

LOCAL VESSELS ADVISORY COMMITTEE

Draft “Code of Practice - Working in Confined Space on Local Vessels”

Purpose

This paper is to seek members’ endorsement on the draft Code of Practice – Working in Confined Space on Local Vessels (the “Code”) to be issued under Section 45A of the Merchant Shipping (Local Vessels) Ordinance, Cap 548.

Background

2. Due to the enclosed nature and the restricted entrance, a confined space has been known to be a workplace of high risk. On board vessels, confined spaces such as enclosed compartments for provision of buoyancy, storage and housing of equipment are always found. There were accidents with fatalities occurred inside these confined spaces in the past.

3. Currently, the “Shipbuilding and Ship-repairing Safety Guides” issued in the seventies and the “Shipboard Cargo Handling Safety Guide” issued in the nineties provide general safety guidance to the industry for carrying out works inside confined space. Annex U-3 of the “Code of Practice – Safety Standards for Classes I, II and III Vessels” issued by the Local Vessels Safety Section of Marine Department in 2006 provides useful guidance to the operators of local vessels to enter a confined space during operation. All these guidance are however not specific nor comprehensive to guide the industry to carry out *works*¹ safely inside confined space on board local vessels.

Code of Practice - Working in Confined Space on Local Vessels

4. The Code aims to provide practical guidance and recommendations on safety and health practices for the industry in carrying out works related activities inside confined space or enclosed compartments on board local vessels afloat in the water of Hong Kong. Vessel

¹ “Works” means –(a) repair to a vessel;
(b) the breaking up of a vessel;
(c) cargo handling; or
(d) marine construction.

owners, vessel coxswains, persons in charge of works, works supervisors, safety personnel, employers and persons employed engaged in these activities should follow this Code.

5. The Code lays down an explicit definition of Confined Space that makes direct reference to the same term defined in the IMO document “Revised Recommendations for Entering Enclosed Spaces Abroad Ships – Resolution A.1050(27), 2011”. In the Code, a term “*Competent Person*” is introduced. A *Competent Person* is a person, other than the “*Approved Person*²”, who can conduct risk assessment and issue air test certificate for a confined workplace where “*Gas Free Certificate*³” is not required. Thereof, the roles and competency requirements of “*Approved Person*” and “*Competent Person*” are also distinguished in the Code.

6. The Code depicts a safe system of work similar to the one applied to the works carried out in confined space on land. The system includes the application of risk assessment, air/gas test, work permit, controlled entry and precautionary measures. The Code incorporates information of the various hazards possibly encountered and the respective safe practices while working inside confined space.

7. The Code also highlights the duties of the employer, person in charge of works and the employed and outlines the training required for the persons engaged in the works inside confined space.

8. A similar Code of Practice – Working in Confined Space to be issued under Section 44A of the Shipping and Port Control Ordinance, Cap. 313 will also be issued for working in confined space on non-local vessels.

Consultation

9. The draft Code attached at the ANNEX has been discussed extensively in the

² “Approved Person” means a person approved by the Director (of Marine) to issue the Gas Free Certificate required under Section 21 of the Dangerous Goods (Shipping) Regulations, Cap 295C. It is synonymous with the local term “Gas Free Inspector”.

³ Section 21 of Cap. 295C describes “for the purpose of Part III and Part IV of Cap. 295C, any type II or type III vessel which has had on board below decks or in any tank any dangerous goods in category 5, class 1 or 2, shall be deemed to be a vessel conveying or having on board such dangerous goods until a *Gas Free Certificate* has been issued in respect of such vessel by a person approved by the Director.”

meetings of Sub-committee on Safety for Works on Vessels in the past two years. Comments from the Sub-committee members representing ship operators, shipyards, the employed and the relevant trade have been considered and incorporated in the Code. The Sub-committee on Safety for Works on Vessels expressed support to the draft Code.

Action Requested

10. Members are invited to comment and endorse the draft Code.

Marine Department
Shipping Division
Marine Industrial Safety Section
February 2013

CODE OF PRACTICE –

Working in Confined Space on Local Vessels

(Issued under Section 45A of the Merchant Shipping (Local Vessels) Ordinance, Cap 548)



Marine Industrial Safety Section
Marine Department, HKSAR
(Draft February 2013)

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FOREWORD

Confined spaces are very common on vessels and floating structures. There had been many cases of fatalities as a result of working afloat in enclosed compartments or confined spaces, in some cases, narrow working space with moving objects, harmful atmosphere. Such accidents could have been avoided if the persons in charge of works and workers concerned were aware of the hazards and risks associated with working in confined spaces.

This Code of Practice (the “Code”) provides a practical guide to the local marine industry especially to the person in charge of works on how to minimize the risk associated with the works to be carried out under the Merchant Shipping (Local Vessels) (Works) Regulation, Cap 548I (the “Regulation”).

This approved code is issued by the Director of Marine (the “Director”) under section 45A(1) of the Merchant Shipping (Local Vessels) Ordinance, Cap 548 (the “Ordinance”). Section 45A(1) of the Ordinance empowers the Director to issue codes of practice for the purpose of providing practical guidance in respect of any one or more of the requirements of the Ordinance or of regulations made under the Ordinance. It is important to note that compliance with this Code does not, of itself, confer immunity from any legal obligations in Hong Kong. Responsible persons are reminded to observe other applicable legal requirements.

Section 45A(4) of the Ordinance stipulates that a failure by any person to observe a provision of an approved code shall not of itself cause him to incur any criminal liability, but where –

- (a) in any criminal proceedings the defendant is alleged to have committed an offence either -
 - (i) by reason of a contravention of or a failure to comply with, whether by act or omission, the Ordinance or regulations under the Ordinance; or
 - (ii) by reason of a failure to discharge or perform a duty imposed by the Ordinance or such regulations; and
- (b) the matter to which the alleged contravention or failure relates is one to which, in the opinion of the court, an approved code relates,

then section 45A(5) of the Ordinance shall apply as regards to the proceedings.

Section 45A(5) of the Ordinance stipulates that in any criminal proceedings to which the section applies, the following, namely -

- (a) compliance with a provision of an approved code found by the court to be relevant to a matter to which a contravention or failure alleged in the proceedings relates;
- (b) a contravention of or failure to comply with, whether by act or omission, any such provision so found,

may be relied on by any party to the proceedings as tending to establish or to negative any liability which is in question in the proceedings.

1. SCOPE

- 1.1 This Code outlines the basic elements of the work that should be carried out by a person in charge of works to ensure the workplace has in place a safe atmosphere, the proper ventilation, and the protection against fumes so as to protect the workers from being harmed. This Code applies to ‘works’ activities carried out in confined space on local vessels while they are afloat at sea. These activities include the *works* related inspection carried out by non-crew members, including workers, works supervisors or persons in charge of works, prior to, during or after the conduction of *works*.
- 1.2 When tanks and other enclosed spaces are entered by persons involved in the operation of local vessels, the safety precautions given in Annex U-3 of the “Code of Practice – Safety Standards for Classes I, II and III Vessels” issued by the Local Vessels Safety Section of Marine Department should be followed. In particular, these precautions are applicable to any inspection activities to the local vessels, including but not limited to statutory surveys, inspection by classification society, insurance company or loss adjuster while the vessel is afloat at sea.
- 1.3 Neither this Code nor the safety precautions mentioned in paragraph 1.2 is applicable to local vessels under repair in dry dock or on slipway.
- 1.4 In this context, the meaning of enclosed compartment or confined space would be defined for the purpose of this Code.
- 1.5 This Code outlines the conditions for adequate ventilation and the proper proportion of oxygen in air.
- 1.6 Accordingly, this Code also outlines the basic conditions for a safe atmosphere and the related tests to be conducted by the Competent Persons testing the composition of various gases in the atmosphere.
- 1.7 The tests for gases refer to using various testing equipment and/or chemicals for identifying the composition of different gases that exist in the atmosphere of the workplace, and such tests are required to be made in order to meet the intents stated under the respective sections in the Ordinance and the Regulation.

- 1.8 For the purposes stated in the preceding paragraphs 1.6 and 1.7, the result of tests must be recorded in the format for ‘Gas Free Certificate’ when the tests are done in accordance with Section 21 of Dangerous Goods (Shipping) Regulations, Cap 295C (the “DG(S)R”).

[Note: When the Dangerous Goods (Shipping) Regulation 2012, Cap 295F (the “DG(S)R2012”) is enforced, all references to Section 21 of the DG(S)R in this Code shall be considered as making reference to Section 4 of the DS(S)R2012.]

- 1.9 As persons employed have to be properly trained for the job they would undertake in the course of their works, they have to be trained for the necessary knowledge for entry into confined spaces.

2. INTERPRETATION

The terms used in this Code shall, unless specifically defined in this Code, have the same meaning as those in the Ordinance, the Regulation or the DG(S)R.

- 2.1 **Approved Person**
(認可人士) An Approved Person means a person approved by the Director to issue the Gas Free Certificate required under Section 21 of the DG(S)R. It is synonymous with the local term “Gas Free Inspector”.
- 2.2 **Competent Person**
(合資格人士) A Competent Person means a person who is competent to carry out risk assessment for work in the confined space on a local vessel and make recommendations on safety measures before the person in charge of works may carry out works therein. He should be a person having ‘*relevant experience*’ (see *Note*) in such work and bear any one of the following qualifications:
- (1) an Approved Person;
 - (2) a person approved by Director of Fire Services under Dangerous Goods (General) Regulations, Cap. 295B;
 - (3) a holder of Class 2 Certificate of Competency as Deck Officer (Seagoing Vessel) or above issued or recognized by Director of Marine;
 - (4) a holder of Class 2 Certificate of Competency as Marine Engineer Officer (Seagoing Vessel) or above issued or recognized by Director of Marine;
or
 - (5) a person recognized by the Commissioner for Labour to carry out the duties of a competent person under Factory and Industrial Undertakings (Confined Spaces) Regulation, Cap. 59AE.

Note: ‘*Relevant experience*’ refers to proven experience involved in risk assessment for work in confined space while serving for not less than one year in any of the following positions:

- (a) deck or engineer officer of seagoing vessels;
or
- (b) safety officer, operation supervisor or above of oil terminals, ship repair yards, or container and cargo terminals.

[Marine Department maintains a list of Competent Persons who has expressed their interest to provide the service of a Competent Person. The list will be posted onto its webpage to facilitate Persons in Charge of Works to engage their services. Competent Persons can apply to Marine Department for enlisting their names in the list.]

2.3 **Confined Space**
(密閉空間)

Means a workplace, by virtue of its enclosed nature or its restricted access and egress, that may be subject to harmful atmosphere or physical change, is not subject to continuous ventilation and is not designed for continuous worker occupancy, and without limiting the generality of the foregoing, includes chamber, tank, container, boiler, pressure vessel, duct keel, compartment, hatchway, void space, ballast tank, fuel tank, oil tank, water tank, double bottom, cofferdam, pump-room, cargo space or silo (including any access ways and other adjacent spaces therein) in which such harm may arise.

The interpretation of ‘Confined Space’ in this Code makes direct reference to the definition of ‘Confined Space’ as determined/amended by the International Maritime Organization (IMO) from time to time.

DG(S)R
S21
or
DG(S)R 2012
S4(1)

2.4 **Gas Free
Certificate**
(氣體清除證
明書)

Refers to the certificate mentioned in Section 21 of DG(S)R before DG(S)R2012 is enforced, which reads:

For the purposes of Part III and Part IV of DG(S)R, any type II or type III vessel which has had on board below decks or in any tank any dangerous goods in category 5, class 1 or 2, shall be deemed to be a vessel conveying or having on board such dangerous goods until a Gas

Free Certificate has been issued in respect of such vessel by a person approved therefor by the Director;

OR

When DG(S)R2012 is enforced, refers to the certificate mentioned in Section 4(1) of DG(S)R2012, which reads:

For the purposes of this Regulation, a type 2 or type 3 vessel that has carried on board Class 2, 3 or 3A dangerous goods in bulk is to be regarded as carrying those dangerous goods on board the vessel until a gas-free certificate is issued in respect of the vessel by a person approved by the Director.

| | | | |
|--------------------------------|-----|---|---|
| <i>Ordinance</i> <i>S41</i> | 2.5 | Permission to Repair (書面允許修理) | Refers to the permission mentioned in Section 41 of the Ordinance, which reads: (1) Subject to subsections (1A) and (2), no owner or coxswain of, or other person having control over, a local vessel shall, except with the written permission of the Director, carry out, or cause to be carried out, any repairs to, or break up, the vessel. (1A) Subsection (1) does not apply to any local vessels of 50 metres or less in length unless the Director gives written notification to the person in charge of works that subsection (1) applies to that vessel. (2) The Director may, by notice in the Gazette, specify any type of repairs to a local vessel in respect of which permission under subsection (1) is not required. |
| <i>Regulation</i> <i>S2</i> | 2.6 | Person Employed (受僱人) | Means a person employed to carry out works. |
| <i>Ordinance</i> <i>S2</i> | 2.7 | Person in Charge of Works (工程負責人) | Means – (a) the owner or coxswain of, or other person having control over, a local vessel on, to or by means of |

which any works are to be, or are being, carried out;

- (b) a principal contractor or sub-contractor, if any, who contracts to carry out, or who carries out, any works; or
- (c) any other person having for the time being the command or charge of any works being carried out on, to or by means of a local vessel

2.8 **Safe Atmosphere**
(安全空氣) Means an atmosphere at a workplace where works are being carried out without hazards harmful to persons by reason of its oxygen deficiency or enrichment, flammability or toxicity.

Ordinance
S2

2.9 **Works**
(工程) Means-

- (a) repairs to a local vessel;
- (b) the breaking up of a local vessel;
- (c) cargo handling; or
- (d) marine construction.

3. RESPONSIBILITIES

3.1 Person in charge of works

*Regulation
S10*

3.1.1 Maintain Safe Atmosphere in Workplaces

It is the responsibility of the person in charge of works to provide for the person employed ventilation and protection against fumes at the workplace, etc. The Regulation further provides that:

- (1) Effective and suitable arrangements shall be made for the adequate ventilation of every workplace and every other part of a local vessel to which a person employed is permitted or required to proceed in the course of his employment.
- (2) Without limiting the generality of subsection (1), the ventilation of a place mentioned in that subsection is not adequate if
 - (a) the proportion of oxygen in the air in that place is, or may have been, substantially reduced below the normal proportion; or
 - (b) there exists, or is likely to exist, any fume, gas, vapour, dust or other impurity in the air that may be injurious to health.
- (3) All practicable measures shall be taken to protect a person who is in a place mentioned in subsection (1) against inhalation of any fume, gas, vapour, dust and other impurity in the air that may be injurious to health.

3.1.2 Appointment of Competent Person

It is the responsibility of the person in charge of works to appoint a competent person to carry out a risk assessment for the work in the confined space and make recommendations on safety and health measures before persons employed are allowed to enter a confined space to carry out the work.

*Regulation
S19*

3.1.3 Appointment of Works Supervisor

- (1) For the purposes of supervising works carried out on, to or by means of a local vessel, a person in charge of works may, subject to subsection (2), appoint a person as a works supervisor.

- (2) An appointment made under subsection (1) is not valid unless
- (a) it is in writing; and
 - (b) the person appointed is a person who
 - (i) has attained the age of 18 years;
 - (ii) has at least 2 years practical experience in relevant works on any vessel; and
 - (iii) holds a valid certificate in respect of the relevant safety training course; or such other certificate relating to safety training recognized by the Director.

3.2 Employer

*Regulation
S10(5)*

- 3.2.1 Where the employer is not the person in charge of works and if there is a contravention of the Regulation cited in paragraph 3.1.1(1) or (3) above, the employer shall make the arrangements or take the measures required by the Regulation as soon as reasonably practicable after the contravention occurs.
- 3.2.2 The employer shall ensure that the person in charge of works is in possession of a copy of the Permission to Repair; and
- 3.2.3 The employer shall ensure that the person in charge of works undertakes to comply with the conditions specified in the Permission to Repair.
- 3.2.4 The employer should pay attention to any direction or Marine Department Notice currently in force.

3.3 Works Supervisor

*Regulation
S19 & S20*

- 3.3.1 A works supervisor shall
- (1) supervise works carried out on, to or by means of a local vessel in accordance with the safety instructions given by a person in charge of works;
 - (2) assist a person in charge of works in performing any duties imposed on that person under the Regulation;
 - (3) carry with him while at work a certificate issued to him in respect of the “Works Supervisor Safety Training Course” he has taken.

- 3.3.2 The works supervisor is appointed in writing by the person in charge of works or the employer, as the case may be, to oversee the works in respect of its preparation, monitoring and completion, where the situation may warrant, continual surveillance.
- 3.3.3 The works supervisor must organise the work by managing the available resources to minimise the risks, in so far as reasonably practicable, involved in the works under his charge. Where two or more geographically interconnected work sites are involved on one or more vessels and one works supervisor may not be able to look after effectively the works going on in such work sites, additional works supervisors should be there to share the workload and responsibilities arising from the works.
- 3.3.4 The works supervisor must undertake the necessary safety training and acquire the necessary knowledge so that the protection in respect of the occupational safety and health of all persons employed for the work are commensurable with a level not lower than that required by the extant laws of Hong Kong.
- 3.3.5 The works supervisor should station himself on site whenever the situation demands. However, he may exercise his own judgment in allocating the time span of overseeing in person the work in progress at different locations and the time spent on indoor administrative activities without derogating 3.3.2 above.
- 3.3.6 He should direct the attention of the person employed toward the proper execution of the work in accordance with established safe practices.
- 3.3.7 The works supervisor should provide administrative and technical support to the workers under his direct supervision and to issue instruction and guidelines for the workers to follow.
- 3.3.8 The works supervisor should ensure safety promotional materials such as safety posters, leaflets and circulars issued by the person in charge or company are available on site and displayed at conspicuous positions. The relevant safety pamphlets, Marine Department Notices and Codes of Practice issued by the Marine Department should also be made available to the workers.

3.4 Person Employed

3.4.1 All persons employed must ensure that they have received the necessary safety training before undertaking the work in confined space.

*Regulation
S24*

3.4.2 A person employed must co-operate with or assist a works supervisor to the extent necessary for enabling the works supervisor to perform the duty imposed on him as cited in paragraph 3.3.1(1) and (2).

3.4.3 All persons employed must not enter any cargo hold or compartment without the permission, either verbally or in writing, of the person in charge.

3.4.4 All persons employed should familiarize themselves with the details of the job arrangement and know the ways to handle the work assigned to them. They should raise any question to their supervisor when in doubt.

*Regulation
S24*

3.4.5 A person employed must take care of his own safety and health by various means, e.g. use of personal protective equipment.

3.5 Competent Person

(Hereunder, unless otherwise specified, Competent Person includes Approved Person.)

3.5.1 When appointed by a person in charge of works to conduct a risk assessment for the work in the confined space, the Competent Person should thoroughly assess the working environment (including compartments adjoining to the confined space) and provide the necessary advice and assistance to the person in charge of works to warrant the safe working of persons in the confined space on board the local vessel.

3.5.2 In carrying out the risk assessment, a Competent Person should carry out the necessary tests to ascertain the safety of the atmosphere in the confined space. He shall issue an Air Test/Gas Free Certificate suitable for the works involved. (Gas Free Certificate is issued only by Approved Person.)

3.5.3 A Competent Person may, upon request of an employer or a person in charge of works, conduct tests on the atmosphere of a place other than a confined space.

3.5.4 A Competent Person may call upon the assistance of other competent

persons when conducting the tests.

- 3.5.5 A Competent Person must record the result of test in the format specified in this Code and sign the record of test result accordingly.
- 3.5.6 Competent Persons must keep themselves fully familiarized with the up-to-date legislation and technical codes or standards including the amendments thereto from time to time.
- 3.5.7 Competent Persons must ensure that the testing equipment or chemicals used by them are kept ready for immediate application, as such, the testing equipment must be calibrated from time to time and immediately before use; where chemicals are used, they must be verified usable and effective for testing purposes.
- 3.5.8 A Competent Person must conduct his work '*carefully*'. The practical meaning of '*carefully*' is described in the "Code of Practice for Competent Examiner on the Examination of Lifting Appliances and Lifting Gear" issued by the Marine Department.
- 3.5.9 A Competent Person should cooperate with Marine Department and provide the necessary information and cause no interference to any investigation conducted.
- 3.5.10 Competent Persons should engage themselves in any relevant form of voluntary continuous professional development for the purpose of keeping abreast with technological advancement and any findings from investigative studies for enhancing workplace safety and health.

4. SYSTEM OF WORK AND SAFE PRACTICES

4.1 Safe System of Work

4.1.1 The person in charge of works, the works supervisor and the competent or approved persons are individuals who are responsible, in their respective role, for making decision on how much supervision and mitigation are required for entering into and work inside confined spaces. However, it is the liability of the person in charge of works and employer to take measures, in so far as reasonably practicable, to ensure the safety of a person employed at work.

*Regulation
S23(2)*

4.1.2 When there is a need to enter a confined space on local vessels for work, the person in charge of works should consider the application of following system of work to ensure the safety of the persons employed during work.

Step 1 - Person in charge of works appoints a Competent Person to conduct a Risk Assessment of the workplace (including the space adjacent to the confined space).

Step 2 - Competent Person conducts testing of the atmosphere and risk assessment, furnishes the person in charge of works a risk assessment report (including recommended mitigation measures).

Step 3 - Person in charge of works performs recommended mitigation measures (e.g. ventilation, fencing, staging, entrance attendant, rescue equipment, etc.) to eliminate the hazards or reduce the risk of accident occurrence to an acceptable level.

Step 4 - Person in charge of works conducts safety briefing to the persons employed. The briefing should cover the hazards identified and the respective precautionary measures.

Step 5 - Person in charge of works grants entry/work permission to the persons employed.

Step 6 - Monitor the work process to ensure the precautionary measures are strictly adhered to and maintain close surveillances of the workplace for any change that would affect the validity of the entry/work permission and initiate emergency procedures if necessary.

- 4.1.3 It is the responsibility of the person in charge of works or the employer to determine if a Permit System should be put in place to manage the entry of personnel into the confined space. If a Permit System is applied, the identified hazards, the results of the test of the atmosphere, the recommended measures and the entry permission should be recorded in the permit together with the signatures of corresponding responsible persons. *Appendix 6* is a sample of a Confined Space Work Permit.
- 4.1.4 The person in charge of works should also make arrangement for the need of emergency. The arrangement should include the preparation of the team and equipment to save life from the confined space.

4.2 Risk Assessment

4.2.1 Identification and Report of Hazards

- (1) When appointed by the person in charge of works, a Competent Person should, basing on the type of works to be carried out, assess the entire working environment of the confined space and its adjacent area, if applicable, and identify the hazards possibly encountered by the persons employed during their entry into or working inside the space.
- (2) The identified hazards should be notified to the person in charge of works via a Risk Assessment Report. In the report, the Competent Person should recommend to the person in charge of works the respective mitigation measures to eliminate the hazards or reduce the risk of accident occurrence to an acceptable level. Please refer to following publications for the methodology to determine the level of risk:
 - (A) Section A1.2 of Appendix I of the “Code of Practice on Shipboard Container Handling on Local Vessels, 2007” (*Reference 12*).
 - (B) Section 5.11.4 of the “Code of Practice on Safety Management, 2002” (*Reference 10*).
- (3) Testing of the atmosphere of the confined space should form part of an assessment process.

- (4) Assessment can be made in stages subject to the works to be carried out at each stage. It can also be a complete assessment of the entire work process covering all the works to be carried out at each stage.
- (5) Any change in the working environment or process rendering the possible presence of new risks or alternation of risk level of existing risks, the person in charge of works should arrange the Competent Person to conduct a fresh risk assessment. For works required to carry out in confined space for long periods, a periodic review of the working environment and process should be carried out by the person in charge of works or the nominated responsible person.
- (6) If necessary, the Competent Person should state in his report if measures like testing of the atmosphere or risk assessment is required to carry out periodically.

4.2.2 Gas Free or Air Test Certificate (Reference 7)

- (1) To ensure the safety of the persons employed, a safe atmosphere must be available inside the confined space. The Competent Person should select the correct and effective equipment and chemicals to test the atmosphere inside the confined space to ascertain it is free of toxic or explosive gas or vapour and contains adequate oxygen for respiration.
- (2) The testing of the atmosphere is part of the risk assessment process. The result of the tests should be recorded and reported to the person in charge of works.
- (3) There are different kinds of test requirements for a safe atmosphere and hence different test certificates should be issued. The Gas Free Certificate can only be issued by the Approved Persons.
- (4) Requirements for issuance of Air Test/Gas Free Certificate:
 - (A) When a Gas Free Certificate is required under section 21 of DG(S)R or required for works covered by a Permission to Repair issued by the Director, an Approved Person shall issue the Gas Free Certificate and the conditions to be satisfied include:-
 - (a) no flammable or toxic gas;
 - (b) no oil impregnated scale or other material likely to give off gas;
 - (c) no flammable material which might catch fire including

material in adjacent spaces;

- (d) no release of petroleum gas or liquid while hot work is in progress;
 - (e) the space should be tested with a suitable combustible gas indicator and a reading of 1% or less of the Lower Flammable Limit obtained; and
 - (f) provision made for effective ventilation while the work is in progress.
- (B) Where only an Air Test Certificate is required, either a Competent Person or an Approved Person shall issue the following certificates as applicable:-
- (a) Air Test Certificate for entry to confined space – the conditions to be satisfied include:
 - (i) tank or space to be tested with an approved combustible gas indicator. Readings obtained should show sufficiency of oxygen, absence of toxic gas and 1% or less of the Lower Flammable Limit; and
 - (ii) provision made for effective ventilation to be maintained.
 - (b) Air Test Certificate for cold and hot work - the conditions to be satisfied include:
 - (i) tank or space to be tested with an approved combustible gas indicator. Readings obtained should show sufficiency of oxygen, absence of toxic gas and 1% or less of the Lower Flammable Limit. If needed, adjacent compartments or space should also be tested to ascertain no risk of fire;
 - (ii) effective means should be established to isolate the confined space to prevent any accidental ingress of substances which could endanger the life of persons working inside the space;
 - (iii) no residue substance remains which could cause fire or emission of dangerous fume, gas or vapour;
 - (iv) no loose scale exist which, if disturbed, could give off gas; and

- (v) provision made for effective ventilation while the work is in progress.

A sample of a Gas Free and Air Test Certificate is shown in *Appendix 7*.

- (5) The Competent Person and Approved Person shall record the results of the tests performed by him in a form that contains the following information:-
 - (A) Test Apparatus: the serial number.
 - (B) For electronic apparatus: the calibration date.
 - (C) The date of test.
 - (D) The name of the vessel together with: the vessel's licence / registration number; for vessel or floating structure without a licence, a description of the vessel.
 - (E) The location or the inherent name of the hold / tank / compartment on the vessel.
 - (F) The results should be legibly entered into separate sections for different hold / tank / compartment / space.
 - (G) Conditions under which the certificate remain valid and the state of the particular space and the type of work that may be carried out with safety.
 - (H) The date of issuing the report: this should be the same as the date of test.
 - (I) Signature of the person issuing the certificate (for an Approved Person, the signature must be the one registered in Marine Department).
 - (J) The certificate should bear a certificate number.
 - (K) The name of the person/company requesting the test.
 - (L) The name of the recipient of the certificate.
- (6) *Appendix 5* provides information of the Approved Persons approved by the Director.

4.3 Ventilation

- 4.3.1 Ventilation is an effective means to warrant a safe atmosphere inside a confined space. It can be used to purge a contaminated confined space and maintain a constant supply of clean air to a confined space.
- 4.3.2 A confined space may be purged by using portable system; a capacity of 16 air changes per hour should be provided by using portable fans or blowers. For permanent ventilation installation, it should be 8 air changes per hour.
- 4.3.3 Care must be taken in positioning the ventilation installation. It is important that clean or fresh air is supplied to the ventilation installation. If necessary, flexible ducting should be used to connect the inlet of the ventilation installation to a clean air source.
- 4.3.4 For mechanical ventilation of confined space, there are many options in achieving through ventilation or uniflow ventilation.
- 4.3.5 The arrangement of supply fans/blowers and/or extraction fans should be so designed as to prevent the stratification of air pockets. In any case, stagnant air is to be avoided and turbulent airflow is preferred.
- 4.3.6 It is not allowed to enrich the atmosphere of a confined space with a supply of high concentration of oxygen. However, it is acceptable to do so with oil free compressed air.
- 4.3.7 The engine room on board a vessel, because of its enclosed nature, is a confined space unless it is ventilated. To make it readily accessible to attending personnel, ventilation of the engine room has to be maintained at all times.

4.4 Entry Permit or Work Permit

- 4.4.1 A permit in the form of a checklist may be used in implementing an entry permit system. The permit should be displayed outside the entrance of the confined space, along with any statement or instruction, in particular, the period of validity should be indicated.
- 4.4.2 The permit should be issued by the person in charge of works or the nominated responsible person, e.g. a works supervisor, a coxswain of a local vessel, or the manager of a stevedore company.

4.4.3 The entrance attendant stationed outside the confined space should ensure workers entering into the confined space are aware of the conditions or requirements for entry.

4.4.4 The entrance attendance should record and monitor the entry and exit of every person working inside the confined space. A “Tag-in & Tag-out” system should be an effective tool providing such function.

4.5 Person Employed

The persons employed to work in a confined space should have received proper training in working in confined space (Refer to Section 6 in this Code). The training should enable them to work in proper manner and it shall include and not limiting to their responsibilities, the general duties of care, knowledge in breathable air, use of breathing apparatus, hazard with confined spaces and avoidance of unsafe behaviour. It is the responsibility of the person in charge of works to ensure that the persons employed have been properly trained and relevant record of training kept for verification.

4.6 Works Supervisor

The works supervisor should also be trained in managing safety and health issues associated with working in confined spaces. He is responsible for assisting the person in charge of works in ensuring the overall operation complies with the relevant provisions of the Regulation and this Code. In respect of the progress of works, he assumes a supervisory and monitoring role. His presence on the spot would be necessary at the beginning and at the end of the works. In between the beginning and the end, he should avail himself at times to monitor the progress and to render any necessary advice or help to workers in situ.

4.7 Entrance Attendant

4.7.1 The entrance attendant should be able to maintain a surveillance of the activity inside the confined space. His responsibility is mainly for seeking the assistance of a rescuing team in case of emergency. For this purpose, he should be furnished with proper means for communicating with the parties concerned, including the workers inside. The person in charge of works should ensure that the attendant is capable of performing this duty.

4.7.2 Unless permitted by the person in charge, the attendant should not go inside the confined space for whatever reason. If the attendant is not available, the work supervisor or the person in charge of works should arrange an evacuation.

4.8 Emergency Preparedness

4.8.1 The workforce engaged in the works should have sufficient training and drill for handling emergencies such as serious personal injury, fire and the release of harmful substances in the confined spaces, with emphasis in evacuating workers in the confined space.

4.8.2 As part of the necessary safety measures, the emergency preparedness should include the availability of life saving equipment, man-lift tripod (if applicable), first aid box, resuscitator, stand-by SCBA for rescue use. The contact telephone numbers for summoning help should be clearly displayed for immediate use in case of emergency.

4.8.3 In the event of an emergency, under no circumstances should the entrance attendant nor any person in the vicinity enter the confined space before help has arrived and the situation has been evaluated to ensure the safety of those entering the space to undertake rescue operations. Only properly trained and equipped personnel should perform rescue operations in confined spaces.

4.9 Safe Working Practices

4.9.1 General Safety Precautions

(1) Permanent notices should be displayed in conspicuous places on board, stating:-

(A) Smoking and the use of naked lights strictly prohibited except at times and in places authorized by the person in charge.

(B) The precautions to be taken before entering compartments, such as cofferdams and dry tanks, which are infrequently opened.

(2) All reasonably practicable steps should be taken to ensure and maintain adequate ventilation in any confined space in which persons are employed.

(3) The use of SCBA or air hose with mask is recommended under

circumstances that the persons entering the confined space will be exposed to contaminated air or air having impurities at a level exceeding acceptable limits.

- (4) Compressed oxygen should not be used to ventilate any confined space. The extra oxygen will increase the flammability of materials and widen explosive limits, making ignition leading to serious fires or explosions more likely. If such a situation develops, the oxygen or enriched air supply should be cut off and the confined space thoroughly ventilated before any further work is undertaken.
- (5) Do not take gas cylinders into a confined space as far as reasonably practicable. If it is unavoidable, then keep the number, size and quantity to a practical minimum. By all means, prevent any gas leak and exercise detailed gas detection either using fixed or portable gas detection equipment. Do not expose the gas cylinders to intense heat. Remove all cylinders right after use.
- (6) Where in any confined space in any part of the local vessel flammable solvents are used in the removal of oil sludge or any other process liable to produce flammable gas or vapour, effective and suitable provision should be made by adequate ventilation or by other means to prevent formation of a flammable atmosphere in such space.
- (7) If deodorising is required in the confined space, it is advisable to avoid using spray type deodorant.
- (8) The use of personal alarm device during the stay in the confined space is advisable.
- (9) In general, no person should enter a tank, cofferdam or similar enclosed space without the permission of a responsible person or person in charge of works. A responsible person or person in charge of works may grant permission to persons to enter a confined space only when the following arrangements are in place:-
 - (A) Effective steps have been taken to prevent any ingress of dangerous fumes.
 - (B) Any sludge or other deposits liable to give off dangerous fumes has been removed or its fume emission is under effective control.
 - (C) The space has been adequately ventilated and tested for dangerous fumes (not more than 1% of LFL and 50% of OEL of

any flammable or toxic vapours or gases) and that provision of a supply of air adequate for respiration has been made.

- (D) Responsible person is in constant attendance outside the compartment.
 - (E) Life lines and harness are ready for immediate use.
 - (F) Approved breathing apparatus is in an easily accessible position and an entrance attendant familiar with the use of the breathing apparatus is available.
- (10) When it is necessary to enter a tank or compartment where it is suspected that the atmosphere may contain petroleum gas or be deficient in oxygen, the responsible person or person in charge of works should continuously supervise the operation and should ensure that :-
- (A) Personnel wear breathing apparatus and life line.
 - (B) Means of communication are provided and a system of signals is agreed and understood by the personnel engaged.
- (11) Where persons are employed to work in any confined space, there should be provided and kept readily available:
- (A) Sufficient numbers of breathing apparatus of a type approved by the Commissioner for Labour or the respiratory protective equipment described in Section 11 of “Code of Practice on Using Protective Clothing and Equipment for Works on Local Vessels” published by the Marine Department, where appropriate.
 - (B) A sufficient number of persons employed should be trained and practiced in the use of the approved breathing apparatus and in the method of restoring respiration.
 - (C) A portable self-contained electric battery operated safety lamp or safety torch for each set of breathing apparatus; and
 - (D) A fire-proof life-and-signaling line, an adjustable safety belt or harness and a light-weight safety helmet.
 - (E) When the confined space becomes hot or humid, person employed for prolonged work should be provided with sufficient water and salt to avoid heat stroke. The daily consumption of cold water (not ice cold water) should not be less than 4.5 litres, and the water intake should be administered

in small quantities spreading over a period of time.

4.9.2 Lighting

Places where works is being carried on should have an illumination of not less than 20 lux. The illumination should be suitably raised when the visibility falls because of fume or dust. The lighting should be evenly arranged and the contrast between shades and bright spots should be minimized to a level that does not affect proper vision. Glare should also be avoided.

4.9.3 Sealing off of Confined Spaces

The person in charge should be responsible for ensuring the confined space is positively sealed off before re-entry is permitted or the space concerned has been declared fit for entry without a permit. Any door or cover of a confined space left open may be wrongly taken to be an indication of a safe atmosphere and therefore, an entrance attendant or a mechanical barrier, such as a rope or chain positioned across the opening with an attached warning sign, should be arranged to prevent the accidental entry of any person into the space.

4.9.4 Safety Check List

A safety checklist may be used to ensure the adequacy of preventive measures established by the person in charge of works. It is best used before permitting entry. Any deviation from or non-compliance with the checklist should be dealt with by the responsible person immediately. The checklist should be used as a tool and it should not be used to replace the judgment of the person in charge of works, the works supervisor or the individuals, such as ship inspectors or surveyors, who have to enter confined spaces. Example of a checklist can be found in *Reference 13*.

4.9.5 Tankers

For oil tankers, the “International Safety Guide for Oil Tankers and Terminals” may be used as a reference concerning entry to enclosed spaces. A similar guide for liquefied gas tankers is the “Liquefied Gas Handling Principles on Ships and in Terminals”. The above mentioned guides are primarily written for tanker and terminal personnel, they are also useful for persons in charge of works and works supervisors.

*Ordinance
S66 (2) & (4)*

4.9.6 Laid up vessels

The Director may attach conditions to a “laid-up vessel permit” issued under the Ordinance. The conditions so made, in respect of confined spaces, may include a safe system of work or a safe operating procedure, e.g. permit system for entry, to be implemented by the employer or person in charge of works.

5. HAZARD IDENTIFICATION

5.1 Hazards

5.1.1 In any shipboard enclosed compartment or confined space, unless proved gas-freed, toxic vapour or atmosphere lacking in oxygen and, for any storage tank or cargo hold where a petroleum product has been stowed, flammable vapour may always be expected.

5.1.2 Threshold Limit Value and Exposure Limits

(1) Within certain limits a person may be repeatedly exposed to air-borne concentration of otherwise harmful substances without adverse effects. Values of average tolerable concentrations for the more commonly met substances are useful as a guide in the control of hazards relating to confined spaces. Commonly referred to as Threshold Limit Value (TLV) these relate to daily exposure periods of eight hours constituting a normal working day. TLVs of some of the substances met in shipboard work are:-

- (A) Petroleum ----- 500 ppm (0.05%)
- (B) Hydrogen Sulphide ----- 10 ppm (0.001%)
- (C) Benzene ----- 25 ppm (0.0025%)
- (D) Carbon dioxide ----- 5000 ppm (0.5%)

For safety, personnel should not enter a tank, a pump-room or other enclosed space unless the vapour concentration of the substance concerned is below its TLV.

(2) Occupational Exposure Limit (OEL) refers to the airborne concentration of individual chemical agents that represent levels that are regarded to impose no adverse health effects to nearly all workers on exposure by the route of inhalation. Under no circumstances, should any person be allowed to expose in an atmosphere comprising toxic vapour or gas of more than 50% OEL.

(3) Occupational Exposure Limit – Time-Weighted Average (OEL-TWA) refers to the time-weighted average concentration of a chemical substance over an eight-hour working day for a five-day workweek, to which nearly all workers can be exposed day after day without adverse health effects. In the eight-hour averaging period of a working

day, excursions above the TWA are permitted provided that these excursions are compensated for by equivalent excursions to maintain the exposures below the limit. For some chemical substances that can produce acute health effect by exposures to high concentrations even for a short period, excursions above the OEL-TWA should be limited by the short-term exposure criteria where applicable.

- (4) Occupational Exposure Limit – Short-Term Exposure Limit (OEL-STEL) refers to the 15 minute time-weighted average of the airborne concentration of a chemical substance. Exposures above the OEL-TWA up to the STEL levels should not be longer than 15 minutes and should not be more than four times in a day. A minimum of 60 minutes should be allowed between successive exposures in this range. It provides a guideline for the control of the short-term exposure and is a supplement to the OEL-TWA.
- (5) Occupational Exposure Limit – Ceiling (OEL-C) refers to the airborne concentrations of a chemical substance that should not be exceeded during any part of a working day. Chemicals having OEL-C do not have any 8-hour OEL-TWA or OEL-STEL.

The TWA & STEL value of some chemicals are extracted from *Reference 9* and tabulated below for ease of reference:

| Chemical | TWA | STEL |
|--|-----------------------|-----------|
| Benzene | 0.5 ppm | 2.5 ppm |
| Carbon Dioxide | 5000 ppm | 30000 ppm |
| Carbon Monoxide | 25 ppm | |
| Hydrogen Sulphide | 10 ppm | 15 ppm |
| Liquefied Petroleum Gas | 1000 ppm | |
| Cotton dust, raw | 2.5 mg/m ³ | |
| Grain dust (oat, wheat, barley) | 4 mg/m ³ | |
| Welding fumes (Not otherwise classified) | 5 mg/m ³ | |
| Portland Cement | | |
| Inhalable dust | 10 mg/m ³ | |
| Respirable dust | 4 mg/m ³ | |
| Starch | | |
| Inhalable dust | 10 mg/m ³ | |
| Respirable dust | 4 mg/m ³ | |

The effects of extensive exposure to Carbon Monoxide and Hydrogen Sulphide on human are shown in *Appendix 1*.

5.1.3 Toxic Vapours, Fumes and Gases

(1) *Petroleum*

- (A) Volatility and toxicity are closely related. The more volatile the petroleum, the greater the risk of inhalation of hydrocarbons leading to poisoning. With non-volatile petroleums, provided the space has been well ventilated and the bilges, pumps and pipelines free from volatile products, there is little hazard.
- (B) The harmful effects of petroleum vapour depend on the concentration of the gas and the time during which it is inhaled. Inhalation gives rise to behaviour similar to drunkenness followed by loss of consciousness and with prolonged exposure, death ensues. Although no permanent physical harm may be expected from direct inhalation of hydrogen vapour over a short period, lack of oxygen, or presence of hydrogen sulphide or benzene may also result in the same effect. Gassing incidents may of course involve several conditions existing concurrently. For example, a person may be overcome through having inhaled a poisonous gas in an atmosphere lacking in oxygen.
- (C) A tank may become gassy even after it has been gas-freed due to evaporation of volatile constituents in sludge or scale, particularly if there has been a rise in temperature or the scale or sludge has been disturbed. Although a minimum concentration of 1% is required to form a flammable mixture, prolonged exposure to same can prove fatal. Thus a non-flammable atmosphere is no criterion for safety.

(2) *Benzene*

- (A) Some blends of gasoline contain a significant amount of benzene. It is a clear, colourless liquid, with a pleasant odour. Benzene vapour must not be inhaled. It is highly toxic and can cause serious physical harm.
- (B) The IDLH (Immediately Dangerous to Life or Health) concentration is about 500ppm.

(3) *Hydrogen Sulphide*

- (A) It has an odour of rotten eggs and can be detected by smell in very low concentrations (0.1ppm). However, smell is not a reliable guide with the gas in high concentrations, as it dulls the

sense of smell. Short exposures may damage the brain and kidney, and in high concentrations a few breaths may produce unconsciousness followed by death.

(B) The IDLH concentration is about 300ppm.

(4) *Others*

(A) Toxic vapour may also result from dangerous goods carried in enclosed spaces and the use of paints, solvents and cleaning chemicals which may react with sludge etc. The decomposition of coal, fishmeal, bark or other cargoes may give rise to oxygen deficiency.

(B) Oxygen depletion and carbon monoxide formation may occur at the same time during shipment of wooden pellets in closed cargo hatches. (Note: the wooden pellets are produced by milling wood chips, bark, planner shavings or sawdust into a fine powder, which after drying is compressed into pellets of 6 to 8 mm diameter.)

(C) The process of gas welding and flame cutting may give rise to metal fume fever by inhaling freshly formed metal oxide fumes; toxic fumes of metals such as lead, cadmium and beryllium may also be present; the oxides of nitrogen and fluorides may cause bronchial and pulmonary irritation.

(D) Ammonia and methyl chloride may be found on ships as refrigerants. They are susceptible to ignition and are hazardous. Ammonia is highly toxic and methyl chloride moderately so.

5.1.4 Fire and Explosion

(1) For a fire to start, the presence of the following three ingredients is required:

(A) combustibles;

(B) oxygen; and

(C) an ignition source.

(2) Explosion is the combustion of combustibles in a restricted environment leading to a rapid rise in temperature and pressure which eventually causes the environment enclosure to rupture.

- (3) Explosion can happen in a ship fire in an enclosed compartment when flammable substance in the form of vapour, gas, or fine mist of liquid or dust present is mixed with oxygen in the air in certain proportions. A list of substances liable to form explosive mixtures with oxygen is shown in *Appendix 2*.
- (4) For a hydrocarbon gas which is often found in compartments carrying fossil fuel, a mixture with air cannot be ignited and burned unless its composition lies within a range of gas in air concentrations known as the flammable range. The lower limit of this range, known as the Lower Flammable Limit (LFL), is that hydrocarbon concentration below which there is insufficient hydrocarbon gas to support and propagate combustion. The upper limit of the range, known as the Upper Flammable Limit (UFL), is that hydrocarbon concentration above which there is insufficient air to support and propagate combustion.
- (5) In practice, the Lower and Upper Flammable Limits of oil cargoes carried in tankers can, for general purposes, be taken as 1% and 10% by volume respectively.

5.1.5 Lack of Oxygen

- (1) Tanks may be deficient in oxygen if steam or inert gas has been used in them. If an empty tank has remained sealed for a long time, the oxygen content of the atmosphere may be reduced due to oxygen combining with the iron in steel in the process of rusting. Lack of oxygen will also occur in a laid up boiler or other vessels where oxygen absorbing chemicals have been used to reduce rusting. Decomposition or rotting of cargo may result in lack of oxygen.
- (2) Nitrogen is a colourless and odourless gas that, when used as an inert gas, causes oxygen deficiency in enclosed spaces, at exhaust openings on deck during purging of tanks, void spaces and in cargo holds. It should be noted that one deep breath of 100% nitrogen gas will be fatal.
- (3) Hydrogen may occur in a cathodically protected cargo tank used for ballast, or in a battery room in the process of charging batteries. When tank covers or doors leading to the battery rooms are opened the gas will disperse readily. However, pockets of hydrogen may still exist in the upper part thus displacing the oxygen.

- (4) If carbon dioxide has been discharged, e.g. to extinguish or prevent a fire, the oxygen content will be reduced.
- (5) The general guide for the effect of oxygen content is:
 - (A) to maintain the oxygen level not less than 19.5% v/v and not greater than 23% v/v;
 - (B) that all personnel must leave the workplace with oxygen level at 18% v/v or below, it is not acceptable to continue works at an oxygen level at or below 18% v/v; and
 - (C) that oxygen level at or below 16% v/v will not sustain life.
- (6) The nominal composition of dry air is shown in *Appendix 3*; and *Appendix 4* is a list of the substances capable of causing oxygen depletion.

5.1.6 Skin Contact Hazard

- (1) Physical injury may result from skin contact with hydrocarbons, corrosives or other chemicals.
- (2) The lighter petroleums, such as kerosene and gasoline can cause skin defatting, leading to dermatitis. Certain gasoline additives may cause skin allergy. Heavier petroleums, such as lubricating oils plug pores and result in oil acne. Prolonged contact with some substances may give rise to skin cancer.

5.1.7 Testing for Gases, Vapours and Dust

- (1) There are many types of instruments for testing the atmosphere in an enclosed space; the combustible gas indicator and the chemical absorption type of detector are among the commonly used ones. The combustible gas indicator detects the presence and proportion of hydrocarbon vapour in air. However, it is not suitable for detecting gases and vapours toxic at very low concentrations and also has certain limitations, e.g. a combustible gas indicator will not reliably indicate the presence of hydrogen.
- (2) Chemical absorption detectors are particularly useful for the purposes detecting toxic gases and vapours at low concentrations. Amongst the substances whose presence may be accurately established by these are Benzene and Hydrogen Sulphide in sour crude oils.

5.1.8 In general, all vapours, except water vapour, are toxic to various extents. All flammable vapours are toxic at levels well below 25% of LFL, most are toxic below 1% of LFL. Since gases (except air or oxygen) are asphyxiants (their effect on personnel is due to their diluting the oxygen content of the air), it is important that fresh air is used in ventilating a confined space.

5.2 Application of Gas Tester

5.2.1 In identifying gases, one may use portable multiple gas meter/tester or chemical absorption sampler.

5.2.2 When used as a personal protective equipment to monitor the quality of air inhaled, the gas sampler should be placed within 30cm of the nose of the user. However, it must be reminded that the equipment used in this way is not adequate for protection against the sudden presence of air containing unwanted and harmful gases, especially in large quantity. In this context, the use of self-contained breathing apparatus (SCBA) is advisable to guard against possible sudden changes in air composition, especially in situations where both personnel and gas release are inter-related, e.g. workers moving in a gas laden fluid bed of assorted materials.

5.2.3 Portable apparatus should normally be selected for such purposes as leak detection, verification and monitoring of gas-free conditions, safety checks and similar applications. A portable gas detection apparatus is normally used in classified areas (Zone 0, Zone 1 and Zone 2), with certified intrinsically safe apparatus to International Electrotechnical Commission equipment protection level *Ex ia* (suitable for zones where explosive atmosphere highly likely) being usable in all three, and certified flameproof apparatus to *Ex d* (flameproof protection, for example) being usable in the last two. (*Note: the zoning scheme used in Europe and the States is different from that used in China; the former scheme is used here.*)

5.2.4 If there is a chance of sensor ‘poisons’ (such as silicones, leaded petrol, acids, etc.) being present, the sensitivity of an apparatus, using catalytic combustion or semiconductor sensors, should be checked at frequent intervals.

5.2.5 Assessing Exposures to Impurities

The employer and person in charge of work should provide appropriate measures for preventing the entry and accumulation of air impurities in the workplace and to take steps to protect the person employed against inhaling

impurities that may be injurious to health. The person in charge of works may make reference to Code of Practice on Control of Air Impurities (Chemical Substances) in the Workplace published by the Labour Department.

5.2.6 The “Read and Run” concept

Without extensive training, the user of a gas detection apparatus should not be put in a position to test an atmosphere where significant amounts of gases or vapours are actually present or expected.

In such situation, accuracy is not important as long as the apparatus will respond to a response check: the user is not to be expected to make measurement; the intention is just to detect harmful gas. The basic operations are as follows:

- (1) Observe the readings in clean air.
- (2) Adjust the apparatus to its proper clean air readings.
- (3) On going to the area where the tests are required, if there is any indicated change from the clean air reading, this is a ‘positive reading’.
- (4) If a ‘positive reading’ is obtained, GET OUT, that is “Read and Run”.
- (5) Then inform the responsible person, who may then carry out a proper survey by experienced personnel, taking proper precautions.

This concept is applicable to person using a personal air-monitoring device for the purpose of personal protection.

5.3 Multiple Access and Egress

A confined space may have one or multiple access and egress. Where the access and/or egress have restriction, there may be difficulties in getting through them and more time and effort are needed. The use of mechanical means to provide access/egress, e.g. lift, elevator, platform, ropeway, boson chair, etc. may be considered. The effect of time on persons exposing to toxic gases like carbon monoxide and hydrogen sulfide can be illustrated in *Appendix 1*.

5.4 Exhaust from Internal Combustion Engines

Load shifting vehicles that use internal combustion engines may give rise to exhaust gases that can dilute the oxygen content in the cargo hold. The exhaust gases may also be harmful to health when large quantity is inhaled. Continuous thorough forced ventilation by fresh air is required in such cargo holds during cargo operation.

5.5 Fumigated Cargo Holds and Freight Containers

5.5.1 Cargo holds or stores that have been fumigated must be certified safe for entry by a Competent Person or an Approved Person. Competent Persons and Approved Persons should make reference to the “Recommendations on the Safe Use of Pesticides in Ships” published by the International Maritime Organization for the necessary guidance.

5.5.2 For hazards with fumigated freight containers, the person in charge of works may make reference to the safety pamphlet “Unseen Dangers in Freight Containers” published by the International Safety Panel of the ICHCA International Limited.

5.6 Irritating Dust or Fume

5.6.1 Stevedores working in hazard or irritating dust or fume must put on suitable respiratory apparatus and eye protection.

5.6.2 When selecting suitable respiratory apparatus, it is worth noting the nature of dust and fume. Dust is generally understood to be an aerosol of solid particles, mechanically produced, with individual particle diameters of 0.1 μ m upwards. Fume is an aerosol of solid particles generated by condensation from the vapour state usually following the volatilization of molten metals. The individual particle diameters are typically less than 1 μ m, though the existence of multi-particle aggregate is common.

6. ACCEPTABLE SAFETY TRAINING COURSES

*Regulation
S23(3)*

- 6.1** It is the duty of the person in charge of works and the employer to provide information, instruction, training or supervision as may be necessary to ensure, in so far as reasonably practicable, the safety of a person employed at work.
- 6.2** The training required to provide to the persons employed to work safely inside a confined space should include the recognition of:
- (1) hazards likely to encounter while entering and working in a confined space and the requirements of a safe atmosphere;
 - (2) situations and activities that could affect adversely the safety of a confined space;
 - (3) precautions and response to be taken against accidents occurred inside a confined space; and
 - (4) the use of personal protective equipment including breathing apparatus.
- 6.3** A person certified to have completed the Works Supervisor Safety Training recognized by the Director and has been suitably trained in using breathing apparatus is considered to be competent to supervise the works in confined space.
- 6.4** A person certified to have completed the safety and health training for working in confined space, as required under Section 4(1) of Cap 59AE, is considered to be a suitably trained person for working in confined space.
- 6.5** Person employed who has undertaken any mandatory safety training course, either local or abroad, the contents of which covers the majority of the principles and the scope outlined in this Code shall be considered as properly trained. In this context, mandatory safety training courses include overseas and mainland safety training courses that satisfy the prevailing requirements of STCW95. The meaning of majority purports a proportion of not less than 70% of the whole.

7. MISCELLANEOUS

- 7.1** For dumb lighters licensed locally as Class II Vessel used solely for carrying and transferring freight containers in cargo operation, the hold bounded by the transverse bulkhead, longitudinal bulkheads and tank top plating shall normally not be regarded as ‘confined space’.
- 7.1.1 Yet, freight containers (with cargo inside) in transit may be damaged and leak out substances that may be harmful. Under such circumstances, the person in charge shall take appropriate preventive measures to guard against any worker/person coming into contact with harmful dust, fumes, vapour, gases, etc. Further, if, for any reason, the top opening of the hold is being sealed either partially or completely by canvas/tarpaulin or a hatch of any form of construction or the like, the hold shall then be regarded as ‘confined space’.
- 7.1.2 Other circumstances under which the cargo hold may become a ‘confined space’ include running an engine in the hold without extracting or diluting the exhaust gases by forced ventilation, carrying out extensive repair to the steel plating by using gas cutting/welding or electric arc welding equipment.
- 7.2** This Code shall be read along with other Codes issued by the Director in relation to works conducted on local vessels.

8. REFERENCES

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13. Confined Space Safe Practice, 2007 (International Association of Classification Societies Ltd., UK)
14. General methods for sampling and gravimetric analysis of respirable and inhalable dust, Methods for the Determination of Hazardous Substances, February 2000 (Health & Safety Executive, UK)

15. Guidance Notes on Medical Examinations for Workers engaged in Hazardous Occupations in Industrial Undertakings, 2003 (Occupational Safety and Health Council, HK in association with the Labour Department, the Government of HKSAR)
16. Guide to Safety and Health in Dock Work, 1988 (International Labour Office, Geneva)
17. International Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk (IBC Code), 2008 (International Maritime Organisation)
18. Recommendations on the Safe Use of Pesticides in Ships, MSC.1/Circ. 1358, 2010 (International Maritime Organization)
19. Revised Recommendations for Entering Enclosed Spaces Aboard Ships, Resolution A.1050(27), 2011 (International Maritime Organization)
20. Safety and Health in Ports, 2005 (International Labour Office, Geneva)
21. Safety Supervision of Work in Confined Space, Practice Note No. 1/2007, 2007 (Drainage Services Department, the Government of HKSAR)
22. Shipboard Cargo Handling Safety Guide, 1995 [*Incorporating Marine Department Notice No. 115A/92 - Precautions to be taken before entering tanks and other closed spaces*] (Marine Department, the Government of HKSAR)
23. Shipbuilding and Ship-repairing Safety Guide, 1973 (Marine Department, the Government of HKSAR)
24. Standard for the Control of Gas Hazards on Vessels, NFPA 306, 2009 (National Fire Protection Association, USA)
25. Standard Practice for Confined Area Entry, D4276 – 02 (Reapproved 2007) (ASTM International, USA)

Appendix 1 – Life threatening effects of Carbon Monoxide and Hydrogen Sulphide

For illustration purpose only

| Effects of Carbon Monoxide Exposure | | |
|--|-------------|-----------------------------|
| PPM | Time (hour) | Effects & Symptoms |
| 35 | 8 | Permissible exposure level |
| 200 | 3 | Slight headache, discomfort |
| 400 | 2 | Headache, discomfort |
| 600 | 1 | Headache, discomfort |
| 1000 – 2000 | 2 | Confusion, discomfort |
| 1000 – 2000 | ½ - 1 | Tendency to stagger |
| 1000 - 2000 | ½ | Slight heart palpitations |
| 2000 – 2500 | ½ | Unconsciousness |
| 4000 | > 1 | FATAL |

| Effects of Hydrogen Sulfide Exposure | | |
|---|-------------|---------------------------------------|
| PPM | Time (hour) | Effects & Symptoms |
| 10 | 8 | Permissible exposure level |
| 50 – 100 | 1 | Mild eye and respiratory irritation |
| 200 – 300 | 1 | Marked eye and respiratory irritation |
| 500 – 700 | ½ - 1 | Unconsciousness, DEATH |
| > 1000 | Minutes | Unconsciousness, DEATH |

Appendix 2 – Substances liable to form explosive mixtures

Acetylene

Acetylene is a colourless gas which has quite a pleasant smell when pure. It is slightly lighter than air and appreciably soluble in water. It is very violently explosive when mixed with air. The range of explosive mixture with air is very wide.

Propane gas

Propane gas used in gas welding/cutting is non-toxic and heavier than air. Its explosive limits range from 2.37 to 9.5%. It may contain an odorant such as ethanethiol or thiophene so that people can easily smell the gas in case of a leak.

Methane or Marsh Gas

It is usually found in coal bunkers in natural form. It may also be present in empty oil tanks. It is the simplest and lightest form of hydrocarbon, frequently found in association with, and as a constituent of crude oils. Being lighter than air, it would form a layer beneath the ceiling of a compartment.

Town Gas

The composition of town gas is:

| | |
|-----------------|--------|
| Carbon Dioxide | 19.5 % |
| Carbon Monoxide | 3 % |
| Methane | 28.5 % |
| Hydrogen | 49 % |

It is mainly supplied by shore pipelines and is normally not used on ships. However, the individual gases may be found on ships.

Liquefied Petroleum Gas

It is a mixture of hydrocarbon gases, including but not limiting to propane (up to 60%) and butane (up to 40%). Ethanethiol (as stenching agent) is added as an odorant for leak detection. The hazards include fire and explosion, at high concentration – anesthetic and asphyxiate.

Compressed Natural Gas

It is compressed natural gas, mainly composed of methane, to less than 1% of its volume at standard atmospheric pressure. The normal storage pressure is 200 - 220 bar.

Liquefied Natural Gas

Natural gas (mainly methane) is processed by liquefaction and is condensed into a liquid by cooling it to about minus 163degC. The hazards include flammability, freezing and asphyxia.

Combustible Dust

Finely divided combustible solids, suspended in air or in a gas that will support combustion can be ignited and lead to a dust explosion. Such explosions usually originate with a gas ignition. Dusts which ignite and propagate flame readily are:-

| | |
|-------------------|----------------|
| Aluminium | Dextrin |
| Bronze | Ebonite |
| Cellulose acetate | Ferromanganese |
| Chicory | Flax |
| Coal | Flour |
| Cocoa | Grass, Dried |
| Cork | Grains |
| Cornflour | Magnesium |
| Cotton, ground | Malt |

Appendix 3 – Nominal composition of dry air

In general, the nominal composition of dry air at sea level can be found to contain the following gases:

| Gas | % by volume | Molecular mass |
|--|----------------|------------------------|
| Nitrogen, N ₂ | 78.08 | 28.01 |
| Oxygen, O ₂ | 20.95 | 32 |
| Argon, Ar | 0.93 | 39.95 |
| Carbon Dioxide, CO ₂ | 0.03 | 44.01 |
| Other trace gases: Ne, He, Kr, H ₂ , Xe | Make up to 100 | Make up to 28.98 g/mol |

(For reference only)

It is assumed that the mixture consists of perfect gases and is homogeneous below 20m high. The moisture content, temperature and pressure of air varies as the atmospheric condition changes. The total pressure exerted by a gaseous mixture is equal to the sum of the partial pressures of each individual component in a gas mixture (Dalton's Law of partial Pressure). This total pressure can be used to determine the volume-based concentration of any individual gaseous component.

Respiration physiology:

Dry air inhaled would undergo a change as exemplified by the following process:

| Gas | Inhaled, Dry | | Tracheal, Saturated | | Alveolar | | Exhaled, Dry | |
|------------------|--------------|------|---------------------|------|----------|------|--------------|------|
| | % | mmHg | % | mmHg | % | mmHg | % | mmHg |
| O ₂ | 21 | 160 | 20 | 150 | 13 | 100 | 15 | 110 |
| CO ₂ | 0 | 0 | 0 | 0 | 5 | 40 | 4 | 28 |
| H ₂ O | 0 | 0 | 5 | 47 | 6 | 47 | 6 | 47 |
| N ₂ | 79 | 600 | 74 | 563 | 76 | 573 | 75 | 575 |

Note: The figures are for illustrative purpose only. It varies from person to person.

It is noted that there is a 6% reduction in O₂ and 4% increase in CO₂ of the air inhaled in the respiration process. (For reference only)

Appendix 4 – Substances liable to cause oxygen depletion

The materials listed below are known to be capable of causing oxygen depletion. However, the list is not exhaustive. Oxygen depletion may also be caused by other materials of vegetable or animal origin, by flammable or spontaneously combustible materials, and by materials with a high metal content:

- grain, grain products and residues from grain processing (such as bran, crushed grain, crushed malt or meal), hops, malt husks and spent malt;
- oilseeds as well as products and residues from oilseeds (such as seed expellers, seed cake, oil cake and meal);
- copra;
- wood in such forms as packaged timber, roundwood, logs, pulpwood, props (pit props and other propwood), woodchips, wood-shavings, wood pellets, woodpulp pellets and sawdust;
- 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;
- fish, fishmeal and fishscrap;
- guano;
- sulphidic ores and ore concentrate;
- charcoal, coal, lignite and coal products;
- direct-reduced iron (DRI);
- dry ice;
- metal wastes and chips, iron swarf, steel and other turnings, borings, drillings, shavings, filings and cuttings;
- scrap metal.

Appendix 5 – Persons approved by the Director of Marine to issue Gas Free Certificates

A guidance notes to the application requirements for becoming an Approved Person can be found on the following Marine Department website:

http://www.mardep.gov.hk/en/pub_services/ocean/pdf/miss_gfcert_req.pdf

The updated list of persons providing the services of issuing “Gas Free Certificates” under Regulation 21 of the Dangerous Goods (Shipping) Regulations, Cap. 256 is available on the Marine Department’s website at:

http://www.mardep.gov.hk/en/pub_services/ocean/miss_gfcert.html

The list will be updated whenever there is a withdrawal from or an addition to the ones enlisted.

Appendix 6 – Sample of Confined Space Work Permit

| Confined Space Work Permit | | | | | |
|---------------------------------|--|------------------|--|--|-------|
| 1 | Vessel | | Registration No. | | |
| 2 | Location/Name of Compartment | | | | |
| 3 | Material last stored in Compartment | | | | |
| 4 | Works to be carried out | | | | |
| 5 | Isolation of Compartment (Valves/pipelines) | | | | |
| 6 | Air Test done on | | Air Test result (details in Air Test/Gas Free Certificate) | Acceptable for Entry / Cold Work / Hot Work | |
| | | | | Acceptable for Entry / Cold Work / Hot Work | |
| | | | | Acceptable for Entry / Cold Work / Hot Work | |
| 7 | Ventilation | Natural / Forced | Duration | Continuous / hours | |
| 8 | Hazards | | | | |
| 9 | Recommended precautionary measures | | | Responsible person signs on the right when measures are done | (on) |
| | | | | | (on) |
| | | | | | (on) |
| | | | | | (on) |
| | | | | | (on) |
| | Special Requirement: | | | | |
| Entrance Attendant required | | | Yes / No | | |
| Continuous supervision required | | | Yes / No | | |
| 10 | Works Supervisor (WS) | | | | |
| 11 | Person in Charge of Works (PIC) | | | | |
| 12 | I confirm all safety measures are done and a safe atmosphere is maintained inside the Compartment. I am authorized to grant permissions to persons to enter and work inside the Compartment after the safety briefing. | | | Name and signature | () |
| 13 | Safety briefing conducted | by | on | by | on |
| | | by | on | by | on |
| | | by | on | by | on |
| 14 | Entrance Attendant | | on | from | to |
| | | | on | from | to |
| | | | on | from | to |
| | | | on | from | to |
| | | | on | from | to |

| Confined Space Work Permit | | | | | | | |
|---------------------------------|---|--|-----------------------------|----------|-------------|----------|--|
| 15 | Emergency Arrangement | Fire Fighting Equipment | Fire Hose prepared | Yes / No | Pressurised | Yes / No | |
| | | | Fire Extinguisher available | Yes / No | Type | | |
| | | | | | Quantity | | |
| | | Others | | | | | |
| | | Life Saving Equipment | BA set | sets | | | |
| | | | Resuscitator | Yes / No | | | |
| | | | First Aid kit | Yes / No | | | |
| Others | | | | | | | |
| 16 | <p>The hazards to work inside the Compartment (confined space) was identified and known to me. Respective measures had been conducted to reduce the risk of accident occurrence. The atmosphere inside the Compartment was tested and certified to be safe for working inside. A safety briefing was conducted to me prior I was permitted to enter the Compartment. Hereunder, I sign to acknowledge acceptance of the Permit.</p> | | | | | | |
| Name & Signature | Date: | Date: | Date: | | | | |
| | Date: | Date: | Date: | | | | |
| | Date: | Date: | Date: | | | | |
| | Date: | Date: | Date: | | | | |
| | Date: | Date: | Date: | | | | |
| | Date: | Date: | Date: | | | | |
| Remarks (if any) | | | | | | | |
| 17 | Completion of Work/Project | Confirm all personnel were retrieved and no one remained inside the Compartment. | Signature | Date: | | | |
| | | Confirm all tool and equipment were removed from the Compartment. | Signature | Date: | | | |
| | | Permission granted to seal up the Compartment | Signature | Date: | | | |
| Emergency Contact Phone Numbers | Person-in-Charge | | | | Tel: | | |
| | Works Supervisor | | | | Tel: | | |
| | Competent Person | | | | Tel: | | |
| | Ambulance | | | | Tel: | | |
| | Fire Service | | | | Tel: | | |

(Company Name)

(address 1)

(address 2)

(address 3)

(Tel & Fax)

(E-mail address)

Certificate No.: _____

Air Test Certificate

This is to certify that the undersigned did at _____ (time) hours on _____ (date) attend on board the _____ (name of vessel) whilst she was laying at _____ (location) _____ to conduct tests for the presence of explosive, combustible or toxic gases in the undermentioned compartments and/or tanks of the vessel.

The following compartments and/or tanks were tested by me by means of a gas detector for the presence of explosive, combustible or toxic gases. The gas detector used is branded _____ (optional) and typed _____ (optional) bearing a serial number of _____. The last calibration of it was done on _____ (date). The gases tested are H₂S*, CO*, O₂*, LEL* and _____ (name of other gases if any).

| COMPARTMENTS | RESULTS AND/OR REMARKS |
|--------------|------------------------|
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I hereby certify the above tests and results and declare that I am a Competent Person as defined in the current version of the Code of Practice – Working in Confined Space issued by the Director of Marine.

(Signature of Competent Person)
(Full name of Test Conductor)

Note: This certificate is valid only under the conditions prevailing at the time of test.

Date: _____

* Delete as necessary

Appendix 8 – Marine Department Contacts

1. For enquiries on occupational safety and health matters relating to shipboard industrial operations including cargo handling, ship-repairing and marine construction; and for reporting of industrial irregularities during office hours –

Marine Industrial Safety Section

Room 2315, Harbour Building, 38 Pier Road, Central, Hong Kong

Tel.: 2852 4472, 2852 4477 Fax: 2543 7209

2. For reporting of marine and shipboard accidents during office hours –

Marine Accident Investigation Section

Room 2103, Harbour Building, 38 Pier Road, Central, Hong Kong

Tel.: 2852 4523, 2852 4496 Fax: 2543 0805

OR

For reporting of marine and shipboard accidents during and outside office hours –

Vessel Traffic Centre

Tel.: 2233 7801 Fax: 2858 6646

V.H.F.: Channel 12, 14 and 67

3. For enquiries on matters relating to dangerous goods carried by vessels during office hours –

Dangerous Goods Unit

Room 307, Harbour Building, 38 Pier Road, Central, Hong Kong

Tel.: 2852 3085, 2852 4913 Fax: 2815 8596, 2805 2584

4. For alerting the search and rescue authority (24 hours manned) –

Hong Kong Maritime Rescue Co-ordination Centre (HK MRCC)

Tel.: 2233 7999

Fax: 2541 7714

5. Marine Department Web-site: <http://www.mardep.gov.hk/en/home/html>