Confined Space Workbook
“Failure to observe simple procedures can lead to people being unexpectedly overcome when entering confined spaces. Observance of the principles ... will form a reliable basis for assessing risks in such spaces and for taking necessary precautions.”

IMO RESOLUTION A.864(20) RECOMMENDATIONS FOR ENTERING ENCLOSED SPACES ABOARD SHIPS

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Part 1

Principles of Safety in Confined Spaces
Purpose

The purpose of this workbook is to provide information to seafarers and others who may be required to enter a confined space to enhance the safety of entry into, and working in, such spaces and conducting rescues from them. It is intended to be of value to HSE personnel, trainers and other persons with a shipboard, onshore or offshore safety remit.

It may be used within a formal training programme or for self study but it is not, by itself, intended to replace an appropriate certification process.

Nothing in this publication supersedes those procedures required by your vessel's safety management system, flag state requirements and/or any recommendations or regulations recommended or required by the International Maritime Organisation or individual port states.

Each section is followed by a quiz. Each question may have more than one answer. The answers should be checked against the section preceding the quiz.
Introduction

Note:
For the purposes of this book the terms “enclosed space” and “confined space” are synonymous terms.

‘Competent person’ for this book means a person who has been assessed as demonstrating the knowledge and skills required to enter, work and perform or participate in a rescue from a confined space, to a given standard, safely.

Confined spaces represent one of the most hazardous shipboard environments for the unwary seafarer. It has been estimated that working in a confined space is 150 times more dangerous than working elsewhere. In almost every case, often involving injury and multiple deaths, the incident would have been avoidable had the individual seafarers involved been aware of the hazards presented by confined spaces and the means to avoid or mitigate those hazards.

Some 65 per cent of confined space casualties are the result of atmospheric hazards, from toxic atmospheres to oxygen deficient atmospheres.

Most tragically about 60 per cent of the fatalities involve seafarers who have tried to rescue someone else without taking the proper precautions or assessing the dangers involved.

Note that the same hazards exist in a confined space as when doing the same work elsewhere such as hotwork or work at height but the difficulty of getting help and rescue significantly increase the risk to health and life.

As a seafarer, you, yourself, can ensure that you do not put yourself in a position of danger within a confined space.

On 27 November 1997 the International Maritime Organisation assembly passed resolution A.864(20), Recommendations For Entering Enclosed Spaces Aboard Ships. The resolution notes: “the continued loss of life resulting from personnel entering shipboard spaces in which the atmosphere is oxygen-depleted, toxic or flammable,.. (The assembly) Invites governments to bring the annexed Recommendations to the attention of shipowners, ship operators and seafarers, urging them to apply the Recommendations, as appropriate, to all ships”.

Well-intended though the resolution might have been its effectiveness as an instrument to encourage the safety of seafarers has remained limited by lack of awareness and poor safety practices.

Data collected by the Bahamas Registry at the request of the Maritime Accident Investigators International Forum, MAIIF, recorded some 93 deaths in 120 incidents from 1997 to 2009, about eight a year. Those figures did not include many of the flag states representing the majority of vessels and it is therefore safe to say that the true figure is significantly higher.

MAIIF identified key issues related to enclose space casualties:

- Lack of knowledge, training and understanding of the dangers of entering confined spaces;
- Personal Protective Equipment (PPE) or rescue equipment not being used, not available of inappropriate type, improperly used, or in disrepair;
A conservative estimate, based on available records suggests at least two seafarers die in confined spaces on ships every month. Since the majority of casualty records are not available – many are regarded as a matter of 'commercial confident' by some flag states - or not in a form which allows for adequate analysis, it is not unreasonable to assume the true figure to be significantly higher.

The MAIIF figures disprove the disturbingly widespread myth that confined space hazards are confined to tankers. Some two thirds of confined space happen aboard non-tanker vessels, from fishing boats to cruise liners.

Several definitions of confined spaces appear to assume an atmospheric hazard only. It should be noted that about a third of incidents are not directly related to atmospheric threats.

Whatever the true level of deaths and injuries in confined spaces it is regarded as unacceptably high and efforts have recently been put in place to tackle the issue through training, drills and, to some extent, technology.

Drills and training will only be effective in reducing the toll of seafarers if they result in safety conscious behaviour. Two cases stand as good examples: A pumpman who had recently watched videos related to safe entry into confined spaces who did not follow the procedures demonstrated in the videos, resulting in both his own death and that of the deckboy who tried to rescue him. In another case a chief officer known for a strict attitude towards safety, who had watched 21 videos on safety, died after falling 8 metres because he did not follow correct procedures.

A 'drill', a practical simulation of real-world actions, conditions and procedures carried out under controlled conditions to reduce risks, is a subset of training.

Technology such as remote atmosphere sensors and radio frequency Identity tags, RFID, for access control are useful tools but not solutions. Apart from a relatively low-level of implementation and the cost of acquisition, there are also issues of maintenance and monitoring which, if not fully carried out, may not only make the technology ineffective but create a false sense of security which may lead to more tragedies.

Effective confined space safety depends on the individual seafarer understanding and recognising the hazards, on ships' officers setting good examples and encouraging safety awareness and ship management companies and executive maintaining a commitment to safety.

It should be noted that safety and compliance are separate issues. Compliance is not a guarantee of safety. Safety can only be assured by correct assessment of hazards and taking appropriate measures to reduce the potential impact of those hazards.
Quiz 1

1) Working in a confined space is:
a) Less dangerous than work carried out elsewhere
b) As dangerous as work carried out elsewhere
c) Very much more dangerous than work carried out elsewhere

2) People who attempt to rescue others are
a) Less likely to be killed or injured than the first casualty
b) As likely to be killed or injured as the first casualty
c) Significantly more likely to be killed or injured than the first casualty

3) Confined space accidents occur
a) Mostly on tanker vessels
b) Mostly on non-tanker vessels

4) Which of the following does not contribute to confined space entry accidents:
a) Lack of knowledge, training and understanding of the dangers of entering confined spaces;
b) Personal Protective Equipment (PPE) or rescue equipment not being used, not available of inappropriate type, improperly used, or in disrepair;
c) Inadequate or non-existent signage;
d) Inadequate or non-existent identification of confined spaces on board;
e) Inadequacies in Safety Management Systems; and
f) Poor management commitment and oversight.
   g) Senior officers setting bad examples
   h) All of the above

5) Always comply fully with SMS safe entry procedures
   a) True
   b) False

6) Compliance with procedures will always be an absolute guarantee of safe entry
   a) True

Part 1 Principles of Safety in Confined Spaces
b) False
Who Is At Risk?

All persons who may be required to work in or otherwise enter a confined space are at risk from any hazards that may be present. These include, but are not limited to:

- Members of the ship's company who may be required to enter a confined space for the purposes of maintenance or for any other purpose.
- Shore-based company personnel who may be aboard ship
- Cargo surveyors
- Class society surveyors
- Port State Control inspectors
- Third party contractors, such as welders and fumigators
- Law-enforcement personnel who may board the ship and require access to confined spaces
- Maritime casualty investigators
- Stevedores and other dockworkers.
- Technical personal assigned as consultants on a temporary basis.

Do not assume that persons boarding the vessel who require access to confined spaces have been properly trained, are competent to enter a confined space, are aware of the hazards or the means necessary to mitigate the hazards.

All persons who require to make entry to a confined space must only be permitted to do so under the supervision of a competent person assigned to do so, who is a member of the ship's company and follow shipboard procedures and precautions.

Under no circumstances should a person who is not a member of the ship's company be permitted to move around the vessel alone and unaccompanied by a member of the ship's crew.

If you are not a member of the ship's crew ensure that you are accompanied by a competent crewmember at all times and that you have, and are familiar with, any necessary documents, such as relevant Material Safety Data Sheets, and permits, that are required.

When you enter a confined space it is your responsibility, and your duty towards others on board, to ensure that it is as safe as reasonably practicable to do so and that you are aware of the hazards involved.
Quiz 2

1) Persons at risk in a confined space are:
   a) All persons designated as at risk in the ship's SMS
   b) Person defined as 'At Risk' in IMO Resolution A.864(20), Recommendations For Entering Enclosed Spaces Aboard Ships
   c) Only vessel crewmembers
   d) All persons who enter a confined space

2) When someone who is not a crewmember wants to enter a confined space
   a) It is safe to assume that they are competent to enter a confined space and may be left alone to get on with their work.
   b) Ask if they have been trained to enter a confined space. If they say yes, leave them to get on with it.
   c) Ensure they are supervised by a competent person at all times and that all SMS procedures are followed should they enter a confined space.

3) While inspecting a ship you realise that an area you need to enter is a confined space, although not previously designated as such. Do you:
   a) Follow your own company procedures for safe entry
   b) The ship's SMS confined space entry procedures.
   c) Both
   d) Assume you're wrong and enter anyway.

4) Responsibility for your safety, and others, in an enclosed safe is
   a) The ship safety officer's job
   b) The ship management company's job
   c) The Chief Engineer's job
   d) Your job.
Identify Your Confined Space

Any space which has restricted or no ventilation, in which toxic or flammable vapours or gases can gather, which has limited access, which is not designed for continuous occupation and which big enough for a person to wholly or partially enter should be regarded as a confined space and therefore a potentially dangerous place to be.

Ventilation:

Typical ventilation conditions for confined spaces may include any one of more of the following:

- The space is not normally open to the atmosphere or air cannot flow freely through it;
- The space is not equipped with air conditioning or air conditioning is not operational;
- Air is not regularly forced into and out of the space.

Access:

Access to a confined space may include one or more of the following:

Typically, but not always, entry or exit is made through a manhole or similar big enough for one person to climb through or to place a significant part of the body through.

- The access is difficult
- The access can be closed by gravity or the ship's movement
- Access may be obstructed by, for instance, pipes on a deck.

Working:

Entering a confined pace is not part of, or intended for, the daily working routine of the ship or its operations.

All actual or potential confined spaces should be identified in the vessel's Safety Management System together with the appropriate procedures for entry. Not all confined spaces may be identified in the SMS, if in doubt assume that the space is a confined space unless specifically identified otherwise.

SMS and other mandated procedures must always be regarded as the minimum acceptable for safety. It is acceptable for shipboard confined space entry procedures to be more stringent that those provided for in the SMS or other mandatory procedures but must not, under any circumstances, be less stringent.

All confined spaces should be marked with appropriate warning signage.

All confined spaces should be regarded as hazardous unless positively proven safe by testing.

Typical examples on most vessels would include:

- Cargo Tanks/Holds
- Ballast tanks
• Anchor cable lockers
• Lazarettes
• Bow Thruster Rooms
• Stores compartments
• Crawl spaces
• Boilers
• Scavenge Air Receivers
• Double bottoms,
• Fuel tanks
• Forepeak tanks
• Pump rooms
• Compressor rooms
• Void spaces
• Duct keels
• Inter-barrier spaces
• Engine crank cases
• Sewage tanks

On a chemical tanker, the tanks, which may contained toxic fumes or be inerted with nitrogen, are also confined spaces.

Cargo holds on bulk carriers should be regarded and treated as confined spaces.

This is not a complete list and it is good practice to identify unmarked confined spaces on your own vessel regardless of whether or not they are identified as such in the SMS and, if possible, add them to the SMS.

Confined spaces should be covered in your shipboard familiarisation when joining a new vessel. If they are not, then ask about them.

When considering what may be a confined space consider what sort of hazards may be present and how they might be mitigated.

Note that the hazard that a confined space may present to adjacent spaces to which they may be connected: A seafarer died in his cabin after phosphine gas was transferred through corrosion pinholes from the adjacent cargo hold which had been fumigated; In 1999 four seafarers died in two indents in which phosphine gas had permeated through inadequately sealed hatches into duct keels; Two seafarers died while working in a forward stores compartment due to oxygen deficient air entering the compartment through damaged ventilation trunking; one seafarer died and another was overcome but survived in a stairway trunk into which carbon monoxide had leaked through unsealed hatches leading to a cargo of wood pellets.
'Adjacent' may even include the main deck. Incidents have occurred in which a manhole cover had been removed and the atmosphere inside escaped, resulting in seafarers being enveloped in a cloud of oxygen deficient air rendering them unconscious. While no permanent injuries were caused there remains the potential for serious injury.

Even an area of the maindeck may, under certain circumstances, become a confined space and meet the criteria of the International Maritime Organisation:

confined 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;"
Quiz 3

1) Confined spaces are:
   a) Only those spaces designated as confined or enclosed in the ship’s SMS.
   b) Only those spaces marked by signage as confined spaces
   c) Any space which, at the time of entry, meets the three main criteria of difficult access, poor ventilation, not designed for continuous occupancy.
   d) Those spaces designated as confined or enclosed in IMO Resolution A.864(20), Recommendations For Entering Enclosed Spaces Aboard Ships

2) You are asked to work in a space in which you have worked before. On the previous occasion the space was determined not to be a confined space. Which of the following applies:
   a) It is safe to assume that it is still a non-confined space and no confined space procedures need to be followed.
   b) The space should be re-assessed to determine whether it meets confined space criteria
   c) It is not a confined space unless an officer says it is and so is safe to enter unless otherwise told.

3) Which of the following should you consider when determining whether or not a space should be designated a confined space:
   a) Ventilation
   b) Ease of access
   c) How often it is worked in
   d) Whether or not rescue of a casualty from the space through the access will be difficult.
   e) All of the above.

4) You are to work in the bowthruster room and you test the atmosphere. There are no toxic fumes and oxygen is at 21 per cent on the meter. A small portable fan has been placed at the outlet of a pipe carrying air into the space. Next you
   a) Check that plentiful air is entering the space from the pipe and turn on the fan
   b) Check that adequate air is being pumped into the space and is being drawn from the space
   c) Make sure than the fan works and keeps you cool

5) When working in a non-confined space you should
a) Take no special confined space cautions

b) Check whether any adjacent spaces present explosive or toxic atmosphere hazards and test for them in the non-confined space.

c) Ensure that ventilation in the non-confined space is not compromised and cannot vent oxygen deficient, toxic or explosive gases into the non-confined space.
Confined Space Hazards

Among the hazards associated with confined spaces are:

1) Lack of Oxygen/Oxygen Depletion

We need the air we breath to contain about 21 per cent oxygen by volume, actually 20.8 per cent, otherwise we die. Although you will find references to 19.6 per cent being ‘breathable’ but that may indicate that more than 1 per cent of the oxygen has been replaced by something else which may be toxic.

The body needs oxygen for muscles and the brain, especially, needs oxygen to function properly. Symptoms of lack of oxygen include fatigue, a lack of co-ordination, poor co-ordination, a sense of being ‘drunk’ and tunnel vision but if the level of oxygen is sufficiently low the first symptom may well be almost immediate unconsciousness.

This applies regardless of training, certification, rank, age, experience or years at sea.

Oxygen-depleted air - Air with a low level of oxygen - smells the same as air with oxygen. If the level of oxygen is lower than 8 per cent you can fall unconscious in a matter of seconds and die in minutes. Being returned to fresh air while unconscious may fully revive you, lower levels of oxygen will result in permanent brain damage.

Causes of Oxygen Depletion

Rust: Rust is the result of metal, typically steel, and oxygen in the air combining to form an oxide. The salty, damp marine environment encourages rust. In a space which has been closed for some time, or in which there is little ventilation, the oxygen will be drawn from the air in the space.

Typical areas in which oxygen depletion due to rusting can occur are the anchor cable locker and cargo holds.

Cargo reaction: A wide variety of cargoes will interact with air and absorb oxygen or oxidise in its presence. Wooden pellets, rusting metal scrap and spontaneously-combustible metal turnings have all been involved in confined space incidents in cargo holds.

Displacement: Nitrogen is commonly used to pad liquid cargoes, including chemicals and oil products, to prevent oxygen mixing with flammable vapours to a level at which fire or explosion can occur if a spark or other source of ignition is present, call the Lower Explosive Limit or LEL. Similarly, nitrogen may be used to displace oxygen from an empty hold which has contained flammable liquid products for the same reason.

Nitrogen is used because under normal conditions it does not react with other substances and is called an 'inert' gas, hence the term 'inerting' when using nitrogen. An inerted atmosphere in a tank will not contain enough oxygen for you to survive.

Oxygen depletion may be caused by gases evolving from other processes. A sacrificial anode in a ballast tank may produce enough hydrogen to reduce the amount of oxygen in the tank to hazardous levels while at the same time presenting an explosion hazard.

No facemask filter provides protection against lack of oxygen.
Air inside a confined space may not be homogeneous. Oxygen concentration in one part of the space may be different from that in another. Oxygen test meters may, for instance, record 21 per cent immediately inside the accessway but this may drop to, say, a hazardous level of 5 per cent a metre lower down.

Note that an atmosphere may be oxygen deficient yet still support combustion. Hydrogen, for instance, has an upper explosive limit of 76 per cent. Such an atmosphere would only contain about 5 percent oxygen. This must be considered during rescue operations.

Before entry, it is important to test the atmosphere in the top third, middle third and bottom third of the space as well as side to side of the access.

1a) Oxygen Enrichment

If a source of oxygen is present, such as when carrying out hotwork with oxyacetylene equipment, it is possible for a leaking oxygen hose to result in significantly raised oxygen levels in the space. In such cases a material that might normally just smolder and extinguish itself can burst into flames. Incidents have occurred in which seafarers have been seriously injured when clothing has caught fire in such circumstances.

2) Explosion/Fire

Many substances commonly used or found aboard ship are flammable, such as some cleaning chemicals and solvents used in coatings and paints while a number of processes can evolve flammable gases.

Solvent from epoxy coatings applied in a poorly ventilated space have exploded and caused multiple fatalities. In another case hydrogen evolved during the chemical cleaning of a boiler – a confined space – and exploded causing a fatality when a non-intrinsically safe lamp was put inside the boiler.

Explosive vapours may be more dense, or 'heavier', or less dense, or 'lighter' than air and gather in low areas, especially corners, or in the upper parts of a space. In such cases an explosive atmosphere may be present above or below a level of safe air. The atmosphere in the space may not be homogeneous: there may be invisible 'clouds' of explosive air/vapour (or gas) mixture within an otherwise breathable atmosphere.

If an explosive vapour or gas may be present it is important to test in the top, middle and bottom thirds of the space and to the sides of the accessway.

Note that an atmosphere may be both explosive and oxygen deficient. Hydrogen has an upper explosive limit of 76 per cent. Such an atmosphere will only contain about 5 per cent oxygen. This must be considered during rescue operations.

There is no personal protective equipment which will provide protection against an explosive atmosphere.

3) Toxic Gases/Vapours

Toxic gases or vapours produce chemical reactions that prevent the human body functioning as it should and inhalation may lead to death. Carbon Monoxide, for instance, displaces oxygen in the blood, effectively suffocating the victim while many solvents and insecticides act on the nervous system and others suppress breathing.

Some toxic gases or vapours may have a distinct smell at low concentrations: Hydrogen Sulphide has an odour of bad eggs, phosphine has a 'garlicky' smell. The absence of the smell
does not indicate the absence of the gas: At lethal levels Hydrogen Sulphide, for instance, disables the sense of smell while other smells can be masked.

Examples of incidents involving toxic gases/vapours include the death of a cargo surveyor from poisoning by phosphine gas evolved from pellets used to control pest in cereals; Two fatalities in a bow thruster room where an 'electric cleaner' solution was being used in a poorly ventilated space; several seafarers fell unconscious while cleaning a hold recently emptied of coconut oil due to carbon monoxide created by a heater used in the hold to keep the coconut oil liquid in a cool climate.

Air in a confined space may not be homogenous and 'clouds' of invisible toxic vapours or gas may exist. Some vapours or gases may be denser than air, less dense than air, or the same density. Should the presence of a toxic vapour or gas be suspected it is important to test the top, middle and bottom thirds of the space and to the sides of the space.

Be familiar with mandated exposure limits.

Multigas detectors to cover, at minimum, oxygen, carbon monoxide, hydrogen sulphide as well lower explosive limit are recommended for general use. Spare multigas detector cartridges should be carried.

Filter masks may provide protection but only if the correct filter for the specific vapour or gas is used. Neither dust nor particulate filter masks will provide protection against toxic vapours or gases.

4) Work At Height

Entry to, or work in, a confined space may also involve work at height and the same precautions and procedures must be applied and personal protective equipment worn, such as the use of a fall arrester and hard hat.

Two examples make the point: A Chief Officer entered a ballast tank and apparently slipped from a stringer and fell eight metres to his death; an AB climbing a tall ladder, which was not equipped with safety hoops, to exit a hold where he had been spraying dilute hydrochloric acid, slipped and fell, struck the tank top below with his head and died. Neither wore a fall arrester and, in the last instance, was not wearing his hard hat properly with the result that it fell off during his fall, denying him its protection.

The same personal protective equipment should be used for work at height within a confined space as for work at height from, for instance, the main deck.

6) Entrapment

Certain confined spaces may become hazardous by entrapment – be someone being caught inside and unable to escape. One incident of this kind was the death of a young officer who had entered a scavenge air unit and was unable to escape after the main engine was operated.

No personal protective equipment will defend a seafarer from entrapment.

7) Engulfment

Some cargoes, such as grain and coal may present an apparently firm surface which can give way causing a person to sink into it, or be engulfed and die of suffocation.

8) Environment

Part 1 Principles of Safety in Confined Spaces
Environmental factors such as rain or a heavy seaway may create hazards within a confined space. Even a small amount of rain can make access ladders slippery and the movement of a ship can make it difficult to move safely.

9) Rescue

Rescuing unconscious or injured persons from a confined space is always challenging and time-consuming, reducing the chances of a casualty’s survival.

More tragically, a large number of seafarers have died, and continue to die, while attempting to rescue comrades in distress without using the correct procedures. It is important to bear in mind that entry into a confined space not only puts one’s own life at risk but also the lives of who may attempt to rescue you.

If you enter a confined space without the correct preparations and procedures or without the appropriate personal protective equipment you risk not only your own life and well-being but also those of your shipmates who may try to save you.

10) You

Entering and working in a confined space can be arduous and can make existing health and fitness problems worse. Someone who is unfit, under certain medication, has a heart problem or overweight is likely to be more at risk from the difficulties of entering and working in a confined space, more likely to trip, slip or fall with the movement of the ship and more likely to be affected by atmospheric threats.

They will also have a lower chance of rescue and survival if something goes wrong.

Only those who are fit, healthy and well rested should enter a confined space.

Note that this also applies to those who are not members of the ship’s crew, such as third party contractors, surveyors and other who may require entry into a confined space.

Anyone who believes that seniority or decades of experience means that they need not follow safe entry procedures should neither be allowed to enter a confined space nor supervise others who do.
Quiz 4

1) Your oxygen meter shows that a confined space atmosphere consists of 19.6 per cent oxygen. This shows:
   a) It is positively safe to enter the space
   b) It is positively unsafe to enter the space
   c) The atmosphere should be tested for toxic or explosive gases
   d) The space should be ventilated until the meter shows an oxygen level of almost 21 per cent
   e) A filter facemask should be worn

2) If you can't smell it, it can't do you harm
   a) True
   b) False

3) You open the anchor cable locker and notice heavy rust. Which if these should you suspect to be present
   a) Explosive gas: Methane
   b) Toxic gas: Carbon Monoxide
   c) Oxygen deficient atmosphere.

4) Work at height safety procedures are never necessary when working in a confined space:
   a) True
   c) False

5) You are to check the vessel's CO2 room. Before entry you should ensure:
   a) The door is secured open
   b) All CO2 release valves are closed
   c) CO2 bottles are properly secure
What is 'Entry into a Confined space'?

When any part of the body passes the plane of the access, entry into a confined space has taken place because you are now exposed to the hazards within the confined space.

If you put your head through an access you will be exposed to any toxic fumes or oxygen deficiency inside that space.

If you put your hand into a confined space containing explosive gases or vapours, and you happen to be holding a non-intrinsically safe or non-explosion-proof lamp, you will, again, be exposed to the hazard of fire or explosion.

Remember that explosive or toxic gases or oxygen-deficient atmospheres can harm you even if no part of your body has entered the confined space. Consult the relevant Job Safety Analysis or conduct a risk assessment before opening access to a confined space.

Persons who have not demonstrated the competencies required to safely enter and work in a confined space, or whose competency to do so has not been assessed must not be allowed into confined spaces, be part of a confined space entry work team or participate in a confined space entry rescue.
Quiz 5

Which of these statements are false:

a) Any person possessing a relevant certificate of competency can be assumed to be competent to enter a confined space safely.

b) A JSA should be consulted or a risk assessment carried out before opening access to a confined space.

c) Rank and/or years of sea experience are satisfactory indicators of a person's competency to safely enter and work in an enclosed space.

d) A confined space entry has taken place when any part of the body is inside the confined space.

e) It is not necessary to have rescue equipment on standby if you’re only going to put your head inside the confined space.

f) Only persons of demonstrated competency should be members of a rescue team.
Handling The Risk

The potential for death for injury in a confined space can be significantly reduced by following the correct procedures and wearing the appropriate personal protective equipment and ensuring that others do, too – after all, you may be called upon to rescue them if they don't follow correct procedures.

Training

The objective of training is to ensure that you have sufficient knowledge to enter and work in a confined space with as little risk as reasonably possible.

Training must include confined space entry as well as confined space rescue procedures.

Regardless of the type of training provided – onboard, onshore, computer based, video, a formal training environment or a book like this one - no training will help you unless it is put into action. It is your responsibility to follow the recommendations given in your training and to ensure that others do so as well.

Remember that others may follow your example, especially if you are an officer or other person with leadership responsibilities, so make sure it is a good example. Bad examples are bad leadership.

Confined space entry procedures on your ship may be more stringent than recommended in training courses but must never be less stringent.

Even if you have already undergone training in confined space entry it is wise to review the shipboard training resources and materials occasionally. If time permits, do so just before carrying out the confined space entry - you might be surprised at just how much you're forgotten.

Drills – Confined Space Entry

The objective of drills is to give the seafarer practical experience, and get the seafarer accustomed to, correct entry into a confined space, working in a confined space and rescue from a confined space. By being accustomed to carrying out confined space operation safely the seafarer is more likely to be aware of the need for safe entry, gain familiarity with the procedures and equipment which help ensure safe entry and be more aware of any shortfalls that occur.

At time of writing the International Maritime Organisation does not mandate confined space entry drills but they may be required by a vessel's flag state or by the ship's safety management system.

Regardless of any mandatory requirement, a prudent master of a well-run ship will ensure that such drills are carried out at regular intervals.

Drills should be as realistic as possible and include all those factors that promote safety, including completing a safe entry permit, toolbox talks, atmosphere testing, donning Personal Protective Equipment, using of fall arrest systems and rescue harness, and conducting a safe entry.

Drills – Confined Space Rescue
Confined space rescue drills ensure that seafarers have practical experience in competencies required to carry out the rescue of an injured or unconscious person from a confined space to a place of safety where full medical assistance can be provided.

Removing a person from the place where an incident occurs to a place a hazard still exists – for instance, from one confined space containing toxic fumes to an adjacent space where the same fumes are still present, is not a rescue. Rescue has only taken place when both victim and rescuer are in a place of safety.

Confined space rescue drills must be realistic and take into account:

- The possible need to provide immediate first aid to an injured or unconscious person in case of bleeding or broken bones, the giving of oxygen, and on the assumption that a casualty may also have spinal injuries;
- The need to recover an injured or unconscious person on a stretcher, or otherwise immobilised, through a small access way such as a manhole.
- The need to be able to conduct both vertical rescues, where the point of exit is above the victim, and horizontal exits.
- The need to perform a rescue in the presence of toxic or explosive fumes or gases.

Only trained personnel may be part of a rescue team or permitted to attempt a rescue.

**Personal Protective Equipment**

The appropriate personal protective equipment will depend on the circumstances of the confined space but will always include a hard hat properly worn – a hard hat that can fall off is itself a hazard.

It will include personal oxygen and toxic/explosive gas or vapour monitors.

Where a specific atmospheric threat may be present, or suspected to be present, then an appropriate filter mask or breathing apparatus must be worn until the space is proven safe.

If working more than 1 metre above a surface such as a deck ensure appropriate fall arrest-restraint equipment is used. Those using such equipment must have demonstrated competency in use and wearing.

**Procedures**

Paperwork, policies and procedures are there to provide a safety net for those who work in confined spaces. They should never be regarded simply as bit of paper to be filled in – your safety may depend on them.

**Job Safety Analysis**

Like any other shipboard task, a job safety analysis, JSA, must be carried out for every specific task to be carried out in each identified confined space under specified conditions.

Each JSA will identify the hazards and the means of mitigating those hazards by following appropriate procedures or the use of appropriate equipment, including personal protective equipment and equipment and procedures for rescue should there be a casualty within the space.
If any part of the job changes, or there is a change in the conditions under which the job is to be done, then a new Job Safety Analysis must be performed.

Even small changes in the conditions under which an entry is made may have a significant effect.

For example: Weather is dry and fine. An AB enters a hold through a manhole cover on the main deck which remains open. The vessel runs through a squall and a small amount of rain enters through the manhole. There is now an increased potential for the seafarer to slip on a wet patch and be injured, or for the seafarer's hand or feet to slip off the wet rungs of a ladder while trying to exit.

Be alert to changes in your 'personal space'. A seafarer might be working in a hot and humid space such as a cargo hold while wearing heavy rubber or neoprene gloves. Perspiration builds up in his gloves, providing lubrication. While still wearing the gloves the seafarer attempts to climb up a ladder to exit the space, his hands slip out of the gloves and he falls.

**Confined Space Entry Permit**

To protect seafarers a confined space entry permit is required before any work is carried out in a confined space. It must be checked and signed by a competent person.

One of its most important functions is to ensure that someone knows you are in a confined space and at potential risk.

A confined space entry permit will include:

- The names of those entering the space
- The work to be done and how long it is expected to take.
- The equipment required to do the work
- Ensure that a safety assessment of the work has been done by a responsible person
- A checklist of equipment and procedure to be used to ensure the safety of the seafarer entering the confined space.
- A checklist of personal protective equipment
- A checklist of rescue equipment, such as self-contained breathing apparatus, required to be immediately available
- Communications equipment to be available, such as VHF radios.
- An expiry time after which a new permit must be issued.

A new permit must be issued each time a space is entered. If work is suspended, for instance for a meal break, a new permit must be issued before the confined space is entered again.

**Toolbox Talk**

A toolbox talk is the final briefing before work begins and ensures that seafarers entering a confined space are as safe as reasonably practicable while they work.

A toolbox talk will cover:

- Who is going to do the job
- How they are going to do it
- What personal protective equipment they require
- What tools they will use
- What to do if circumstances change or an unexpected hazard is discovered.
- What emergency procedures are in place
- What to do in case of emergency
- A review of the Job Safety Analysis to ensure that it remains valid and all conditions covered still apply and that there has been no change in the type of work, the equipment used, the hazards faced or the mitigation required.
Quiz 6

1. The objective of confined space entry training is:
   a) To get a certificate that shows that you are competent to enter and work in a confined
   b) Satisfy the requirements of the IMO
   c) To give you a better chance of entering and working in a confined space with causing
   harm to yourself or others.

2. An officer wants to check whether a previously inerted tank has been cleaned properly. He asks you to go with him. He assures you that he has a lot of experience and that it is safe to just hold your breath when entering the tank. Which of the following should you do.
   a) Hold your breath and enter the tank with him.
   b) Enter the tank with an emergency escape breathing apparatus ready, just in case.
   c) Refuse to enter unless the procedure is approved in the ship’s SMS.

3. Checklists, Job Safety Analyses and Risk Assessments are:
   a) Critical parts of keeping you as safe as reasonably possible.
   b) Just part of the paperwork required by insurers, the IMO and flag states.
   c) Unnecessary workload because you already know how to enter a confined space safely.

4. A job safety analysis is no longer valid when:
   a) It is past its expiry date
   b) When a new crew comes aboard
   c) When any of the conditions of the analysis change.

5. Once a task has started there is never any further need to re-assess the risks.
   a) True
   b) False

6. A confined space entry permit is only valid
   a) Until expiry
   b) While there is continuous occupation of the confined space
c) For 24 hours.
Preparing to Enter a Confined Space

A confined entry team consists of a minimum of two persons: One or more persons to carry out the task inside the confined space and never less than one person on safety watch/monitoring. Only persons with demonstrated competencies in entering and working in a confined space should be allowed to do so.

Pre-Entry Measures

Measures taken before entry are intended to ensure that a confined space may be entered and worked in with as little risk as reasonably possible.

Typically, the preparation will consist of:

1. A preliminary assessment, by a person of demonstrated competency, of the confined space and the work to be done. The assessment will have one of three results:
   a) A risk to health or life is present, for example a toxic or oxygen deficient atmosphere.
   b) No immediate risk to health or life but a risk could arise during work in the space, such as the evolution of explosive solvent fumes while coating a bulkhead with paint.
   c) The risk to health or life is as low as reasonably possible.

   Include in the assessment any hazards that may be present but not necessarily specific to confined spaces such as oil, grease or water that may present a slipping hazard, low obstructions that may lead to trips, low overhead obstructions, and ladders that may require word-at-height precautions while being climbed. These, too, will need mitigation measures.

   In the case of a) the risks must be mitigated until the assessment is b) or c). If that is not possible, the space should be entered only for further testing and only when:
   - It is absolutely and immediately necessary for the safety of the vessel, its crew and its operation.
   - No alternative exists.
   - Only trained personnel should enter the space and only if equipped with appropriate personal protective equipment, such as a Self-Contained Breathing Apparatus or airline and, preferably, a rescue harness and other equipment as necessary for safety.
   - All rescue equipment is in place, a rescue team is alerted, and all other confined space entry procedures are followed.

2. Ventilating the space to remove toxic or flammable gases or vapours and ensure sufficient oxygen in the space.

3. Testing the atmosphere in the space:
   - with an oxygen meter to ensure that oxygen is 21 per cent by volume with a steady reading throughout the space.
   - If toxic gases or vapours are suspected to be present, with an appropriate instrument to ensure that levels are at or below recommended occupational limits given in relevant national or international standards throughout the space.
• if a flammable gas or vapour may be present, with an explosimeter/combustible gas
detector to ensure that the level is at or below 1 per cent of the Lower Flammable Limit
throughout the space.

It must be remembered that pockets of oxygen deficient air or toxic or combustible gases may
exist in a space.

4. Ensuring that the space is properly illuminated
5. Ensuring that resuscitation and rescue equipment is in working order and placed close to the
point of access available for immediate use.
6. Ensuring that a means of communication, such as VFH radio, is available, especially b
between the safety watch and the bridge, and tested working.
7. Establishing direct and clear communication with the person assigned to lead the rescue
team in an emergency.
8. Alerting the rescue team.
9. Assignment of one or more safety watchers to monitor those working inside the confined
space.

Where the person or persons inside the space are continuously in line-of-sight from the point
of access, one safety watcher may be assigned, positioned outside the space. Of the person
or persons working inside the space are not continuously visible from the access way a
second safety watch should be set inside the space close to the point of access and
equipped with a means of communication.

The safety watch’s task is to call for help in event of an accident in the confined space.
Under no circumstances must a safety watcher attempt a rescue until help has arrived: It is
difficult to rescue one person from a confined space if a second person requires rescue
because he or she has attempted to rescue someone then the life of that someone is put at
even greater risk.

10. Equipment to be used in the space and tested to be in good working order.
11. Persons entering the space are properly equipped for entry and work within the space.
12. Appropriate ventilation is rigged for the space
13. A confined space entry permit is issued.
14. A toolbox talk
15. Final approval for entry is given by the master or nominated person.

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Quiz 7

1) A preliminary assessment before entry into a confined space should consider:
   a) Only those hazards specific to confined space entry and work.
   b) All potential risks, whether or not specific to confined spaces
   c) Only immediately present hazards.

2) The preliminary assessment determines that a risk to health or life is present, for example a toxic or oxygen deficient atmosphere. This means:
   a) Entry and work may proceed provided appropriate PPE is worn.
   b) Approval is required from head office.
   c) That entry should be made only for further testing, only if there is an immediate risks to the crew, the ship or its operations, and only if all appropriate safety procedures are in place.

3) If tests show the space is oxygen deficient, there is no need to test for an explosive or toxic atmosphere.
   a) True
   b) False

4) If oxygen is about 21 per cent in the centre of the space there is no need to test the rest of the space.
   a) True
   b) False

5) A toolbox talk
   a) Reviews the task
   b) Makes sure that everyone understands what they are expected to do
   c) Checks that equipment has been tested and is in working condition.
   d) Ensures that rescue equipment is in position.
   e) Ensures the rescue team has been alerted
   f) Makes sure the JSA is still valid
   g) all of the above
Entering and Working in a confined Space

The Nevers:

- Never enter or work in a confined space unless at least one safety watcher/monitor is in place.
- Never enter or work in a confined space unless rescue and resuscitation equipment is in place.
- Never enter a confined space without the knowledge of a person in authority.

The Do's:

- Do wear the appropriate Personal Protective Equipment and wear it properly
- Do ensure that the equipment being used within the space is in good condition.
- Do carry a personal low-oxygen alarm device/multigas detector, if available.
- Do check oxygen levels regularly
- LOOK AROUND YOU. Corrosion, oxidation, rotting organic matter can all indicate hazards such as pockets of gases.

At the very least, the first person to enter the space should be equipped with a portable oxygen monitor.

On Safety Watch:

- Never leave your position, under any circumstances, while someone is in the confined space
- If an accident occurs, never enter the space unless help has arrived and the correct equipment is worn.

Work you do in a confined space may change the conditions in the space. Hot work, for instance, may deplete oxygen in the space unless there is adequate ventilation, resulting in oxygen depletion. Solvent from paint being applied in a space may result in an explosive atmosphere that could, and has, resulted in explosion or fire.

If work is suspended, for a meal break, for instance, and the confined space vacated then a separate confined space entry permit must be issued before the space is re-entered.

If you work safely in a confined space you protect not only your own health and life but those of your fellow seafarers.

Those on safety watch/monitoring should be alert to any potential changes in the conditions under which the work is done. They should also maintain contact with those working the space.
and watch for any symptoms that might suggest that those within the space are being affected by oxygen deficiency or toxic gases/fumes.

As the safety watch/monitor you have absolute authority to order someone out of a space if you consider them at risk. You have no authority to enter the space.
Quiz 8

1) You are safety monitoring work in a confined space. You are told by the engine room that a bursting disk has blown and your assistance is immediately required. Do you:
   a) Alert those inside the space that you are leaving and proceed to the engine room.
   b) Tell the engine room that you are on safety watch, request a relief and proceed to the engine room.
   c) Request a relief, order the confined space to be evacuated and wait for your relief before allowing anyone to enter the space again.
   d) Request a relief and continue monitoring until the relief arrives, brief the relief, then proceed to the engine room.

2) You are working in a confined space and realise that you cannot see the safety monitor from your position. Do you:
   a) Move your position and make sure he or she is still outside, then go back to your previous position and continue working
   b) Shout out and ask if the safety monitor is still awake.
   c) Stop work, exit the space, make sure the safety monitor is there, if so, return and keep working.
   d) Stop work, exit the space and request a more alert safety monitor.

3) You are on safety watch and see the person inside the confined space collapse. Do you:
   a) Alert the rescue team, don breathing equipment and enter the space to begin the rescue
   b) Make sure rescue and retrieval equipment is ready for use and wait for the rescue team
   c) Hold your breath, go into the confined space and do what you can.

4) While monitoring someone working inside a confined space its clear they're having a problem putting a spanner on a nut, then they drop the spanner. You talk to them by radio or voice but you can't quite make out what they're saying. Do you:
   a) Keep asking until you get a response you understand
   b) Go into the space to make sure they're okay
   c) Order the person out of the space and alert the rescue team
   d) Alert the rescue team then go into the space to see if the person is okay.
Confined Space Rescue

Rescue is the process of removing a casualty, or potential casualty from a place of danger, with the least possible risk to the rescuer, to a place of safety where first aid can be applied and from which evacuation to an appropriate medical facility can be carried out.

Typically this means removing a casualty from a confined space to the main deck where CPR is applied and from where the casualty is evacuated to a shore-based medical facility for further treatment and recovery.

The same initial consideration is required as when considering entry into a confined space – is it necessary? At sea, it almost always will be but when alongside, and provided that the atmosphere is safe and has sufficient oxygen and contains toxic or explosive vapours, consideration should be given to maintaining the casualty in place until shore-based rescue services can be summoned.

By its nature, rescue from a confined space is inherently hazardous both for the casualty and the rescuer.

A successful rescue from a confined space without putting others at risk requires appropriate training, appropriate experience thorough drills, appropriate equipment and, above all, discipline,

Rescuing a casualty from a confined space is challenging and presents significant hazard both to the rescuer and the casualty. Some 60 per cent of confined space casualties are persons who have attempted to rescue another person alone and without the correct equipment.

Never attempt a rescue alone, even with the correct equipment. By definition, access and exit from a confined space is difficult and to manhandle an unconscious, injured or confused casualty out of the space alone is at best so time-consuming that the chance of a casualty’s survival is significantly lessened while the risk to your life and health, at worst it will result in your also becoming a casualty and create a situation in which the person you attempted to rescue dies because other rescuers must concentrate on rescuing you – and you may become a fatality, too.

In a related issue, it is usually only possible to rescue one person at a time from a confined space.

If there is more than one casualty in a confined space it is necessary to carry out triage, the person most likely to survive, the person more likely to survive, who must be rescued first, so by waiting for trained and properly equipped help you are increasing the chances of saving your fellow seafarer’s life.

Only persons with demonstrated competencies in confined space rescue should attempt to recover a casualty from a confined space.

A rescuer’s primary responsibility is to his or her own safety. It is not a rescuer’s job to put themselves at any more risk than is absolutely necessary.

Rescue Equipment
Rescue equipment onboard your vessel will partly depend on ship type and cargo but the following should be considered a minimum:

Breathing apparatus – airline or self-contained for two persons
Handlamp/flashlight – intrinsically safe/explosion proof
Safety/retrieval harness
Safety/retrieval line
Retrieval tripod
Communications equipment such as VHF radio
Stretcher/Litter appropriate for recovery from a confined space – Neal-Robinson/Stokes

Rescue Levels

There are three rescue levels:

Self-Rescue – When a potential casualty can exit the space without assistance. This is the safest form of rescue. If you feel unwell, tired, confused or have difficulty doing a simple job, such as putting a spanner on a nut, are warned by a safety monitor, or become aware that ventilation has stopped, you must exit the space immediately.

If you are the safety monitor/watcher you have the authority to order someone out of a space if you consider that person to be at risk. For instance, you may become aware that they seem unco-ordinated or not behaving or responding to you appropriately, you have the authority to order that person out of the space. You have no authority to enter the space.

Non-Entry Rescue – Rescue carried out by use of a pole, rope, or other equipment which enables rescuers to gain hold of the casualty and bring the casualty to the point of access. This is easier if the casualty wears a recovery harness while working.

Non-entry rescues are safer for the rescuer but rescuers may still be affected by oxygen deficient, toxic or explosive atmospheres which may leak out of the space and appropriate equipment such as breathing apparatus should be worn.

Whenever possible, non-entry rescues are preferred to entry rescues.

Non-entry rescues usually require recovery equipment.

Entry rescue – Requires the entry of one or more rescuers into the space. It is the most hazardous and challenging. They should only be carried out when absolutely no other alternative is available.

When making an entry rescue it should be assumed that atmospheric hazards are present unless positively proven otherwise.
Some 60 percent of confined space deaths and injuries are of persons who have attempted to perform a rescue without the appropriate equipment or training.

Breathing apparatus should always be worn when conducting an entry rescue. Emergency escape breathing devices, EEBDs, should not be used by rescuers – EEBDs do not have sufficient airtime to conduct a rescue and fatalities have occurred when they have been used as an alternative to breathing apparatus.

The rescuer should also be attached to a safety/retrieval line to allow for recovery should he or she become incapacitated.

If the entry to a space is too small to admit a rescuer wearing an air tank the rescuer enters the space breathing through the BA mask with a second person holding the tank. Then the second person passes the tank to the rescuer through the opening. An airline may also be used.

Entry rescue must be practiced in realistic drills and must include the recovery of an unconscious person wearing breathing apparatus on a stretcher through a narrow accessway both vertically and horizontally.

Only persons with appropriate knowledge, training, appropriate equipment properly worn and demonstrated competence in confined space entry rescue should be permitted to carry out such a rescue.
1) The most common casualties of confined space incidents are:
   a) Rescuers
   b) Initial casualties
   c) Shore-based rescue personnel

2) Your friend collapses in a confined space. You rush in to rescue him. Which is the most likely outcome:
   a) You will rescue your friend
   b) Your friend dies because rescuers have to rescue you first

3) When considering entering a confined space to conduct a rescue your first consideration must be:
   a) How much air is in the SCBA cylinder
   b) Can the rescue be done without entry
   c) How many people you have in the rescue team.

4) Person participating in an entry rescue must be:
   a) Anyone nearby so long as their English is good.
   b) Only senior officers
   c) Only persons with the demonstrated and verified competencies necessary to conduct a rescue.

5) While conducting a rescue you discover that you cannot get through a small opening while wearing SCBA. Your options are:
   a) Use an airline
   b) Get a smaller crew member to wear the SCBA and enter the space
   c) Use an EEBD
   d) Remove the tank and while another crew member holds the tank breath through the
      facemask, enter the space, have the tank passed through to you then re-don the tank.