Guidance on
Enclosed Space Entry and Rescue

Based on guidance in the
ICS Tanker Safety Guide (Chemicals)

The following guidance and advice relates to enclosed space entry and rescue on board ships, and includes background information on the hazards and potential atmospheres that might accumulate in such spaces. It contains specific advice on pre-entry procedures, entry into and work in enclosed spaces, and emergency rescue.

In addition to the particular risks associated with the atmosphere in an enclosed space, the same risks exist as in any working environment, including 'slips, trips and falls'. The characteristics of enclosed spaces however, make the preparation and planning of procedures to address such risks additionally difficult.

This guidance is based on the relevant section of the ICS Tanker Safety Guide (Chemicals), and may be found to be useful information for enclosed space entry on a variety of ship types. For operations particularly on chemical tankers the original text of the ICS Tanker Safety Guide (Chemicals) as well as ISGOTT, should be used, as this extract lacks some information including cross references to supporting information that is only available in the complete and unabridged publication(s).

Important Note

The advice given in this document is intended purely as guidance to be used at the user's own risk. No responsibility is accepted by the International Chamber of Shipping (ICS) for any consequences whatsoever resulting directly or indirectly from compliance with or adoption of this guidance even if caused by a failure to exercise reasonable care.

A. Introduction

An enclosed space is a space with poor or no natural ventilation which is not designed for continuous occupancy, where access is limited and which may contain a dangerous atmosphere.

Enclosed spaces include but are not limited to cargo tanks, double bottoms, cargo pumprooms, duct keels,[1] ballast tanks, void spaces, peak tanks, cofferdams, chain lockers, bunker tanks, freshwater tanks, machinery internals and any other spaces that are normally kept closed.

An enclosed space may include a deck area that due to its construction and location has poor or limited access and where a dangerous atmosphere may accumulate. The hazards identified below may be present around such a deck area.

IMO Guidelines

Due to the high risks associated with enclosed space entry and the number of accidents that have occurred on board various types of ship, IMO has issued two specific sets of safety Guidelines:

1. Assembly Resolution A.1050(27) (Revised Recommendations for Entering Enclosed Spaces Aboard Ships);

2. MSC.1/Circ.1401 (Guidelines on Tank Entry for Tankers Using Nitrogen as an Inerting Medium).

The above IMO Assembly Resolution and Guidelines are important documents that should be followed when entering enclosed spaces and when inert gas (nitrogen) is used as an inerting medium. The guidance provides for practical application of these IMO guidelines.

B. Hazards

Enclosed space atmospheres can be hazardous due to one or a combination of the following conditions:

- Oxygen deficiency;
- Inert gas including nitrogen;
- Presence of toxic and/or flammable gases;
- Accumulation of toxic and or heavy gases at lower levels within the space; and/or
- Oxygen enrichment.

When it is intended that personnel should enter or work in an enclosed space, care should be taken to create and maintain safe working conditions. It should be recognised that conditions within an enclosed space may change while personnel are in the space. The use and monitoring of personal multi-gas detectors is therefore important and will help to identify any change of conditions.

[1] On some ships, there is no door or hatch restricting passage from a pumproom into a duct keel. Even in these circumstances, the duct keel should be regarded as being a separate enclosed space.

The following contributory factors have been frequently identified following enclosed space accident investigations:

- **Non-compliance with procedures;**
- **Poor supervision;**
- **Complacency and over familiarity leading to short cuts being taken;**
- **Monitoring equipment not used or not working properly; and**
- **Improper action in an emergency.**

In addition to the particular risks associated with the atmosphere in an enclosed space, the same risks exist as in any working environment including 'slips, trips and falls'. A number of accidents have involved falls from height inside enclosed spaces. It is particularly important that rescue and recovery access to all appropriate parts of the enclosed space is considered, as well as the entry and exit of rescuers and their equipment.

The presence of toxic gases from cargo residues should always be expected in cargo tanks and adjacent spaces. Each gas presents its own dangers and personnel should be aware of the properties of the gases involved and the safe levels of exposure permitted.

The impulse to go to the rescue of personnel who have collapsed in an enclosed space presents a particular risk. It is a common human reaction to go to the aid of a colleague in difficulties. However, far too many additional deaths have occurred from impulsive or ill prepared rescue attempts. It is essential that all personnel are aware of the dangers of attempting to rescue colleagues without assistance.

In an emergency, the first action should be to activate the emergency alarm and wait for assistance.

The nominal oxygen level in fresh air is 21% by volume. Any space having an atmosphere of less than this should not be entered until the reason for the low oxygen level has been established and appropriate measures taken.

When the oxygen supply to the brain is depleted, victims will frequently feel dizzy, become disorientated, and may develop a headache before finally losing consciousness. By the time the victim is aware of these symptoms they may not be able to act rationally and may not be able to leave the space safely. There is a danger of permanent brain damage after only 4 minutes in an oxygen deficient atmosphere. A successful rescue therefore depends upon the victim being resuscitated in the shortest possible time.

At oxygen concentrations:

- Below 21% to 16% - pulse and breathing rates drop, and mental functions are impaired;
- Below 14% - severe symptoms are experienced, including increasing fatigue, emotional upset, poor judgment, and faulty coordination. Further reductions result in nausea, vomiting, permanent heart damage and loss of consciousness; and
- Below about 5% - a coma may occur within 40 seconds, requiring emergency administration of oxygen to have any chance of survival.

Oxygen deficiency

When an enclosed space is left closed and unventilated for any length of time, the internal atmosphere may become oxygen deficient due to the natural process of oxidisation of steel (rusting). The oxidising process depletes the oxygen within the space.

The use of inert gas or nitrogen will also reduce the oxygen content of the tank. Cargoes, such as vegetable or animal oils, that are prone to decomposition, fermentation or slow oxidisation may deplete the oxygen content in the tank. These processes may also generate toxic gases (hydrogen sulphide and carbon monoxide) which present an added risk, especially in tanks which have been emptied but not yet adequately cleaned.

Toxic and/or flammable gases

In spaces that have previously contained toxic and/or flammable cargoes there is a danger to personnel even if the space has been cleaned, tested and previously found to be safe for entry.

Some toxic and/or flammable cargoes may be absorbed by tank linings (especially epoxy type coatings) and, as these leach out, the space may become unsafe for entry. Cargo residues may be trapped within tank fittings such as heating coils, cargo pumps and vapour lines, and these may be released into the tank after initial cleaning has been completed.

Presence of inert gas including nitrogen

Nitrogen is a commonly used inert gas. Whereas inert gas produced by combustion, in an inert gas generator, is usually detectable by smell, it is very important to be aware that nitrogen is odourless and colourless and therefore presents particular risks.

<u>Dangers of nitrogen</u>

Nitrogen is a colourless and odourless gas that will cause oxygen deficiency in confined spaces, and at exhaust openings on deck, during the purging of tanks and void spaces.
The normal air we breathe contains about 78% nitrogen and 21% oxygen with much of the remainder made up of a small amount of carbon dioxide. Breathing is stimulated and regulated by the amount of carbon dioxide present in the blood.

In a space where the oxygen has been partly replaced by carbon dioxide, due to corrosion/rusting, decomposition of organic material, or inert gas produced by combustion, the increase in carbon dioxide stimulates the lungs to work harder and thus sends a clear message that should alert the person to the danger.

However, the effect of nitrogen gas is to reduce the oxygen content but also with an associated drop in carbon dioxide levels in the blood. As a result the lungs are not stimulated to work harder to compensate for the lack of oxygen. The person is not aware of any danger and may even feel a state of euphoria before the stimulus to breathe is removed completely and the person is asphyxiated.

Oxygen enrichment

Oxygen behaves differently to air, compressed air, or inert gas such as nitrogen. It is very reactive. Pure oxygen, at high pressure, such as from a cylinder, can react violently with common materials such as oil and grease. Other materials may catch fire spontaneously. Nearly all materials including textiles, rubber and even metals will burn vigorously in oxygen.
Even a small increase in the oxygen level in the air to 24% can create a dangerous atmosphere. It becomes easier to start a fire, which will then burn hotter and more fiercely than in normal air. It may be almost impossible to put the fire out. A leaking valve or hose in a poorly ventilated room or confined space can quickly increase the oxygen concentration to a dangerous level.

The main causes of fires and explosions when using oxygen are:

- Oxygen enrichment from leaking equipment;
- Use of materials not compatible with oxygen;
- Use of oxygen in equipment not designed for oxygen service; and
- Incorrect or careless operation of oxygen equipment.

C. Atmosphere in Enclosed Spaces

Enclosed spaces, including tank atmospheres, may be contaminated by leaks from adjacent tanks or by the improper operation or failure of cargo, vapour and inert gas lines and valves.

Enclosed spaces should not be entered until it is confirmed that the atmosphere is safe and then only for a specific authorised purpose.

Entry precautions

It is vital that no personnel enter an enclosed space until it is confirmed that the atmosphere is safe.

Suitable notices should be prominently displayed to warn and inform personnel about the dangers of entering enclosed spaces. Instructions should clearly explain the precautions to be taken when entering tanks or other enclosed spaces, and listing any restrictions placed upon the permitted work.

Entry doors or hatches leading to enclosed spaces should at all times be secured against entry, when entry is not required. The company should ensure that their enclosed space entry procedures are understood and followed.

D. Requirements for Enclosed Space Entry

The tank cleaning plan should not permit personnel to enter a tank unless it is confirmed safe for entry.

Planning

Prior to entering an enclosed space, all personnel who are to be involved in the work should meet to:

- Define the purpose of entering the space;
- Identify the steps required to achieve the purpose;
- Identify the risks involved;
- Develop a plan of action; and
- Agree responsibilities.

The meeting should address:

- Manpower requirements for the enclosed space entry:
    - Under the Master's authority, an officer should be designated with responsibility for the work and for compliance with related procedures;

    - Atmosphere testing should be by personnel trained in the use of the equipment used. Manufacturers' procedures should be followed and equipment should be correctly calibrated; and
    - An attendant should be designated who should remain outside the entrance to the enclosed space. Their primary function is to maintain a safety watch over the work and personnel involved and to maintain communications. The attendant should be trained in emergency response and should be responsible for initiating emergency procedures in the event of an incident;

- Identification and mitigation of physical hazards;

- Identification of safety, fire-fighting, communication, escape and rescue and other equipment and tools required;

- Information to personnel entering enclosed spaces on the particular hazards of the operation;

- How to maintain safe operating conditions in the enclosed space; and

- A review of emergency procedures, including that:

    - The rescue party leader should coordinate operation from close to the enclosed space access but should NOT enter the space;
    - Sufficient personnel should be available to recover a casualty from the enclosed space;
    - The rescue team should have sufficient personnel, all trained in the use of rescue equipment and first aid; and
    - A decision to recover a casualty from the enclosed space should assess the nature of injury and need for immediate first aid against the risk associated with remaining longer in the space.

Entry permit

Prior to allowing personnel to enter an enclosed space, an entry permit should be issued. An example of an Enclosed Space Entry Permit is provided in Appendix 1.

It is recommended that the permit should be signed by the Master or a designated officer with sufficient knowledge and experience of the procedures requiring compliance.

The entry permit should contain a clear indication as to its maximum period of validity, which should not exceed 8 hours. It should also describe the maximum permitted time between testing of the atmosphere and entry of personnel into the space. A single permit for entry into more than one enclosed space may be issued as defined in the company's SMS. However, this should only be applicable for entry to cargo tanks.

It is essential to ensure that while personnel are within an enclosed space the levels of oxygen and any contaminants are regularly checked, and that personnel entering a space use multi-gas detectors, and that the levels remain within safe limits. If there is any doubt regarding the oxygen level or the presence of toxic or flammable gases the space should be immediately evacuated.

A condition of the entry permit should require that if the enclosed space is vacated for any reason, such as for refreshment or a meal break, ventilation should be continued during the break and the atmosphere of the enclosed space should be fully retested prior to re-entry.

Entry permits must only remain valid for as long as the permit conditions are met.

The responsible officer supervising enclosed space entry should confirm that:

- If enclosed space entry is in the cargo area, no inerting or purging is taking place;
- The space has been thoroughly ventilated by natural or mechanical means to remove any toxic, hazardous or flammable gases, and to ensure that there is an adequate level of oxygen throughout the space;
- Adequate illumination is provided;
- All personnel entering the space are properly trained in enclosed space entry procedures, and are familiar with the company's safety and emergency procedures;
- There is a system in use to record personnel entering and leaving the space;
- The atmosphere of the space has been tested and found safe before any personnel enter the space;
- All personnel entering the space are wearing appropriate PPE and should be provided with calibrated personal multi-gas detectors to monitor the levels of oxygen, LEL, carbon monoxide and other gases as appropriate;
- All crew members entering the space understand that the space is to be vacated immediately if any personal multi-gas detector alarm is activated;
- A crew member (attendant) who is familiar with the action to take in the event of an emergency is standing by at the entrance and is in direct contact with persons within the space and with the navigating bridge or control room as appropriate;
- A reliable system of communication has been established, tested and is understood, both by those entering the space, and by the crew member (attendant) standing by at the entrance;
- The duty officer(s) on the bridge or in the cargo control room and in the engine room are aware of the enclosed space entry operations;
- Rescue procedures are understood and sufficient trained personnel are readily available to form a rescue party;
- Rescue equipment, suitable for the enclosed space, is ready for immediate use. Rescue equipment should be readily capable of being placed into and recovered from the space and moved to any part of the space in which personnel may work;
- Outside contractors involved in enclosed space operations comply with the company's enclosed space entry procedures. It should be confirmed that any such contractors are aware of the particular dangers involved and the actions to take in an emergency; and
- PPE used by outside contractors, as a minimum, complies with the ship's equipment standards and procedures for use.

Irrespective of whether ship's crew or outside contractors are entering an enclosed space, the person standing by at the entrance (attendant) should always be a member of the ship's crew.

No tank entry should be made when any inerting operations are being carried out in the cargo area.

A system should be in place to indicate which cargo tanks are safe for entry by marking (or tagging) all appropriate tank entry hatches.

E. Testing before Entry

Before the space is entered it should be thoroughly ventilated. The time necessary to ensure thorough ventilation depends upon the size and construction of the space, the capacity and efficiency of the ventilation system, the level of contamination and the density of the vapour to be displaced.

Effective ventilation capacity is also dependent upon the size and position of openings to the space. Well placed openings improve the flow of air and will help ensure that all areas within the space are effectively ventilated.

Once the space has been ventilated, the atmosphere should be checked using a suitable instrument(s) to test for oxygen, flammable gases or vapours, carbon monoxide, hydrogen sulphide and other toxic gases as appropriate:

- The oxygen content should be measured and a nominal reading of 21% achieved. Any space with an atmosphere having less than 21% oxygen by volume should NOT be entered until the reason for the low oxygen level has been established and resolved;
- Flammable vapours should be measured with a suitably sensitive combustible gas detector. The concentration of flammable vapour must be below 1% of the Lower Flammable Limit (LFL) before entry can proceed; and
- A toxic gas detector should be used to ensure that the levels of toxic gases are within the required safe Threshold Limit Value (TLV).[2]

Multi-gas detectors intended to be carried by personnel within an enclosed space are not suitable for conducting pre-entry atmosphere testing.

Ventilation should be stopped about 10 minutes before the above tests are carried out and not restarted until after the tests have been completed. A number of test readings should be taken from different locations and levels within the enclosed space, utilising extension hoses as appropriate. Gas or vapour with a relative density greater than that of air will be found at the bottom of any space, and those that have a relative density less than that of air will be found at the top of a space. Gas and vapour will also tend to remain where the ventilating airflow is least effective.

[2] OEL and MAK are other examples of broadly complementary but different systems for categorising maximum recommended exposure levels of personnel to toxic chemicals.

Testing and measurement should only be carried out by personnel trained and proficient in the use of the equipment. Testing equipment should comply with an appropriate recognised standard and be properly maintained and calibrated.

Testing equipment should only be used to measure gases for which it is designed and within the limits set by the manufacturer.

Even after a space has been made gas free and found to contain a safe atmosphere, local concentrations of gas should always be suspected. Cargo residues may be trapped within tank coatings, fittings or in residual scale. Generation of vapour should always be considered possible, even after loose scale has been removed. As persons move around within an enclosed space they should always be aware of the dangers of isolated concentrations of gas and carry out further tests. This is especially important in spaces with a complicated internal structure where effective ventilation is difficult to achieve.

Testing of enclosed spaces from outside the space should be continued at appropriate intervals while personnel work within the space.

If any of the criteria required above for initial entry to the space are not maintained the space should immediately be evacuated.

F. Enclosed Space Entry

On chemical carriers entry into cargo tanks is a more frequent requirement than it is on oil tankers. Chemical carrier operators' instructions should make allowance for this when preparing cargo tank entry procedures. It is essential that procedures ensure the safety of personnel but are not so onerous that personnel become inclined to disregard them.

A system should be in place to indicate which cargo tanks are safe for entry by marking (or tagging) all appropriate tank entry hatches. The marking should be unambiguous, and procedures should be such that the absence of a safe to enter mark will prohibit entry.

The tank to be entered should be segregated from all other spaces which contain or may contain a non-gas free atmosphere. All common line valves should be lashed in the closed position and labelled. All cargo pipes in the tank being entered should have been flushed and drained.

Entry permits may be coordinated so that more than one cargo tank is shown on one entry permit. This helps to simplify the administration of permits, and avoids possible duplication and confusion as to which permit applies to which tank. If such a combined permit system is used there should be rigorous control measures in place to ensure, if one or more tanks named on the permit are subsequently tested and found to be unsafe to enter, that the whole permit is cancelled. A new permit will then need to be issued for all tanks.

It is particularly important that the permit system is supplemented by the marking of tank lids with notices indicating which tanks are safe to enter.

Any tank to be entered must be completely disconnected from any active cargo operations.

Entry into enclosed spaces other than cargo tanks

On chemical carriers, entry into enclosed spaces other than cargo tanks should be treated with the same degree of caution as for cargo tanks. Familiarity with routine work in cargo

tanks should not be allowed to induce any sense of over confidence or complacency when entering other types of enclosed space.

For tanks other than cargo tanks it is recommended that a permit to enter is only issued for one space at a time and that multi-space permits are not used. Rescue equipment, suitable for the enclosed space, should be ready for immediate use.

Dangers in such spaces include:

- Depletion of oxygen due to rusting;
- Presence of cargo and cargo vapours that may have leaked from adjacent tanks; and
- Inert gas or nitrogen getting into such spaces.

The atmosphere should therefore be checked for both oxygen content and cargo vapour before entry.

G. Work in Enclosed Spaces

Ventilation should be continuous while personnel are inside the space and the atmosphere should be monitored at appropriate intervals, including by the use of personal multi-gas detectors. If personnel begin to feel dizzy or unwell they should leave the space immediately. In particular, tests should be made before the resumption of work after a break and prior to re-entry.

It is a normal practice in some trades for personnel to be sent into a cargo tank being drained of animal and vegetable oils or fats in order to sweep the final traces towards the pump suction.

Familiarity with this routine practice should not obscure the potential dangers of cargo generated vapours and the presence of an oxygen deficient atmosphere. Personal multi-gas detectors and appropriate PPE should be used. Adequate lighting and continuous ventilation should be maintained throughout the period that the space is occupied.

Further dangers associated with cargo sweeping include:

- Heat exhaustion;
- Burns from heating coils;
- Slips, trips and falls due to slippery surfaces; and
- Burns caused by corrosive cargoes.

Where shore workers are employed to carry out cargo sweeping, confirmation should be obtained that they are fit for such work and at least meet the requirements of the company's SMS. Even after a cargo tank has been cleaned there will always be a possibility of some cargo remaining, which could be a source of further flammable or toxic gas, including hydrogen sulphide (H2S).

Many chemical carriers have individual cargo pumps and pipelines dedicated to each cargo tank. However, on ships where cargo tanks share cargo, vapour or inert gas lines with other tanks, further precautions should be taken to ensure effective isolation of the tank prior to any work commencing. This may require valves to be lashed closed or the fitting of blanks.

Whenever cargo pumps, pipelines or valves are to be opened, they should first be cleaned and gas freed. Even after cleaning, care is always required whenever a pipeline or equipment within a tank is opened up, since cargo residues may still be released. Personnel

working on pipelines, pumps and other equipment within a cargo tank should be aware of the last cargo carried and wear the appropriate PPE for that cargo. If unexpected quantities of liquid or vapour are released, the tank should be evacuated.

Hot work in an enclosed space should only be carried out when all applicable regulations and safety requirements have been met and a hot work permit has been issued in addition to the tank entry permit. A full risk assessment should also be carried out and risk mitigation measures implemented before any work commences.

H. Entry into an Enclosed Space where the Atmosphere is Known or Suspected to be Unsafe

Enclosed spaces that have not been tested should be considered unsafe for persons to enter. If the atmosphere within the space is known or suspected to be unsafe, the space should only be entered for emergency purposes. The number of persons entering the space should be the minimum compatible with the scope of the work to be performed.

When toxic vapour detection equipment is not available for products that require such detection, the IBC Code allows flag administrations to permit tank entry subject to the provision of additional BA equipment and an entry being made in the IMO Certificate of Fitness regarding the particular product and the required provisions.

Entry into an enclosed space which is known or suspected of being unsafe should always be considered a non-routine operation. This should only be carried out under the direct supervision of a senior officer.

All personnel entering the enclosed space should wear suitable breathing apparatus, either of the air line or self-contained type, and should be trained in its use. Where an air line type is used a back-up air supply should be provided in the event that the air line fails. Air purifying respirators or filter masks should not be used as they do not provide a supply of clean air from a source independent of the atmosphere within the space and do not protect against an oxygen deficient atmosphere.

Additional PPE may be required, particularly if there is the possibility that personnel entering the space might come into contact with toxic or corrosive substances.

The requirements of the tank entry permit should be complied with as far as practicably possible. For those elements where compliance is not possible a full risk assessment should be carried out to identify the additional risks involved.

Before entry, the supervising officer should ensure that all risk mitigation measures agreed to in the risk assessment are implemented.

The following should always be addressed prior to entry into an enclosed space where the atmosphere is known or suspected to be unsafe:

- Safety equipment and PPE should be suitable for the intended purpose;
- Breathing apparatus should be checked, tested and confirmed to be in good working order;
- All personnel involved are aware of the planned activity and the action to take in an emergency;
- The requirements for PPE also apply to those supervising the operation from outside the enclosed space. Persons standing close to the entrance to an enclosed space may also be exposed to the atmosphere from within the space;

- Rescue equipment that is suitable for the intended space should be rigged and ready for immediate use close to the entrance of the enclosed space;
- The rescue team should be standing by, fully equipped with PPE and breathing apparatus, and ready to provide immediate assistance in the event of an emergency; and
- If an explosive atmosphere is present, or suspected, the risk assessment should address potential ignition sources.

Entry into an enclosed space where the atmosphere is known or suspected to be unsafe should only be conducted in an emergency.

I. Rescue from Cargo Tanks and Other Enclosed Spaces

General

It is essential that regular drills and exercises to practise rescue from enclosed spaces are carried out, and that all members of a rescue team know what is expected of them.

When personnel are in need of rescue from an enclosed space, the first action from the person assigned as the attendant should be to raise the alarm. Although speed is often vital in the interest of saving life, rescue operations should not be attempted until assistance has arrived and a planned approach can be made. Over the years, there are many examples of lives having been lost through hasty, ill prepared rescue attempts.

Preventing enclosed space accidents

Enclosed space accidents can be avoided with good planning. In addition, providing all crew members with a suitable safety harness when working within an enclosed space will greatly speed up the rescue effort should an accident occur. Safety lines should be used unless, because of the particular circumstances, their use is considered impractical.

Rescue and recovery organisation

Enclosed space rescue procedures should be well planned and regular drills held to improve effectiveness. There are a number of issues that rescue procedures should address.

Team composition

The rescue team should comprise a dedicated team of personnel drilled and trained as appropriate in all aspects of enclosed space rescue including in the use of resuscitation equipment. All team members should be familiar with the ship's SMS, and its operating and emergency procedures. Although a dedicated team offers major advantages it is essential that back up personnel are also identified in case a member(s) of the dedicated team is unavailable.

Team roles

The Rescue team should consist of the following personnel:

- Team leader - this should be a senior officer. The role will be to direct the rescue effort, therefore the leader should not form part of the team that enters the enclosed space;

- Entry team - the number of entry team personnel should be kept to a minimum. However, at least two persons should enter the space to carry out the rescue; and

- Back up personnel - these should be employed to rig the rescue equipment, ensuring that the entry team have the equipment and support necessary to carry out their task and to monitor the enclosed space atmosphere. One crew member should be assigned to assist the rescue team leader with communications and to maintain a record of events.

Regular training of the emergency rescue team is essential to ensure a successful enclosed space rescue.

Emergency rescue team members should be:

- **Prepared for the physical and technical demands of enclosed space rescue;**
- **Well trained in all rescue team duties;**
- **Familiar with the use and deployment of rescue equipment that should be of a size and weight to allow its ready deployment into the enclosed space and placement in any location where work may take place; and**
- **Capable of fulfilling any role within the rescue team.**

Depending on the overall crew composition and assessment of the incident some roles can be executed by a single person who may carry out more than one function.

The rescue operation

The person on watch at the entrance to the enclosed space (attendant) should, as soon as they are aware that a person in the space is in difficulty, immediately raise the alarm. It is therefore essential that a method of raising the alarm is agreed and tested in advance together with a means of communicating the details of the emergency. It is also essential that the rescue team is advised regarding the nature of the accident and how many persons are affected.

Rescue team personnel should proceed immediately to the entrance to the enclosed space together with any additional equipment. No one should enter the space without the team leader's permission.

Unless it has been positively assessed that the atmosphere in the enclosed space is safe to breathe, the entry team should in addition to wearing appropriate protective equipment use breathing apparatus. Only after a full test has confirmed that the enclosed space atmosphere is safe to enter should the entry team proceed without breathing apparatus.

In an emergency rescue, the atmosphere of an enclosed space should always be considered to be unsafe unless confirmed otherwise.

On reaching the casualty the entry team should ascertain if the casualty is still breathing. If the casualty is not breathing the entry team should remove the casualty from the space as soon as possible for resuscitation.

If the casualty is breathing, any injuries should be assessed before the casualty is removed from the space. If the condition of the atmosphere in the enclosed space is not verified as safe, the casualty should be provided with a safe independent air supply in the enclosed space.

During the incident the team leader and back up personnel should:

- Monitor the rescue team and ensure the provision of spare air supplies;
- Rig rescue equipment such as hoists;
- Monitor the atmosphere of the space;
- Communicate with the vessel's command team; and
- Arrange additional lighting, ventilation and improve access to the space, as appropriate.

Removal of the casualty should be carried out utilising the most appropriate equipment such as stretchers, lifting harnesses and hoisting apparatus.

Rescue and recovery equipment

The following equipment is recommended to ensure a successful rescue from an enclosed space:

Hoist

A dedicated hoist for enclosed space rescue operations should be rigged before entry or be readily available. When selecting a suitable hoist the following should be considered:

- The Safe Working Load (SWL) should be appropriate to the anticipated lifting requirement, i.e. maximum weight of a casualty including stretcher and resuscitation equipment. The rescue team should be aware of whether or not the SWL allows for the lifting of multiple personnel;
- It is important that the hoist can be properly positioned and secured over any enclosed space entrance from which a casualty may need to be lifted; and
- The hoist should be portable, lightweight and easy to assemble at the site.

Should a powered hoisting motor be fitted, which should be safe to use in the operating environment, this should be capable of lifting the casualty in a controlled manner.

Stretcher

When selecting a stretcher for enclosed space rescues the following should be considered:

- In enclosed spaces where a vertical lift is required the stretcher should be able to secure the casualty properly and prevent head injury;
- The stretcher and casualty should be able to pass through the enclosed space openings and around tight corners; and
- The stretcher should be capable of being handled by rescuers wearing full protective equipment.

Breathing apparatus

The following should be considered:

- The design of the apparatus should be lightweight and enable the wearer to access confined spaces without the need to remove it; and
- Radio communication should be possible when using the breathing apparatus.

Resuscitation equipment

The following should be considered:

- It should be light, portable and preferably capable of being recharged on board;
- It should be provided with a manual and automatic resuscitation system; and
- Due to the potential fire risk, pure oxygen should not be used for resuscitation in an enclosed space.

Communication equipment

An effective system of communication between the team leader and the entry team should be agreed. It is strongly recommended that two way radios are used.

Other equipment

The following equipment should also be considered for use during an enclosed space rescue:

- Personal Protective Equipment (PPE) - protective suits, head and eye protection, gloves and safety boots suitable for the expected hazards to be found within the space;
- Atmosphere testing equipment;
- Where practical, harnesses and lifelines should be used;
- Extra lighting including portable lighting; and
- Additional ventilation capacity. Care should be taken if the space contains a dangerous atmosphere as this could affect the rescue team standing by at the entrance to the space.

Appendix 1

Enclosed Space Entry Permit*

This permit relates to entry into any enclosed space and should be completed by the Master or responsible person and by any persons entering the space, e.g. competent person and attendant.

General
Location of enclosed space(s): Reason for entry: _____ Permit valid From_____Date _____(DD/MM/YYYY) To__ Date _____(DD/MM/YYYY)

(See Note 1)

SECTION 1 – PRE-ENTRY PREPARATION (To be checked by Master or nominated responsible person)		Confirmed	Initials
Has the space been thoroughly ventilated by mechanical means?			
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** (See Note 3):			
	Test reading:	**Time**	**Initials**
Oxygen	_____% vol (21%)		
Hydrocarbon	_____% LFL (less than 1%)		
Toxic gases	_____ppm (less than 50% OEL of the specific gas)		

* It should be noted that this is a generic entry permit that may be used for all enclosed spaces on board all ships.

** Note that national requirements may determine the safe atmosphere range.

	Confirmed	Initials
Have arrangements been made for regular atmosphere checks to be made while the space is occupied?		
Have arrangements been made for the space to be continuously ventilated throughout the period of occupation and during work breaks?		
After work breaks are arrangements in place to ensure re-testing of the atmosphere?		
Are access and illumination adequate?		
Is rescue and resuscitation equipment available for immediate use by the entrance to the space?		
Has an attendant 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 each person entering the space)	**Confirmed**	**Initials**
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)	Confirmed	Initials
Those entering the space are familiar with any breathing apparatus to be used.		
The breathing apparatus has been tested as follows: • Gauge and capacity of air supply; • Low pressure audible alarm if fitted; and • Face mask – under positive pressure and not leaking.		
The means of communication have been tested and emergency signals agreed.		
All personnel entering the space have been provided with rescue harnesses and, where practicable, lifelines.		

SECTION 4 – PERSONNEL ENTRY (To be completed by the responsible person supervising entry)		
Names	**Time in**	**Time out**

SECTION 5 – COMPLETION OF THE JOB (To be completed by the responsible person supervising entry)		
	Date (DD/MM/YYY)	**Time**
Job completed:		
Space secured against entry:		
OOW informed:		

Signed upon completion of Sections 4 and 5 by:

Responsible Person Supervising Entry:

Date:_____(DD/MM/YYY) Time:

This permit is rendered invalid should ventilation of the space stop or if any of the conditions noted in the checklist change.

SECTION 6 – RE-ENTRY PREPARATION (To be checked by Master or nominated responsible person) *When a break in regular testing of enclosed space atmosphere occurs such as for a refreshment or meal interval, appropriate checks as required under Section 1, Section 2 and Section 3 must be completed prior to re-entry to the space. In all cases the checks listed under Section 6 must additionally be completed.*	**Confirmed**	**Initials**
Has the space been tested and found safe for entry? *(See Note 2)*		
Re-entry atmosphere test readings** *(See Note 3)*		

Test reading		**Time**	**Initials**
Oxygen	_____% vol (21%)		
Hydrocarbon	_____% LFL (less than 1%)		
Toxic gases	_____ppm (less than 50% OEL of the specific gas)		

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; and
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.