects which may be missed in the heat of the moment but are an important factor.
- The manner in which the vessel liaises with third parties including shore management, shore authorities and the media.

Acknowledgments

BW TECHNOLOGIES
BW Technologies by Honeywell
5 Canada Close
Banbury OX16 2RT
Email: bwesales@gasmonitors.com
Website: www.gasmonitors.com

IACS
IACS "Confined Space Safe Practice" document.

IMO
IMO Resolution A.864(20), Adopted on 27th November 1997 (Agenda item 9) – Recommendations For Entering Enclosed Spaces Aboard Ships.

MARINE ACCIDENT INVESTIGATION BRANCH (MAIB)
Website: www.maib.gov.uk

MCA
Code of Safe Working Practices, chapter 17 - www.mcga.gov.uk/c4mca/coswop-2.pdf
The Merchant Shipping (Entry into dangerous spaces) regulation 1988 SI 1638

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Appendix 1 The following case studies have been issued by the MAIB

Case Study 1

A 12,000 gross registered tonnage foreign flagged Ro-Ro cargo vessel, operated by British Officers, was on passage to the UK. The vessel's fuel oil was found to contain water and during the search to find the cause, tanks were opened and inspected. The Chief Engineer carrying out the inspection was found by a watchkeeper with his legs protruding out of a tank manhole. He was removed from the tank and First Aid was carried out immediately, but without success. The pathologist who carried out the post mortem, confirmed the cause of death was due to lack of oxygen and exposure to oil fumes.

Observations

1. No forced ventilation of the tanks was used.
2. No test on the tank atmosphere was made, as the oxygen meter's battery was flat.
3. No other person was in attendance at the tank entrance.
4. Breathing apparatus was not made available.

Comment

1. There have been many similar accidents, one was reported in the MAIB Summary of Investigations 3/93 publication, page 2. For those who have not seen the guidance regarding safe entry into spaces it is contained in the following:

   – The "Code of Safe Working Practices for Merchant Seamen[1]" (1991 Edition), Chapter 10 – Entering Enclosed or Confined Spaces;

   – A MARITIME SAFETY CARD published by the International Maritime Organization which sets out basic precautions on tank entry and provides a safety check list.

2. It is disturbing that officers who should be aware of the requirements for safe entry to spaces do not carry out basic checks and take the necessary precautions.

3. For UK vessels the legislation contained in the Merchant Shipping (Entry into Dangerous Spaces) Regulations 1988 as amended, would apply.

1 Please note that since this case study has been published, the information on 'Entering Enclosed or Confined Spaces' can now be found in Chapter 17 of the 2004 consolidated version of the 'Code of Safe Working Practices for Merchant Seaman'

Case Study 2

A small coaster was at anchor off the south coast of England sheltering from severe weather conditions. Loaded with a cargo of coal, her hold was fitted with a moveable bulkhead, the position of which was dependent on the quantity being carried. For this consignment it was set about 3 metres forward of the engine bulkhead. The access hatch, fitted with a vertical ladder, opened into the space between the engine room bulkhead and the moveable bulkhead. The only ventilation into this space was that provided naturally through the access hatch.

The master was on the bridge on the morning after anchoring, but it wasn't until that evening that anyone realised he hadn't been seen all day. The chief officer noticed the cargo hold access hatch was open and, on looking into the hold, saw the master lying at the bottom.

The local authorities were called and the master was removed. He was found to be dead, with the cause of death later determined to be asphyxiation. The oxygen level in the hold was less than 3.5% and carbon monoxide, together with higher than normal levels of carbon dioxide, were also present.

The Lessons

1. Anyone who has been at sea for some time in merchant ships will be all too familiar with stories of people who have entered enclosed spaces without taking the necessary precautions, and died as the result. The lessons from such incidents have been hammered home time and time again and still it happens. Although it is impossible to know exactly what victims are thinking before they make an entry, it is feasible to assume they think the space is sufficiently safe to warrant entry. After all, it looks all right, so what could possibly go wrong?

2. Some spaces are evidently dangerous, and there are very sound rules in place to prevent accidents. Consult the IMDG code to know the properties and characteristics of dangerous bulk cargoes before entering a space where such cargo is being, or has been carried. Follow the excellent advice in Chapter 17 of the Code of Safe Working Practices for

Merchant Seamen, which documents the procedures for entering enclosed spaces. The main points are: the space must *always* be tested before and during each entry, personnel should be standing by with safety equipment at the entrance, and the space should be well ventilated.

3. Other spaces are not necessarily quite so obvious. They include void spaces not normally entered, compartments that might have been flooded, or areas separated from dangerous cargo by a portable bulkhead. If in doubt, assume the space is potentially dangerous and take the necessary precautions. Remember 3.5% of oxygen looks exactly the same as the 18%[1] which is the minimum required for human beings to breathe safely. Anything below that can lead to loss of life.

4. Never ever carry out an entry alone. A well-formulated plan should always be followed. A short-cut could prove fatal.

5. And one final point. If you see someone lying motionless at the bottom of a ladder in an enclosed space, don't rush in to carry out a rescue without taking all the appropriate precautions. Failure to do so will only result in more fatalities.

[1]Reference should be made to IMO Resolution A.864 (20) Section 6 “Testing the Atmosphere” where it states for entry purposes 21% oxygen by volume is required.

Case Study 3

A single-hold general cargo vessel of 996 gross registered tonnage was alongside in port and had commenced discharging her cargo of timber. The timber consisted of approximately 3 metre length cut hard wood logs of up to 30cm in diameter with bark attached. The logs were loaded inside the cargo hold up to the level of the hatch coaming and also as deck cargo on top of the closed hatch covers.

Prior to opening the hatch covers, it was normal practice for the crew to sweep up any remaining debris on top of the hatch covers upon completion of the deck cargo discharge. In preparation for this task, the Mate instructed one of his crew to fetch some brooms, which were stored both in the forward storerooms and also at the bottom of the cargo hold aft access trunkway.

A few minutes later, the attention of the Mate was drawn to the crew member, who was now lying at the bottom of the aft access trunkway. While assistance was being summoned, the Mate entered the trunkway and was subsequently found lying on top of the first crew member. Another crew member entered the trunkway but, after experiencing difficulty in breathing, climbed back out. A shore worker then attempted to enter the trunkway but was prevented from doing so by another member of the crew.

After being alerted to the emergency, the Master started the cargo hold fan and then entered the trunkway wearing a self-contained breathing apparatus set. Both men were removed from the trunkway using a block and tackle but subsequent attempts to revive them failed.

Observations

1. The cargo hold and access trunkways had not been ventilated since the logs were loaded approximately 6 days before the accident.

2. Although the vessel carried gas detection equipment, no means were provided for remote detection.

3. Brooms were stored at the bottom of the trunkway for the purpose of sweeping the cargo hold upon completion of discharge.

4. In order to confirm the probable condition of the atmosphere inside the trunkway at the time of the accident, atmospheric tests were conducted under similar conditions upon the vessel's next arrival at the port. The test results included a minimum oxygen reading of 1.9% and a maximum carbon dioxide reading of 10.5%.

Comments

1. The two men died when they entered a dangerous enclosed space, which was deficient in oxygen and contained gas products of the timber cargo.

2. The Merchant Shipping (Entry into Dangerous Spaces) Regulations 1988 (as amended) apply to UK vessels and to non-UK vessels when in a UK port. They require that entrances to unattended dangerous spaces should be secured against entry and that procedures for safe entry should be laid down and enforced. A conscientious regard for the training of crew and for the strict enforcement of clearly understood procedures would probably have prevented this accident.

3. Although it is generally known that a depletion of oxygen may occur in cargo spaces filled with certain types of wood cargoes, the danger associated with the carriage of logs requires increased attention.

Appendix 2

IMO Resolution A.864 (20), Recommendations For Entering Enclosed Spaces Aboard Ships. Adopted on 27 November 1997.

1 INTRODUCTION

The atmosphere in any enclosed space may be deficient in oxygen and/or contain flammable and/or toxic gases or vapours. Such an unsafe atmosphere could also subsequently occur in a space previously found to be safe. Unsafe atmosphere may also be present in spaces adjacent to those spaces where a hazard is known to be present.

2 DEFINITIONS

2.1 *Enclosed space* means a space which has any of the following characteristics:

.1 limited openings for entry and exit;

.2 unfavourable natural ventilation; and

.3 is not designed for continuous worker occupancy,

and includes, but is not limited to, cargo spaces, double bottoms, fuel tanks, ballast tanks, pump-rooms, compressor rooms, cofferdams, void spaces, duct keels, inter-barrier spaces, engine crankcases and sewage tanks.

2.2 *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.

2.3 *Responsible person* means a person authorized to permit entry into an enclosed space and having sufficient knowledge of the procedures to be followed.

3 ASSESSMENT OF RISK

3.1 In order to ensure safety, a competent person should always make a preliminary assessment of any potential hazards in the space to be entered, taking into account previous cargo carried, ventilation of the space, coating of the space and other relevant factors. The competent person's preliminary assessment should determine the potential for the presence of an oxygen-deficient, flammable or toxic atmosphere.

3.2 The procedures to be followed for testing the atmosphere in the space and for entry should be decided on the basis of the preliminary assessment. These will depend on whether the preliminary assessment shows that:

.1 there is minimal risk to the health or life of personnel entering the space;

.2 there is no immediate risk to health or life but a risk could arise during the course of work in the space; and

.3 a risk to health or life is identified.

3.3 Where the preliminary assessment indicates minimal risk to health or life or potential for a risk to arise during the course of work in the space, the precautions described in 4, 5, 6 and 7 should be followed as appropriate.

3.4 Where the preliminary assessment identifies risk to life or health, if entry is to be made, the additional precautions specified in section 8 should also be followed.

4 AUTHORIZATION OF ENTRY

4.1 No person should open or enter an enclosed space unless authorized by the master or nominated responsible person and unless the appropriate safety procedures laid down for the particular ship have been followed.

4.2 Entry into enclosed spaces should be planned and the use of an entry permit system, which may include the use of a checklist, is recommended. An Enclosed Space Entry Permit should be issued by the master or nominated responsible person, and completed by a person who enters the space prior to entry. An example of the Enclosed Space Entry Permit is provided in the appendix.

5 GENERAL PRECAUTIONS

5.1 The master or responsible person should determine that it is safe to enter an enclosed space by ensuring:

.1 that potential hazards have been identified in the assessment and as far as possible isolated or made safe;

.2 that the space has been thoroughly ventilated by natural or mechanical means to remove any toxic or flammable gases, and to ensure an adequate level of oxygen throughout the space;

.3 that the atmosphere of the space has been tested as appropriate with properly calibrated instruments to ascertain acceptable levels of oxygen and acceptable levels of flammable or toxic vapours;

.4 that the space has been secured for entry and properly illuminated;

.5 that a suitable system of communication between all parties for use during entry has been agreed and tested;

.6 that an attendant has been instructed to remain at the entrance to the space whilst it is occupied;

.7 that rescue and resuscitation equipment has been positioned ready for use at the entrance to the space, and that rescue arrangements have been agreed;

.8 that personnel are properly clothed and equipped for the entry and subsequent tasks; and

.9 that a permit has been issued authorizing entry.

The precautions in .6 and .7 may not apply to every situation described in this section. The person authorizing entry should determine whether an attendant and the positioning of rescue equipment at the entrance to the space is necessary.

5.2 Only trained personnel should be assigned the duties of entering, functioning as attendants, or functioning as members of rescue teams. Ships' crews should be drilled periodically in rescue and first aid.

5.3 All equipment used in connection with entry should be in good working condition and inspected prior to use.

6 TESTING THE ATMOSPHERE

6.1 Appropriate testing of the atmosphere of a space should be carried out with properly calibrated equipment by persons trained in the use of the equipment. The manufacturers' instructions should be strictly followed. Testing should be carried out before any person enters the space, and at regular intervals thereafter until all work is completed. Where appropriate, the testing of the space should be carried out at as many different levels as is necessary to obtain a representative sample of the atmosphere in the space.

6.2 For entry purposes, steady readings of the following should be obtained:

.1 21% oxygen by volume by oxygen content meter; and

.2 not more than 1% of lower flammable limit (LFL) on a suitably sensitive combustible gas indicator, where the preliminary assessment has determined that there is potential for flammable gases or vapours.

If these conditions cannot be met, additional ventilation should be applied to the space and re-testing should be conducted after a suitable interval. Any gas testing should be carried out with ventilation to the enclosed space stopped, in order to obtain accurate readings.

6.3 Where the preliminary assessment has determined that there is potential for the presence of toxic gases and vapours, appropriate testing should be carried out using fixed or portable gas or vapour detection equipment. The readings obtained by this equipment should be below the occupational exposure limits for the toxic gases or vapours given in accepted national or international standards. It should be noted that testing for flammability does not provide a suitable means of measuring for toxicity, nor vice versa.

6.4 It should be emphasized that pockets of gas or oxygen-deficient areas can exist, and should always be suspected, even when an enclosed space has been satisfactorily tested as being suitable for entry.

7 PRECAUTIONS DURING ENTRY

7.1 The atmosphere should be tested frequently whilst the space is occupied, and persons should be instructed to leave the space should there be a deterioration in the conditions.

7.2 Ventilation should continue during the period that the space is occupied and during temporary breaks. Before re-entry after a break, the atmosphere should be re-tested. In the event of failure of the ventilation system, any persons in the space should leave immediately.

7.3 In the event of an emergency, under no circumstances should the attending crew member enter the space before help has arrived and the situation has been evaluated to ensure the safety of those entering the space to undertake rescue operations.

8 ADDITIONAL PRECAUTIONS FOR ENTRY INTO A SPACE WHERE THE ATMOSPHERE IS KNOWN OR SUSPECTED TO BE UNSAFE

8.1 If the atmosphere in an enclosed space is suspected or known to be unsafe, the space should only be entered when no practical alternative exists. Entry should only be made for further testing, essential operation, safety of life or safety of a ship. The number of persons entering the space should be the minimum compatible with the work to be performed.

8.2 Suitable breathing apparatus, e.g. of the air-line or self-contained type, should always be worn, and only personnel trained in its use should be allowed to enter the space. Air-purifying respirators should not be used as they do not provide a supply of clean air from a source independent of the atmosphere within the space.

8.3 The precautions specified in 5 should also be followed, as appropriate.

8.4 Rescue harnesses should be worn and, unless impractical, lifelines should be used.

8.5 Appropriate protective clothing should be worn particularly where there is any risk of toxic substances or chemicals coming into contact with the skin or eyes of those entering the space.

8.6 The advice in 7.3 concerning emergency rescue operations is particularly relevant in this context.

9 HAZARDS RELATED TO SPECIFIC TYPES OF CARGO

9.1 Dangerous goods in packaged form

9.1.1 The atmosphere of any space containing dangerous goods may put at risk the health or life of any person entering it. Dangers may include flammable, toxic or corrosive gases or vapours that displace oxygen, residues on packages and spilled material. The same hazards may be present in spaces adjacent to the cargo spaces. Information on the hazards of specific substances is contained in the IMDG Code, the Emergency Procedures for Ships Carrying Dangerous Goods (EmS) and Materials Safety Data Sheets (MSDS). If there is evidence or suspicion that leakage of dangerous substances has occurred, the precautions specified in 8 should be followed.

9.1.2 Personnel required to deal with spillages or to remove defective or damaged packages should be appropriately trained and wear suitable breathing apparatus and appropriate protective clothing.

9.2 Bulk liquid

The tanker industry has produced extensive advice to operators and crews of ships engaged in the bulk carriage of oil, chemicals and liquefied gases, in the form of specialist international safety guides. Information in the guides on enclosed space entry amplifies these recommendations and should be used as the basis for preparing entry plans.

9.3 Solid bulk

On ships carrying solid bulk cargoes, dangerous atmospheres may develop in cargo spaces and adjacent spaces. The dangers may include flammability, toxicity, oxygen depletion or self-heating, which should be identified in shipping documentation. For additional information, reference should be made to the Code of Safe Practice for Solid Bulk Cargoes.

9.4 Oxygen-depleting cargoes and materials

A prominent risk with such cargoes is oxygen depletion due to the inherent form of the cargo, for example, self-heating, oxidation of metals and ores or decomposition of vegetable oils, animal fats, grain and other organic materials or their residues. The materials listed below are known to be capable of causing oxygen depletion. However, the list is not exhaustive. Oxygen depletion may also be caused by other materials of vegetable or animal origin, by flammable or spontaneously combustible materials, and by materials with a high metal content:

.1 grain, grain products and residues from grain processing (such as bran, crushed grain, crushed malt or meal), hops, malt husks and spent malt;

.2 oilseeds as well as products and residues from oilseeds (such as seed expellers, seed cake, oil cake and meal);

.3 copra;

.4 wood in such forms as packaged timber, roundwood, logs, pulpwood, props (pit props and other propwood), woodchips, woodshavings, woodpulp pellets and sawdust;

.5 jute, hemp, flax, sisal, kapok, cotton and other vegetable fibres (such as esparto grass/Spanish grass, hay, straw, bhusa), empty bags, cotton waste, animal fibres, animal and vegetable fabric, wool waste and rags;

.6 fishmeal and fishscrap;

.7 guano;

.8 sulphidic ores and ore concentrates;

.9 charcoal, coal and coal products;

.10 direct reduced iron (DRI);

.11 dry ice;

.12 metal wastes and chips, iron swarf, steel and other turnings, borings, drillings, shavings, filings and cuttings; and

.13 scrap metal.

9.5 Fumigation

When a ship is fumigated, the detailed recommendations contained in the Recommendations on the safe use of pesticides in ships* should be followed. Spaces adjacent to fumigated spaces should be treated as if fumigated.

CONCLUSION

Failure to observe simple procedures can lead to people being unexpectedly overcome when entering enclosed spaces. Observance of the principles outlined above will form a reliable basis for assessing risks in such spaces and for taking necessary precautions.

Appendix 3

Example of an Enclosed Space Entry Permit taken from The IMO Resolution A.864 (20), Recommendations For Entering Enclosed Spaces Aboard Ships. Adopted on 27 November 1997.

Example of an Enclosed Space Entry Permit

This permit relates to entry into any enclosed space and should be completed by the master or responsible officer and by the person entering the space or authorized team leader.

General

Location/name of enclosed space _____

Reason for entry _____

This permit is valid from: _____ hrs Date _____

to: _____ hrs Date _____

(See note 1)

Section 1 – Pre-entry preparation

(To be checked by the master or nominated responsible person)	Yes	No
■ Has the space been thoroughly ventilated?	☐	☐
■ Has the space been segregated by blanking off or isolating all connecting pipelines or valves and electrical power/equipment?	☐	☐
■ Has the space been cleaned where necessary?	☐	☐
■ Has the space been tested and found safe for entry? (See note 2)	☐	☐

■ Pre-entry atmosphere test readings:

– oxygen.....% vol (21%) By: _____

– hydrocarbon.....% LFL (less than 1%)

– toxic gases.....ppm (specific gas and PEL) Time: _____

(See note 3)

■ Have arrangements been made for frequent atmosphere checks to be made while the space is occupied and after work breaks?	☐	☐
■ Have arrangements been made for the space to be continuously ventilated throughout the period of occupation and during work breaks?	☐	☐
■ Are access and illumination adequate?		

	Yes	No
■ Is rescue and resuscitation equipment available for immediate use by the entrance to the space?	☐	☐
■ Has a responsible person been designated to be in constant attendance at the entrance to the space?	☐	☐
■ Has the officer of the watch (bridge, engine-room, cargo control room) been advised of the planned entry?	☐	☐
■ Has a system of communication between all parties been tested and emergency signals agreed?	☐	☐
■ Are emergency and evacuation procedures established and understood by all personnel involved with the enclosed space entry?	☐	☐
■ Is all equipment used in good working condition and inspected prior to entry?	☐	☐
■ Are personnel properly clothed and equipped?	☐	☐

Section 2 – Pre-entry checks

(To be checked by the person entering the space or authorized team leader)	Yes	No
■ I have received instructions or permission from the master or nominated responsible person to enter the enclosed space	☐	☐
■ Section 1 of this permit has been satisfactorily completed by the master or nominated responsible person	☐	☐
■ I have agreed and understand the communication procedures	☐	☐
■ I have agreed upon a reporting interval of ..... minutes	☐	☐
■ Emergency and evacuation procedures have been agreed and are understood	☐	☐
■ **I am aware that the space must be vacated immediately in the event of ventilation failure or if atmosphere tests show a change from agreed safe criteria**	☐	☐

Section 3 – Breathing apparatus and other equipment

(To be checked jointly by the master or nominated responsible person and the person who is to enter the space)

	Yes	No
■ Those entering the space are familiar with the breathing apparatus to be used	☐	☐
■ The breathing apparatus has been tested as follows:		
– gauge and capacity of air supply	.....	
– low pressure audible alarm	.....	
– face mask – under positive pressure and not leaking	.....	
■ The means of communication has been tested and emergency signals agreed	☐	☐
■ All personnel entering the space have been provided with rescue harnesses and, where practicable, lifelines	☐	☐

Signed upon completion of sections 1, 2 and 3 by:

Master or nominated responsible person ..... Date ..... Time .....

Responsible person supervising entry ..... Date ..... Time .....

Person entering the space or authorized team leader ..... Date ..... Time .....

Section 4 – Personnel entry

(To be completed by the responsible person supervising entry)

Names	Time in	Time out
.....	.....	.....
.....	.....	.....
.....	.....	.....
.....	.....	.....

Section 5 – Completion of job

(To be completed by the responsible person supervising entry)

- Job completed Date.....Time.....
- Space secured against entry Date.....Time.....
- The officer of the watch has been duly informed Date.....Time.....

Signed upon completion of sections 4 and 5 by:

Responsible person supervising entry..... Date.....Time .....

THIS PERMIT IS RENDERED INVALID SHOULD VENTILATION OF THE SPACE STOP OR IF ANY OF THE CONDITIONS NOTED IN THE CHECKLIST CHANGE

Notes:

1 The permit should contain a clear indication as to its maximum period of validity.

2 In order to obtain a representative cross-section of the space's atmosphere, samples should be taken from several levels and through as many openings as possible. Ventilation should be stopped for about 10 minutes before the pre-entry atmosphere tests are taken.

3 Tests for specific toxic contaminants, such as benzene or hydrogen sulphide, should be undertaken depending on the nature of the previous contents of the space.

Notes

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