Entry into enclosed spaces

Every day seafarers risk their lives by entering enclosed spaces without using the correct entry procedures.

This *Signals* special feature aims to provide yet another reminder about the correct procedures which must be followed before entering an enclosed space to be sure of coming out alive.

Included in this feature is the text of the IMO's Recommendations for Entering Enclosed Spaces Aboard Ships [Resolution A.864(20)], which contains advice on assessment of risk, testing of atmospheres and precautions during entry. It also covers hazards related to specific types of cargo, including oxygen-depleting cargoes and materials.

The advice within the guide has a straightforward aim, that of protecting personnel through the safe and proper implementation of entry procedures - from the correct identification of a confined or enclosed space through to atmospheric testing, safe rescue procedures and an appreciation of the hazards to found within such dangerous spaces.

Safe working in enclosed spaces must be a top priority within a vessel's safety management system. But accidents, sometimes involving highly experienced personnel, continue to happen despite the introduction of modern safety management systems, procedures and techniques.

Deaths still happening

Few aspects of personal safety on ships have received more attention than the importance of following the correct procedures before entering an enclosed space. Unfortunately, fatalities and serious injuries continue to happen with relentless regularity - almost every one of which could have been prevented if the correct procedures had been followed.

Serious efforts have been made by many different sectors of the shipping industry to raise awareness of the dangers of entering enclosed spaces - indeed, *Signals* has regularly featured this important topic. Despite all these efforts, the death toll continues to mount.

The story behind the majority of incidents is all too familiar. One person enters an enclosed space without having taken the necessary precautions then collapses from either lack of oxygen or toxic fumes. The collapsed person is then seen by a second person who, without taking any precautions, attempts a rescue and he or she also collapses. It is not unknown for even a third or fourth person to be overcome in the same way in the belief that they can do better. Eventually, someone starts thinking straight and follows the correct procedures. An emergency party, with the correct rescue equipment, is mustered and carries out a controlled rescue. Unfortunately, the emergency party usually brings out dead bodies.

What is most surprising is that enclosed space accidents appear to involve a wide range of people, including highly qualified and experienced seafarers as well as stevedores and even surveyors. It is perhaps understandable, from a human point of view, to appreciate that one's first reaction on seeing a collapsed colleague is to rush to their assistance. Whilst the intention is good, it is virtual suicide - compounding an already tragic situation.

Almost all the people who die in enclosed spaces have received training and are well aware of the correct procedures. In the agony of the moment, they choose to disregard those procedures.

Making the same mistakes

It is vital to stress the fact that an unplanned rescue will most likely end in tragedy as personnel repeatedly rush into lethal atmospheres under the misconception that they will be able to save colleagues. According to the International Association of Classification Societies (IACS) over 50% of the workers who die in confined spaces are attempting to rescue other workers.

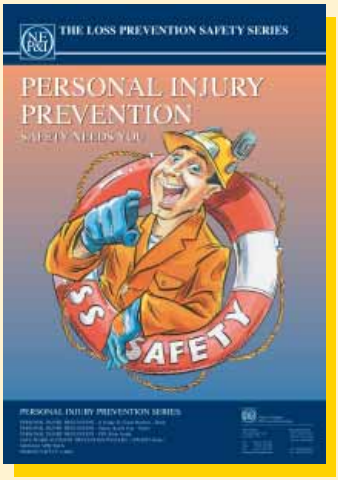
It is also vital to remember that personnel should never trust their senses to determine if the air in a confined space is safe. Many toxic gases and vapors cannot be seen or smelt, nor can personnel determine the level of oxygen present without properly testing the atmosphere.

Letting your guard down just once can be fatal – vigilance saves lives and adherence to this advice will underpin any existing efforts to enter enclosed spaces safely.

How big is the problem?

It is difficult to obtain any meaningful statistics from across the international maritime industry on the extent of the problem of enclosed space accidents. The North of England P&I Association experiences a number of these incidents each year. Reports from the Marine Accident Investigation Branch (MAIB) of the British Government and the Seafarers' International Research Centre are inconclusive as far as exact numbers of incidents are concerned. They confirm however that a significant number of incidents are continuing to occur and the same scenarios continue to repeat themselves.

The issue is not so much how many incidents occur - it is the fact that they are continuing to occur in relatively significant numbers which is sufficient to generate serious concern. Furthermore, of all the accidents which occur on board with a real risk of fatality, there are probably none which are more preventable. Almost every single enclosed space incident could have been avoided if the correct procedures had been followed.



What training is needed?

Because many people tend to respond to instinct rather than what they have been told, theoretical training should be reinforced by frequent practical drills and exercises involving the whole crew. Practice does not just make perfect, it also makes permanent and instinctive.

Posters can also help people remember what they have been taught. As part of the North of England "If only..." campaign, an Entry into Enclosed Spaces poster was distributed with Signals issue 55.

Who can fix it?

We all need to make a personal commitment to raising safety to the highest priority. We must work to develop a culture on board whereby our first instinct is safety. Only then will the rules and regulations stand any chance of working in practice.

It is vital to explore why these unnecessary accidents continue to happen and what needs to be done to prevent them happening again and, by instilling knowledge and discipline, lives can be saved.

Will more rules and regulations solve the problem?

In the UK, the Merchant Shipping Regulations state that procedures for ensuring safe entry to, and working in, dangerous spaces should be clearly laid down by the ship operators and that the master should ensure such procedures are observed on board ship.

The regulations further state that, except where necessary for entry, a ship should ensure entrances to unattended dangerous spaces are either kept closed or otherwise secured against entry.

Other flag administrations have similar rules and regulations. Whilst the ISM Code does not contain such explicit rules and regulations, they are certainly implied within a properly constituted safety management system. Indeed, there are few who would doubt such regulations represent good practice, irrespective of flag.

What can be done?

The truth is that the only way these fatalities will be prevented is if you implement those rules and regulations and good practices each and every time you enter an enclosed space for whatever reason, or require others to enter an enclosed space.

Properly plan and prepare the entry, which includes ensuring that the correct equipment and personnel are available. Use the Entry into Enclosed Spaces checklist card. The solution is in your hands!

IMO Recommendations for Entering Enclosed Spaces Aboard Ships

Annex to Resolution A.864(20) – adopted 27 November 1997

1 INTRODUCTION

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

2 DEFINITIONS

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

.1 Limited openings for entry and exit;

.2 Unfavourable natural ventilation;

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

2.2 Competent person means a person with sufficient theoretical knowledge and practical experience to make an informed assessment of the likelihood of a dangerous atmosphere being present or subsequently arising in the space.

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

3 ASSESSMENT OF RISK

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

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

.1 There is a minimal risk to the health or life of personnel entering the space.

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

.3 a risk to health or life is identified.

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

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

4 AUTHORIZATION OF ENTRY

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

4.2 Entry into enclosed spaces should be planned and the use of an entry permit system, which may include the use of a checklist, is recommended.

An Enclosed Space Entry Permit should be issued by the master or nominated responsible person, and completed by a person who enters the space prior to entry.

An example of the Enclosed Space Entry Permit is provided in the appendix.

5 GENERAL PRECAUTIONS

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

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

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

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

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

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

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

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

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

.9 that a permit has been issued authorizing entry.

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

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

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

6 TESTING THE ATMOSPHERE

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

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

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

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

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

space stopped, in order to obtain accurate readings.

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

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

7 PRECAUTIONS DURING ENTRY

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

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

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

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

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

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

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

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

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

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

9 HAZARDS RELATED TO SPECIFIC TYPES OF CARGO

9.1 Dangerous goods in packaged form

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

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

9.2 Bulk Liquid

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

9.3 Solid Bulk

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

9.4 Oxygen-depleting cargoes and materials

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

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

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

.3 copra;

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

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

.6 fishmeal and fishscrap;

.7 guano;

.8 sulphidic ores, ore concentrates;

.9 charcoal, coal and coal products;

.10 direct reduced iron (DRI);

.11 dry ice;

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

.13 scrap metal

9.5 Fumigation

When a ship is fumigated, the detailed recommendations contained in the Recommendations on the safe use of pesticides in ships (MSC/Circ.612) should be followed. Spaces adjacent to fumigated spaces should be treated as if fumigated.

10 CONCLUSION

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