



PANAMA CANAL AUTHORITY

**MANUAL
ON**

SAFE PRACTICES FOR WORK IN CONFINED SPACES

2005

MANUAL ON SAFE PRACTICES IN CONFINED SPACES

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MANUAL ON SAFE PRACTICES FOR WORK IN CONFINED SPACES

CHAPTER 1

GENERAL

1-1. INTRODUCTION

1-1.1. Purpose. This manual has been prepared to:

- a. Inform personnel performing work in confined spaces about the hazards and precautions involved in confined space operations.
- b. Establish and implement uniform standards to be followed by units and personnel working in confined spaces in or for the Panama Canal Authority.

1-1.2. Scope and Application. This manual establishes mandatory guidelines and procedures for all employees, contractors, and other persons working in confined spaces in Panama Canal Authority installations or equipment, or in Panama Canal operating areas

1-1.3. Special Hazards (exceptions to this manual). In special situations, whenever the emergency measures in these regulations (as set forth in this manual), cannot be taken to render safe a work site, a Class I Competent Person (an Industrial Hygienist/ Marine Chemist) and the Emergency and Contingency Management Division (MRE) shall be called to the scene of the problem. A Class I Competent Person shall determine the actions that need to be taken in order to implement the required emergency measures. If employees are exposed to toxic materials during the emergency, the Manager, Occupational Health Division (HRH) shall be notified.

1-2. CONFINED SPACES

1-2.1. Definitions

1-2.1.1. Confined Space. This term means any enclosed space that:

- a. Is large enough and so configured that an employee can bodily enter and perform assigned work;
- b. Has limited or restricted means for entry or exit, and is not designed for continuous employee occupancy, which would make escape difficult in case of an emergency;
- c. Is not designed for continuous employee occupancy;
- d. Has no natural ventilation;

e. Has one or more of the following characteristics:

- 1) Has or is known to have the potential of containing a dangerous atmosphere (e.g., toxic, explosive, or oxygen deficient). See Appendix A on Dangerous atmospheres;
- 2) Contains a material that has the potential for engulfing an entrant;
- 3) Has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor which slopes downward and tapers to a smaller cross-section; or
- 4) Contains any other recognized serious safety or health hazard.

1-2.1.2. Other Enclosed Spaces. These are enclosed spaces that do not meet enough of the criteria to be classified as confined spaces. Nonetheless, they may become hazardous during specific operations such as: painting, chemical cleaning or hot work; or may contain mechanical, electrical, or evacuation hazards. During the planning stage, supervisors shall assess spaces for potential risks, request the advice of their unit's Safety Specialist or the Industrial Hygienist, and follow his recommendations.

1-2.1.3. Confined Spaces aboard Floating Equipment.

- a. Except as set forth in paragraph b. below, only those spaces that require an entry permit, tanks, empty enclosed spaces, compartments with screwed on hatches, and/or those that have not been designed for continuous access, shall be considered confined spaces.
- b. Spaces below the deck of floating equipment (e.g., tugboat engine, storage, and rudder compartments) shall be considered as confined spaces requiring an entry permit, only when toxic vapors or gases may be generated in operations in or adjacent to them.
- c. Any inquiry regarding confined spaces aboard floating equipment shall be made to the Industrial Hygiene Section, Safety Division.

1-2.2. Special Precautions aboard Floating Equipment.

- a. The lockout and tagout procedures described in Section 6-1.5 of this manual shall be followed whenever the work to be performed below deck will not generate the conditions described in Section 1-2.3.b. of this manual, but will be performed in spaces with hazards due to moving machinery or electrical hazards.
- b. Spaces below deck shall be ventilated at least 10 minutes prior to and maintained throughout their occupation at all times. The natural or forced ventilation installations provided shall be inspected regularly and kept in good operating

condition.

- c. Only a **minimum** quantity of toxic or flammable substances and other hazardous materials may be kept aboard floating equipment. These substances shall be stored in sealed containers, and **only** in compartments designated, designed, and approved for such purpose.

1-3. CLASSIFICATION OF CONFINED SPACES. After a Competent Person has carefully inspected and assessed confined spaces, they shall be classified according to the following categories on the basis of existing or potential hazards:

1-3.1. Class I Spaces. These are spaces containing atmospheres or conditions that are or may become immediately dangerous to life or health (IDLH). These conditions include, but are not limited to, the presence of flammable vapors with a concentration of 10% or more than the lower flammable or explosive limit, or an oxygen content of less than 16% or more than 22%, or the presence of toxic substances that pose an immediate threat to life; can cause irreversible or immediately severe effects against health; or can cause eye injury or irritation or other conditions that could impede escape from the confined space.

1-3.2. Class II Spaces. These are confined spaces with atmospheres or conditions that are or may become dangerous, but do not pose an immediate threat to life if preventive measures are taken. These conditions include the presence of flammable atmospheres in concentrations of more than 2% but less than 10% of the lower flammable or explosive limit, or an oxygen content higher than 16% but less than 19.5%, or more than 21% but less than 22%, or toxic substances in concentrations below levels immediately dangerous to life and health, but within or above the established permissible exposure limits (PEL) or any combination of conditions.

1-3.3. Class III Spaces. These are confined spaces with atmospheres or conditions that are or could be contaminated, although not at a dangerous level that can pose an immediate threat to life. These conditions include the presence of flammable substances with a concentration of 2% or less than the flammable or explosive limit, oxygen levels between 19.5% and 21%, toxic substances with concentrations below the permissible exposure limits (PEL), or any combination of said conditions, provided the prescribed conditions of the flammable substances, oxygen, and toxic substances are reliable and remain unchanged.

1-3.4. Explanatory Note. For a Class III space, the confined space shall be ventilated at least 15 minutes prior to entry, and ventilation kept as warranted. Entry shall only be approved if, after ventilation, the confined space does not contain flammable or toxic substances; it has an oxygen level compatible with outside conditions (20% to 21%), and poses little potential for generating dangerous conditions. The oxygen content level established for Class I, II, and III spaces are approximate percentages. An oxygen deficient atmosphere contains less than 19.5% oxygen per volume. An atmosphere with enriched oxygen levels contains more than 22% of oxygen per volume. Nonetheless, it should be recognized that minor deviations may occur due to atmospheric pressure, instrument accuracy, etc. The oxygen content of confined space atmospheres must be as similar as

possible to that of the outside air. **Oxygen must NEVER be added** to a confined space to increase the oxygen percentage within the space. Ventilation must be used to achieve an oxygen level within the space that may be compatible with the outside air, and to ensure that all air intakes provide clean air to the space.

1-3.5. Non Written Permit Spaces. Some confined spaces do not pose a danger to employees entering for the specific purpose of performing **inspection and routine maintenance**. These spaces may be designated as Non Written Permit Spaces. This means that no Preliminary Planning Form, Entry Permit, or an attendant is needed. However, prior to classifying a confined space as Non Permit, a Class I Competent Person must conduct a physical inspection of the space, taking into account the following factors:

a. **Assessment Factors.**

- 1) The content or former contents of the space that may result in the generation of flammable or toxic atmospheres, or atmospheres that are oxygen deficient or oxygen enriched.
- 2) Adjacent spaces and their content, to ensure the space will not become contaminated.
- 3) The physical condition of the space that may contribute to hazardous conditions such as: slippery surfaces; deteriorated or unstable ladders; bad lighting or electrical and mechanical equipment systems; pipelines, conduits, ducts, or pressurized lines within the space that could be activated from the outside and contribute to hazardous conditions. If the physical condition of the space is the reason for its rejection as a Non Written Permit Space and the hazard can be corrected, a new inspection is required immediately after corrections are made.
- 4) The location and configuration of the space, including the restricted access, any obstructions, and its remoteness, which may inhibit or interfere with movement, ventilation, rescue efforts and the regularity of entry of employees.

b. **Designation Requirements.** If after a physical inspection of the site it is determined that the space can be designated as Non Written Permit Space, the following action shall be taken:

- 1) Class I Competent Persons shall make their designation in writing to the Division Manager.
- 2) Signs shall be posted at all entrances (see Appendix H, Non Written Permit Entry).
- 3) The space shall be ventilated for at least 15 minutes (unless the sign states otherwise) prior to each entry, and at all times while employees are inside.

- 4) All employees entering confined spaces must understand that the purpose of entering these areas is **only to perform inspection work or routine maintenance**, and that their work must not create dangerous atmospheres or other dangerous conditions.
- 5) Although a space may have been certified as a Non Written Permit Space, all persons entering it must not consider this a reason not to take precautions. Employees must stay alert at all times to detect any physical danger inside the space, as mentioned in paragraph “a.3)” of this Section.
- 6) Although no attendant is needed, all persons entering **shall report to their supervisor** the precise time of their entry and their estimated exit time, and shall report to the same person at the time they exit the Non Written Permit Space. It is important to note that the use of the buddy system is recommended in order to have a person at all times who can be notified about any danger.

1-4. COMPETENT PERSON

The variety of confined spaces present at Panama Canal Authority facilities and the complex nature of the activities that take place in those spaces require the availability of specific categories of Competent Persons who may issue permits to enter and perform work. These categories are described below:

"Competent person" means one who is capable of identifying existing and predictable hazards in the surroundings or working conditions which are unhealthy, unsafe, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them.

1-4.1. Class I Competent Person. This person shall be an Industrial Hygienist/ Marine Chemist. At this level, this person is authorized to issue entry permits for Class I to Class III confined spaces. The Industrial Hygienists/ Marine Chemists are **the only persons** authorized to issue hot work certificates for fuel tank operations, whatever the class of confined space may be. This includes confined spaces inside or immediately adjacent to fuel tanks or in pipes, pumps, fittings or other appurtenances connected to the fuel tanks (see Section 4-7). Likewise, industrial hygienists are the only persons authorized to issue an initial permit (first permit) to perform hot work on floating equipment in the areas mentioned in Section 4-7. Industrial Hygienists shall be called whenever recommendations are needed regarding the noise, ventilation, respiratory protection and protective clothing during the planning of confined space work.

1-4.2. Class II Competent Person. This person must be an especially trained employee certified by the Industrial Hygiene Section as a Panama Canal Authority (PCA) Class II Competent Person. At this level, this person is authorized to issue permits for entry to spaces up to Class III, with the hot work restrictions specified in Section 4-7.

1-4.3. Class III Competent Person. This person must be a Safety Specialist or another person with proven experience in safety or health matters, and shall have authorization to issue to Class III confined space entry certificates. Class III confined space entry permits may only be issued if after ventilating the space, the contaminants inside the confined space have been **reduced to normal ambient air levels** (see Appendix A on Normal Ambient Air Levels). In order to certify the entry to the various confined space types, these persons must have a full knowledge of the safety hazards in the various work activities within their areas of responsibility. The restrictions specified in Section 4.7 shall apply.

1-4.4. Class IV Competent Person. This person shall be nominated by the Division Manager, normally at foreman level, and shall be knowledgeable of the hazards of in **a particular work activity**. These persons are authorized to issue Class III confined space entry certificates, and **only for a particular work activity** assigned to them (e.g., manholes, sumps, pits, tanks, bilges, ship holds, etc.). Class III space entry permits may only be issued if after venting them, the contaminants inside the confined space have been **reduced to normal ambient air levels** (see Appendix A on Normal Ambient Air Levels). Hot work restrictions specified in Section 4.7 shall apply.

1-4.5. Confined Space Electrician. This person must be a qualified electrician trained in inspection procedures and verification testing for compliance with the requirements for electrical work in confined spaces according to Parts 1910 and 1915, Title 29 of the Code of Federal Regulations of the United States (see Appendix E). A confined space electrician **is not** a Class III or Class IV Competent Person, unless he has had additional training and certification.

1-4.6. Competent Person Certificates. These certificates shall be issued by the Manager, Industrial Hygiene Section (ESSI), Occupational Health Division (ESS) or his designee, to Division Managers of the rest of the Panama Canal Authority. The decision to designate an employee as a Competent Person is an operations decision to be made by the concerned Division Manager on the basis of the designee's conscientious and reliable work and the need for the services of a Competent Person in the employee's operating area. Division Managers shall then assess trained employees, select those who will perform as Competent Persons in specific work areas, and inform them with regard to their duties and responsibilities. Competent Persons shall be provided special training which shall include tutoring by Industrial Hygienists, and they shall be certified after they show to the Industrial Hygienists that they are capable of successfully performing the tasks required at their level of competence. These Persons may be recertified annually after taking a recertification course and passing a new test.

1-5. RESPONSIBILITIES

1-5.1. Managers are responsible for ensuring that employees and contractors under their jurisdiction or area of responsibility comply with PCA Standards on Work in Confined Spaces and this Manual on Safe Practices for Work in Confined Spaces. Each project

involving work in confined spaces shall have a single designated supervisor responsible for the work to be performed at such location.

- a. **Division Managers** have the responsibility of ensuring that operations are conducted in a safe manner in the confined spaces in their Division. Each supervisor in the supervisory chain is responsible for having the group under his supervision, however small it may be, carry out operations in confined spaces in a safe manner. Division Managers shall designate Class IV Competent Persons to inspect and issue permits for the work activities in which they are knowledgeable. Due to their work experience and training in confined spaces, Class IV Competent Persons are the best qualified to inspect spaces in their work areas and assess the work practices and hazards involved in each individual operation. The Industrial and Safety Training and Development Section (HRTI) shall train Class IV Competent Persons and work in the field with Class I Competent Persons in order to provide a general familiarization and assist in completing the specific projects in their area. Division Managers also have the responsibility of identifying and posting signs at confined spaces at their facilities. After Division employees make a preliminary assessment to identify confined spaces, a Class I Competent Person shall make the final determination of the actual confined spaces, and which of them may be designated as Non Written Permit Spaces (see Section 1-3.5). These determinations and designations shall be made in writing, and the confined spaces shall be identified by means of a sign (see Appendix H).
- b. **Operations Managers and Supervisors** up to the designated supervisory level shall be responsible for ensuring the compliance with the provisions of the Standards on Work in Confined Spaces and this Manual on Safe Practices for Work in Confined Spaces.

1-5.2. Supervisors shall know the provisions of this Manual that cover personnel or the operations under their supervisory control. The designated supervisor of a work project is the employee in charge of the confined space, and **shall be responsible for completing the Preliminary Planning Form and obtaining an Entry Permit from the Competent Person.** Supervisors shall do their utmost possible to eliminate the potential hazards in the operations under their control and shall:

- a. Explain to employees under their immediate supervision the nature of the hazards and the necessary measures to control said hazards (Hazard Communication Standard).
- b. Strictly enforce the requirements in this manual and the pertinent standards and regulations to which it refers.
- c. Promptly inform his immediate superior about any unsafe conditions or procedures and, as justified by the severity of the conditions, suspend all operations until corrective measures have been taken.

- d. Ensure that all employees assigned to work at a confined space work site possess a thorough knowledge of the tasks assigned to them, preventive measures, and emergency procedures; and that all the required protective equipment is available and used as required.
- e. Prior to entry, the supervisor shall inform entrants with regard to the following:
 - 1) Preliminary Planning Form and Entry Permit;
 - 2) Work to be performed;
 - 3) Hazards that are expected or that may be generated;
 - 4) Physical configuration of the space;
 - 5) Communication methods to be used;
 - 6) Rescue or evacuation procedures;
 - 7) Surveillance and alarm devices;
 - 8) Requirements regarding the personal protection equipment and how to use it;
 - 9) Signs and symptoms of exposure to a hazard and the consequences when exposed to it.
- f. Enforce at all times the conditions of the Preliminary Planning Form and the Entry Permit.

1-5.3. Operations Personnel who will enter and work in confined spaces have the responsibility of fully understanding and strictly observing the safety standards, regulations, and procedures that apply to this type of work. Also, each person shall:

- a. Inform his immediate supervisor about any condition, procedure, or equipment he may consider unsafe.
- b. Warn others who may be in danger, regarding what can happen if the proper procedures are not followed or the proper precautions are not taken, or regarding the dangers that may arise.
- c. Inform his supervisor about any injury or sign of disability that may occur during the operations or that may affect the safe performance of his duties.

1-5.4. Owner Unit of the Confined Space and the Unit Performing the Work. There are instances in which personnel from another unit performs the work (**performers**) in a confined space belonging to another unit (**the owner**), e.g.:

- a. A tugboat of the **Department of Maritime Operations / MR** (the **owner**), which is at the **Dredging, Signaling, and Cranes Division** (IPD) or at the **Industrial Drydock Division** (SII) (performing units) for repair or overhaul, which includes confined space work aboard the tugboat;

- b. A contractor (the **performer**) with a project at the locks (the **owner** unit), which includes confined space work, or
- c. The Engineering Division (-IPI) or the Electrical and Water Systems Division (the **performing units**), who must perform water, power, or telephone work in the tunnels in the Balboa Industrial Area. The tunnels are owned by the Panama Maritime Authority (the **owner**).

In the event the **owner** unit and the performers do not belong to the same unit, the **owner** unit shall provide the **performer** with all the available information about the hazards in the confined spaces, the hazards in all the rest of the work sites, the safety rules and the emergency procedures the **performers** must know to comply with these provisions. It is also essential that they establish a close coordination of their activities in order to:

- a. Ensure that each unit knows the sequence of the work tasks being performed near the confined space, and how the operation by one can affect those of another;
- b. Ensure that the necessary precautions are taken to avoid interfering or endangering workers (the **performers**) engaged in the confined space work, and
- c. Keep any interruptions of **owner** unit operations at a minimum.

In order to comply with these provisions, the **owner** unit shall participate with the **performers** in the planning of the confined space work, and shall sign both the Preliminary Planning Form as well as the Entry Permit.

Performers have the responsibility of obtaining and providing the services of a Competent Person.

1-5.5. Industrial Hygienists and Safety Specialists act as advisors. They shall be available to assist, provide information, advice, counsel, and recommendations, without detracting from or taking over a supervisor's responsibility of conducting confined space operations safely. As required by the class of space, they provide services to certify entries. Industrial Hygienists are the final authority on confined spaces.

1-5.6. Competent Persons are responsible for testing and assessing confined spaces by identifying the existing or potential hazards that may arise when working in or adjacent to them, prescribe the proper precautionary measures by reviewing and approving the Preliminary Planning Form and preparing the Confined Space Entry Permit. **The only person who may authorize the entry to a confined space is a Competent Person.**

1-5.7. Contractors working in confined spaces located in PCA areas or equipment or in the proximity of PCA employees shall comply with the confined space standards and the provisions of this Manual. Contracting officers, their representatives and managers in whose areas contractors are working, are responsible for their enforcement.

1-6. PERMIT SYSTEM (CERTIFICATION OF CONFINED SPACES)

An Entry Permit provides a written authorization to enter and work in confined spaces; it clearly states the known or potential hazards; it identifies the safety equipment required to guarantee worker safety; it certifies that a trained Competent Person has assessed all existing hazards and that all the necessary protection measures have been taken to ensure worker safety. For more detailed information, see Chapter 4, Appendixes F and G. Entry into a confined space shall only be allowed with a written authorization, except for entry to Non Written Permit Spaces (see Section 1-3.5). The Confined Space Entry Permit has two parts: The Preliminary Planning Form prepared by the supervisor of the work and verified **by** the Competent Person, and the Entry Permit prepared by the Competent Persons and signed by both the supervisor and the Competent Person.

1-7. ATTENDANT (STANDBY)

To enter into any confined space, except to a Non Written Permit Space (see Section 1-3.5), an attendant shall be stationed (see Section 7-1.) immediately outside the entrance, who shall keep **in constant communication** with the persons inside the confined space. The use of an attendant is mandatory to enter any confined space. Attendants shall be trained properly in the requirements of their duties and the actions they must take in case of an emergency.

1-8. MEDICAL ASPECTS

1-8.1. Physical Requirements

- a. Persons working in Class I, II, and III confined spaces must be capable of wearing respirators and show they can see and hear warnings such as intermittent lights, bells, and sirens.
- b. Persons using respirators shall undergo quantitative fit and spirometric testing.
- c. Persons with difficulty wearing respirators shall be referred to an occupational health physician for a more detailed assessment.

1-8.2. Emergency Medical Attention.

- a. When working in Class II or III confined spaces, at least one person shall be kept immediately available who holds a valid certificate to administer first aid and CPR.
- b. At the start of each job, employees shall be informed about the nearest first aid station and how to obtain emergency assistance; this information shall be repeated

at the beginning of each shift. An adequate supply of first aid equipment shall be kept at the work site, outside the confined space.

- c. The Preliminary Planning Form shall identify the employees at work site who hold a valid certificate to administer CPR and first aid.

1-9. TRAINING

Training shall be provided to the five categories of employees that participate in confined space work.

1-9.1. Competent Persons shall be trained by PCA in order for them to perform at their designated level. Their training will cover: respirators, self contained breathing apparatus (SCBA), lockout/tagout systems, rescue, personal protection equipment, recordkeeping, firefighting, communications, work practices, permits, types of hazards, testing and the use of instruments and alarms.

1-9.2. Supervisors shall be trained by PCA on the following: emergency entry and exit procedures, respirators, self contained breathing apparatus (SCBA), lockout/tagout systems, rescue, personal protection equipment, recordkeeping, firefighting, communications, work practices, permits, types of hazards, and alarms.

1-9.3. Workers shall be trained at operational levels on the following: emergency entry and exit procedures, respirators, self contained breathing apparatus (SCBA), lockout/tagout systems, personal protection equipment, firefighting, communications, work practices, permits, types of hazards and alarms.

1-9.4. Attendants (Standbys) shall be trained at operational levels on the following: emergency entry and exit procedures, respirators, self contained breathing apparatus (SCBA), first aid, CPR, lockout/tagout systems, rescue, personal protection equipment, firefighting, communications, work practices, types of hazards, testing and alarms (see Chapter 7).

1-9.5. Rescue Team Members shall be trained by PCA at operational levels (see Chapter 7). Divisions shall have as first responders a line first responder or an arrangement whereby a team from the Emergency and Contingency Management Division (MRE) will respond to a request for rescue services.

- a. **On Plant Rescue Team.** Urgent response is required and the Division decides to use an on plant team as first responder (with the Emergency and Contingency Management Division team as second responder). The Division shall ensure that:
 - 1) The Emergency and Contingency Management Division provides personal protection equipment, including self contained breathing apparatus (SCBA) and rescue equipment to the on plant rescue team, and trains the team regarding their use;

- 2) The team is trained to carry out the assigned rescue functions;
 - 3) The rescue team (including the Emergency and Contingency Management Division rescue team) gets drilled on confined space rescue at least once every twelve months (check to see whether this is contemplated in your ISO Procedures), by means of simulated rescue operations in which they remove dummies, manikins, or actual persons through representative openings and holes of a size, configuration, and accessibility similar to those of the confined spaces from which rescue is to be carried out; and
 - 4) At least one rescue team member holds a current, basic certification to administer CPR and first aid, and is skilled in the use of air supply.
- b. **Off Plant Rescue Team.** If the Division employs the services of the Emergency and Contingency Management Division rescue team as first responder, the Division shall ensure that the designated rescuers know the hazards they will confront when summoned to perform rescues at its installations, in order that they will have the adequate training, and may equip themselves to perform properly.

CHAPTER 2

PLANNING

2-1. PLANNING

2-1.1. Assessment of Hazards in Confined Spaces. Many factors must be assessed prior to entering or working in or over a confined space. These assessments must be made after conducting a physical inspection of the site and including, but not necessarily limited to, the following:

- a. The current or the three previous contents of the space, which could result in the presence of flammable or toxic substances or atmospheres in which the oxygen has been depleted or enriched.
- b. The location and configuration of the space, including access limitations, obstructions, remoteness, etc., that could inhibit or interfere with the movement, ventilation, rescue or firefighting, etc.
- c. The type of work to be performed inside the space, particularly that which due the nature of its process could generate toxic or flammable substances, oxygen deficiency or enrichment, or sources of ignition.
- d. Lamps, devices, or equipment inside the space that could create or contribute to hazardous conditions, including pipe systems, conduits, ducts, electrical cables, pressurized lines or machinery within the confined space, which could be activated from the outside.
- e. The presence of other hazards such as slippery surfaces, deteriorated or unstable ladders, irritant or caustic materials, the presence of animals, accumulated water, etc.
- f. Adjacent spaces and their content, to ensure that the operations that will be conducted will not cause fire or explosion in these spaces.
- g. The frequency of employee routine entry.

2-1.2. Advance Planning. All confined space work shall be planned prior to entering and performing the work. The complexity of the work to be done shall determine the degree of formal planning. At least, the following elements must be considered for any planning:

- a. The date(s) and time(s) of entry and exit.
- b. The inspection and assessment of the confined space.
- c. The work to be performed:

- 1) Sequence.
 - 2) Manual work required.
 - 3) Tools, materials, and equipment required.
 - 4) Additional support or services required outside the confined space.
 - 5) Personal protection equipment required.
 - 6) Safe work practices.
- d. The designated personnel.
- 1) Supervisor in charge (responsible for health and safety).
 - 2) Attendant or lookout.
 - 3) Task assignment and location of workers in the confined space.
 - 4) Personnel certified to administer CRP and first aid, to be called in case of emergency.
 - 5) Rescue equipment.
- e. Hazard Assessment.
- 1) Determine and list the materials previously stored or used in the confined space,
 - 2) Research the hazards (in Material Safety Data Sheets - MSDS) associated with the products previously stored or used in the confined space, or with combinations of them or their byproducts,
 - 3) Identify the hazards associated with the materials or procedures to be used in the work to be performed.
- f. Preparation of the confined space.
- 1) Washing
 - 2) Cleaning
 - 3) Ventilation
- g. Pre-entry orientation session.
- 1) Date and time
 - 2) Items that should be covered
 - 3) The commitment to adhere to safe work practices
 - 4) Emergency drills
 - 5) Inspection of emergency and rescue equipment
 - 6) Record of the session
- h. Emergency planning.
- 1) A list of emergency procedures and task assignment
 - 2) Location of escape routes

- 3) Rescue or emergency equipment to be kept on hand.
 - 4) Designation of rescue, first aid, CPR, and other emergency support personnel.
- i. Request the services of a Competent Person and Entry Permit.

2-1.3. Standard Operating Procedures. Repetitive or routine work must be standardized in writing in the form of Standard Operating Procedures (SOP). Such work would be, for example, sandblasting, cleaning, chipping and scraping, painting and open flame or arc welding in confined spaces. These procedures may be used to complement the Preliminary Planning Form and are referred to in the Sections describing the "Type of Hazardous Work", "Other Expected Hazards" and "Safety Preparations".

2-1.4. Preliminary Planning Form. Within their area of responsibility, supervisors must know the safety requirements for the work their crews will be performing in the confined space. As part of their planning, supervisors shall prepare a Preliminary Planning Form (see Appendix F). The Competent Person shall use this form as a guide to assess the work to be performed, the possible hazards such work can create, the safety requirements and special testing needed, etc. Once the Competent Person has reviewed the form with the supervisor in charge of the confined space, the testing shall be done and the space assessed. This Preliminary Planning Form will then be attached to the Confined Space Entry Permit issued by the Competent Person, and shall serve as the basic information for the workers' personal safety, isolation, lockout/ tagout systems, etc. For simple and repetitive work, reference may be made to the standard operating procedures in the Preliminary Planning Form, provided they have been reviewed and approved by the Competent Person.

2-1.5. Confined Space Recordkeeping.

- a. Each project or location of a confined space shall have a file or record which the designated project supervisor shall keep with him. The record or file shall contain the following documentation, as applicable:
- 1) Material Safety Data Sheets for each toxic or hazardous substance which the confined space contains or will be used during work in the confined space.
 - 2) The project planning list, to be prepared in advance.
 - 3) Minutes of the orientation provided to employees, its date and the names of the crew members who in attendance.
 - 4) A list of emergency drills conducted and the names of crew members who participated in them.
 - 5) A list of shifts worked, with the names of the crew members.
 - 6) Copies of the permits issued prior to the current permit.

- 7) Copies of the results of any confined space atmosphere tests, which are not those that resulted in the issuance of permits.
- b. In addition to the records to be kept at the project site, or in the work site record or file, operating Divisions shall keep the following records:
- 1) Records on the confined space training provided to employees.
 - 2) Documentation on the inspections of the equipment to be used in the confined spaces or to support such work. This documentation may be in the form of tags, adhesive tags, or logs, and shall have the date in which the inspection was conducted, the name of the inspector, and whether the equipment was in satisfactory condition.
 - 3) Equipment maintenance records. These shall mention the work performed, the person who did it, and whether an inspection was made; the information listed in b.2).

CHAPTER 3

TESTING

3-1. CONFINED SPACE TESTING PROCEDURES

3-1.1. Initial tests and inspections. Initial tests and inspections of a confined space shall include certain established routine steps. The following provisions shall be incorporated to the confined space testing and inspection procedures:

- a. Initial tests shall be conducted from the outside the confined space and prior to its ventilation. If the space is being ventilated, the ventilation shall be turned off prior to testing at least 10 minutes to allow air equalization. The tests of the interior of the confined space may be done by introducing or inserting probes and hoses to collect samples.
- b. The first test shall be for oxygen content, using an approved oxygen gage. The oxygen level should be of approximately 21%, since the normal oxygen level of the ambient air at sea level is 20.9%. At any rate, the oxygen reading inside the confined space must correspond to the air reading outside the space. Oxygen levels less than 19.5% or more than 22% pose potentially hazardous situations.
- c. Next, a test shall be conducted to detect combustible vapors with an approved combustible gas indicator. The Panama Canal Authority safety standards require that combustible atmospheres be kept at less than 10% of the lower explosive or flammable limit (LEL). Nonetheless, due to the many variables of test instruments, and the difficulty in obtaining definite readings, any reading observed in the combustible gas test instrument shall be considered as a sign that the space has potentially unsafe conditions. Oxygen tests must be conducted jointly with combustible gas tests in order to avoid false or inaccurate readings of the combustible gas indicator, due to oxygen deficient atmospheres.
- d. Tests shall be conducted to detect the presence of specific toxic substances, depending on the nature of the confined space and its previous and current contents.
- e. When initial tests show the presence of concentrations of flammable or toxic substances, or deviations in oxygen levels, personnel shall not enter the space and a Class I Competent Person shall be called. The source or cause must be found and eliminated, if possible, and the space ventilated or cleaned to eliminate flammable and toxic atmospheres, and supplied with adequate oxygen levels (see Section 1-3).
- f. When the initial tests do not detect the presence of concentrations of flammable or toxic substances, or deviations in normal oxygen levels, the confined space may be entered and the tests described in paragraphs b, c, and d of this Section conducted

progressively throughout the entire confined space. If these tests show the presence of dangerous concentrations of flammable substances or a deviation in normal oxygen levels, the person conducting the test shall leave the confined space and it must be ventilated (see Sections 1-3 and 1-4).

- g. If the confined space tests do not show the presence of flammable or toxic concentrations, or deviations of the normal oxygen levels, the space shall be inspected to detect the presence of flammable or combustible residues (or toxic, as applicable), blisters, or scaling that could have trapped dangerous substances; rags, ropes, wood, or other materials that could become hazardous when heat is applied. Also, any specific structure, equipment, or location that could affect or be affected by the work to be performed should be tested and inspected.
- h. When the concentrations of flammable or toxic substances cannot be reduced by venting or cleaning, or when it is possible that such conditions may be found, such as in the case of tank cleaning operations, or of flammable or toxic vapors that have been trapped in sediment layers that can loosen when shaken, **and it is necessary for workers to enter the confined space** to conduct more testing, inspections, assessments, etc., these entries shall be subject to the following restrictions:
 - 1) Every entry into spaces containing flammable or toxic substances shall be authorized specifically by a Class I Competent Person, with the exceptions made for those in Class II.
 - 2) Personnel entering confined spaces shall be equipped with approved respiratory protection, safety clothing, and explosion proof equipment (spark roof or intrinsically safe), as necessary. Personnel entering the space shall be equipped with a harness and a lifeline, and a reliable attendant with an assistant shall be stationed outside the space, to provide assistance in case of an emergency. Communication between the persons inside the confined space and the attendant and assistants shall be established and maintained.
 - 3) No entry of personnel shall be allowed into spaces containing flammable atmospheres with higher than 10% of the lower explosive limit (LEL), or toxic atmospheres that pose an immediate danger to life or health (IDLH), except as authorized in Section 4-5.a.1.
 - 4) Personnel may not enter spaces containing oxygen enriched atmospheres.

3-1.2. Continuous or Periodic Testing and Permit Maintenance. Many factors contribute to the deterioration of safe conditions inside a confined space, including the operations performed within the space, environmental conditions, or interruptions in the work. Operations that may create hazardous conditions include, but are not limited to: welding, cutting, burning, spray painting, paint removal, etc. Environmental conditions that may create these hazardous conditions include, but are not limited to, rising temperatures

inside the space due to an accelerated vaporization. During work interruptions, the presence of solvents, rags wet with solvents, welding or cutting torches, closed ventilation, etc., can cause hazardous conditions.

Continuous testing and monitoring of the confined spaces shall be done when, in the opinion of a Class I Competent Person, the conditions within the space deteriorate, or the limitations of the permit are exceeded. Periodic or continuous testing shall be done to confirm if the conditions of the initial permit are being maintained. The basic consideration is to maintain safe conditions within the confined space during operations and after interruptions in operations.

- a. **Types of Operations.** The following types of operations shall be carefully assessed to determine whether a **periodic or continuous monitoring** must be maintained:
 - 1) Hot work with the potential of generating hazardous toxic concentrations.
 - 2) Hot work, if there are preservative materials present.
 - 3) The application of preservative materials, paint, coal tar, etc., capable of generating hazardous concentrations of toxic or flammable vapors.
 - 4) Cleaning operations, the removal of sediments, etc., capable of producing or causing the generation of hazardous concentrations of flammable or toxic vapors.
 - 5) Any similar operations with the potential of producing or generating atmospheres or toxic, flammable, or suffocating materials in the confined space.
 - 6) Any operations capable of depleting, displacing, or enriching the oxygen content.

- b. **Delegation.** When deemed prudent, Class I Competent Persons shall make a preliminary inspection and, to the extent possible, may delegate their authority in the Entry Permit to a Class II, III, or IV Competent Person for periodic or continuous operations similar to those described in item “a.” of this Section, and all the measures taken to control or eliminate hazards in said spaces. Nonetheless, for such action it will be necessary that:
 - 1) The Class II, III, or IV Competent Persons have understood, to the satisfaction of the Class I Competent Person, the safety requirements or the work to be performed in the confined space.

- 2) The Class II, III, or IV Competent Person to whom such duties are delegated conduct the initial inspection of the delegated work along with the Class I Competent Person.
- 3) The Class I Competent Person shall clearly establish in the Entry Permit the testing procedures for periodic or continuous monitoring, and that such procedures are disseminated by means of instructions regarding the process, or standard operating procedures.
- 4) The Class I Competent Person shall provide the necessary information and shall determine whether the Class II, III or IV Competent Person to be delegated is duly qualified by virtue of his training and experience to carry out the specific tasks delegated to him and whether he **clearly understands them**.

3-1.3. Testing and Recertification of Confined Spaces. Whenever events occur that result in a significant change in the conditions inside a confined space, such space shall be tested and certified by means of an initial certification, in accordance with Section 3-1.1. Such events include, but are not necessarily limited to:

- a. Expiration of the permit without conducting tests or updating the permit.
- b. Expiration of the permit without entering or starting work inside the confined space.
- c. Any significant changes occurring inside the space, such as the detection of hazards enough to justify stopping the operations and evacuating the personnel, the introduction of new operations into the space which were not included in the initial Entry Permit (on the Preliminary Planning Form and the Entry Permit).

3-1.4. Atmospheric Testing Equipment. Testing equipment shall be kept in good operating condition. Calibration checks shall be done at the beginning of each work shift on the dates when the instrument is needed. A record book shall be kept to log the calibrations and the maintenance of all instruments (see Appendix I).

3-1.5. Continuous Monitoring Equipment for Atmospheric Testing. Continuous monitoring equipment shall be equipped with an alarm. If they are to be used in very noisy areas, these instruments shall have a visible alarm that can be easily seen. They shall be calibrated to detect the worst possible contaminant that may be generated by the work to be performed, or by any other possible source within the confined space. These monitors shall be worn or mounted inside the confined space, in a location established by the Competent Person.

CHAPTER 4

PERMITS

4-1. INTRODUCTION

Daily normal operations require permits to enter confined spaces and perform work which may consist of simple inspections to complicated cleanup and painting projects.

The initial entry (first entry) to a confined space is the most critical one, because the space has remained closed long enough for potential hazards to develop. Subsequent daily entries to a confined space may pose little or no danger, as cleanup and ventilation of the working environment has already been done. Many Panama Canal Authority projects (in boilers, pipelines, cylinder gates, barge and tank maintenance, etc.) consist of repetitive work performed daily, and the worst hazard an employee faces is not the daily entry conditions but the work performed inside (hot work, cleaning, painting). Therefore, it is necessary that supervisors keep a close surveillance and constantly review work practices, to provide employees with the safest possible working environment.

Permits issued to enter and work in confined spaces shall only be valid for a single work shift. After issuing the initial permit (see Section 4-7), the Class I Competent Person may delegate the authority to a Class II, III, or IV Competent Person to issue subsequent permits, or to conduct the necessary monitoring. If necessary to maintain safe conditions in the space, continuous or periodic testing of the confined space shall be done. The certification shall be updated as the space is monitored. Another option available to the Class I Competent Person for the specific purpose of inspections and routine maintenance work is to designate the space as Non Written Permit Space during a specific period; however, to do so will require compliance with all the provisions in Section 1-3.5.

4-2. GENERAL ENTRY AND WORK REQUIREMENTS

Any entry to confined spaces which requires a permit shall be considered hazardous, and entry to said spaces is prohibited until the appropriate testing has been done and they have been rendered safe. ENTRY TO A CONFINED SPACE SHALL NOT BE PERMITTED BEFORE THE PERMIT IS ISSUED, COMPLIED WITH, AND POSTED AT THE MAIN ENTRANCE.

After reviewing the PRELIMINARY PLANNING FORM FOR ENTRY TO A CONFINED SPACE (Appendix F), completing the tests, conducting the inspection, the assessment, cleaning or ventilation of the space, the Competent Person may prepare and issue a permit for entry to a confined space (Appendix G).

This permit shall show the conditions found at the time of issuance of the permit, any requirements necessary to maintain the conditions within the space if they are adequate, and the requirements relative to the operations that will take place inside the space.

Appendix K shows the various conditions that may be found during the initial testing of confined spaces and those capable of introducing hazards into them. Please note especially that Appendix J only deals with the general conditions, in order to illustrate the basic testing of confined spaces and certification procedures, and does not attempt to cover any special requirements or considerations regarding matters such as hot work, lockout systems, blanking systems, isolation, cleanup procedures, etc. These areas are dealt with separately in another part of this Manual. This section contains the specific requirements for the initial testing and certification, repeat testing, and updating of certificates, etc.

The following provisions are about the conditions illustrated in Appendix K

- a. Whenever significant work interruptions occur, or the operations or conditions are such that, in the judgment of the Competent Person, the safe conditions inside the space could deteriorate, the space shall be tested or inspected again after the interruption and prior to resuming entry or work in the space.
- b. Whenever operations which produce contaminating substances such as spray painting, welding, cleaning with solvents, etc. must be performed in the confined space, periodic or continuous testing shall be conducted according to the nature of such operations, as specified by the Competent Person. The permit shall specify the requirements applicable to these operations, such as ventilation, personal protection equipment, respiratory protection, explosion proof equipment (spark proof), the appropriate fire protection/ suppression equipment, etc. Whenever the requirements are specifically contained in the instructions regarding the process or in the standard operating procedures, reference may be made in the Preliminary Planning Form to the standard operating procedures, and a copy of same attached to the Form.
- c. If upon conducting the initial testing it is determined that the space needs to be ventilated to remove the detected contaminants or to provide adequate oxygen levels, prior to issuing an entry or work permit the space shall be ventilated and retested repeatedly if necessary, until the contaminant or the oxygen are at safe levels.
- d. If after the initial testing it is determined that cleaning is needed to remove contaminants from the space, a temporary permit shall be issued specifying any conditions that must be observed.
- e. **Whenever hazardous conditions are detected during periodic or continuous testing, upon repeating the tests to update the certificate, or by other means, which show that it is a Class I or Class II confined space, all work shall be stopped and the personnel shall leave the space.** The Class I Competent Person and the supervisor of the work shall be immediately notified about these conditions. No one may enter the space and the work may not be resumed until all

the unsafe conditions have been corrected or controlled, and the space has been retested and recertified.

- f. Workers shall not work in a Class I confined space alone, or without communication or surveillance. Communication shall be established and maintained between the personnel outside the confined space and any personnel entering or working in it. The type of communication (voice, signal line, etc.) and the frequency of the contact (continuous, periodic verification, etc.) shall be determined by the Competent Person on the basis of the nature of the space, the operations, and the degree of the hazard (see Section 7-1).
- f. **Unattended entry to confined spaces by individuals or groups is prohibited, unless it is according to the special conditions described in the Section on Spaces Not Subject to Written Permit (Section 1-3.5).**

4-3. PERMIT DISTRIBUTION

When confined space entry permits are issued, their distribution shall be as follows:

- a. A copy of the permit with the Preliminary Planning Form shall be posted at the main entrance or access area most commonly used.
- b. A copy shall be posted at all other access areas that are open and are easily accessible to workers.
- c. A copy of the permit shall be retained for one year in the records of the Competent Person.
- d. Other copies shall be distributed according to the particular administrative or operational requirements of the Department, Division, or Section.

4-4. PERMIT CONTENTS

The entry permit shall contain, as a minimum, the information shown on the Confined Space Entry Permit in Appendix G. Certificates shall include the following information:

- a. Date and time of tests.
- b. Date and time of duration of the permit.
- c. The name of the unit and the person requesting the permit.
- d. The location and identification of the confined space.
- e. The type of operation for which the certificate has been requested, such as hot work, spray painting, etc.

- f. The classification of the confined space.
- g. The category of the conditions that have been found inside the space (e.g., "**Atmosphere Safe for Personnel - Dangerous for Hot Work**").
- h. The test results of the atmosphere in the confined space:
 - 1) Flammability or explosive levels.
 - 2) Oxygen levels.
 - 3) Level of toxic substances, such as carbon monoxide, hydrogen sulfide, etc. according to the Threshold Limit Values (TLV) established by ACGIH.
- i. Any hazards that may be found due to the current or past use of the confined space, and of any purge, or the inert space that has been or will be created prior to entry.
- j. The hazards to be generated by the activities that will take place during the time the confined space will be occupied.
- k. The manner in which the inert space will be created, if such a measure is to be taken.
- l. If continuous or periodic monitoring is needed, **it shall be conducted with the frequency established by the Class I Competent Person.**
- m. Special conditions which shall be included in the Comments section.
- n. The signature of the supervisor assigned to the work, in charge of the confined space operation; and the signature of the Competent Person (with his employee IP number next to his signature).

4-5. CLASS I AND CLASS II CONFINED SPACE ENTRY AND WORK RESTRICTIONS

The following restrictions apply to Class I and II confined space entry and work.

- a. Class I Confined Spaces: Entry or work is not permitted in Class I spaces in normal operations. It will be allowed as authorized by a Class I Competent Person only in the following circumstances:
 - 1) Generally, entry to Class I spaces may only be authorized in extremely urgent cases, such as for rescue efforts or emergency repairs. In the event such entry or urgent work must be made, any personnel entering the space shall be equipped with an approved pressurized self contained breathing apparatus (SCBA), a harness of an adequate type that may allow the

extraction of the person from the space, a lifeline firmly attached to the harness and any other personal protection equipment necessary and appropriate to the conditions and exposure to which personnel may be subjected. Rescue personnel shall immediately be stationed (MRE, or response crews) outside the confined space entrance, equipped with said equipment and any other equipment needed to perform the rescue (see Chapter 7). Communication shall be established and maintained between those who enter the space and the personnel assisting them outside the space. When flammable or vapors, gases, or explosive materials are present, only explosion proof and spark proof, intrinsically safe equipment shall be used, and all other potential sources of ignition are prohibited.

- 2) Cold work may be performed on the external areas from the outside of a Class I confined space, provided it does not generate heat or other sources of ignition that may ignite the atmosphere inside the confined space.
- 3) Hot work may be performed in the external areas of a Class I confined space from outside the space, when the atmosphere within the space does not contain a flammable or explosive atmosphere, or enriched oxygen. In this case, a Class I classification of the space would be based on an oxygen deficiency or the presence of toxic substances or a combination of them, and would include inert spaces.

b. Class II Confined Spaces:

- 1) The flammable or toxic substances, or the deviations in oxygen levels in a confined space may be due to the materials and conditions inside the space, or they may be generated by the operations being performed in the space. When contamination is caused by the materials or conditions inside the space, the source of such contamination shall be identified and eliminated by ventilating the space, or with other treatments prior to entry or work.
- 2) The following restrictions shall apply when operations are performed which could introduce flammable or toxic substances, or oxygen deviations into the space (spray painting, welding, cutting, cleaning with solvents, etc.), as approved by Class I Competent personnel and under the exceptions applicable to Class II:
 - a) When toxic or flammable materials are introduced or may be introduced into the space, general ventilation, air dilution, or local ventilation with an air extractor or a combination of same shall be provided, according to Section 6-1.2 on Ventilation.
 - b) When toxic materials are introduced or may be introduced into the space, personnel working in the space shall be provided with the approved respiratory protection equipment adequate for the exposure to which they

will be subjected.

- c) When gases of flammable vapors are or may be introduced into the space, approved explosion proof and spark proof, intrinsically safe equipment shall be used, and all potential sources of ignition shall be closely controlled.

4-6. PERMIT CATEGORIES

The following certification categories shall be used and included in the confined space permits to indicate the conditions found when testing was performed. In order to provide uniformity and minimize confusion or misinterpretation, only the following categories shall be used:

- a. **ATMOSPHERE SAFE FOR WORKERS – SAFE FOR HOT WORK (mandatory Fire Watch)**. This category shall be used in the permit when:

- 1) There are no materials or toxic vapors or gases present and there is no possibility that they may be generated; when oxygen levels are sufficient or adequate for entrants; or when such conditions are controlled with proper ventilation within the establish permissible exposure limits,
- 2) Flammable materials, vapors, or gases have been eliminated and there is no possibility that they may be generated, or they are controllable with ventilation,
- 3) Foreign flammable or combustible materials have been removed from the space or have been adequately protected,
- 4) Areas adjacent to the confined space have been protected as required, and
- 5) **The work to be performed requires hot work.**

- b. **ATMOSPHERE SAFE FOR PAINTING – NOT SAFE FOR HOT WORK.** This category shall be used in a confined space permit when:

- 1) There are no significant levels, nor is there a possibility that the existing conditions generate toxic materials, vapors, or gases; when the oxygen content is sufficient (19.5% to 22%) and adequate for entrants; when such conditions are properly and constantly controlled with ventilation; and when hot work will **not** be performed in the space, and
- 2) There is a danger of fire or explosion or excessive toxic levels in the presence of hot work due to flammable or explosive materials, vapors, gases, or residues, or
- 3) **The work to be performed in confined spaces does not require hot work**

activities. Hot work shall not be permitted at less than 50 feet from confined space ventilation exhaust discharges.

c. **ATMOSPHERES SAFE FOR CLEANING – NOT SAFE FOR HOT WORK.** This category shall be included in the permit when a temporary permit is required for cleaning, cold work, etc., and conditions such as the following exist:

- 1) When toxic materials, vapors, or gases are or may be generated in a confined space, although at lesser levels than those causing an immediate danger to life or health and within the approved levels for the prescribed respiratory protection apparatus and other personal protection equipment, or
- 2) When the oxygen content is more than 16%, but less than 19.5%, or
- 3) When flammable vapors can be generated, or when there are flammable vapors at levels of less than 10% of the lower explosive limit (LEL), and controls can be installed to keep them at less than 10% of the lower explosive limit, or
- 4) When there is the danger of fire, explosion, or excessive toxic levels in the presence of hot work in the space or in the adjacent spaces that have not been protected as required, or
- 5) When hot work is **prohibited** in spaces contiguous to the confined space for which the temporary certificate has been issued. Hot work shall not be permitted at less than 50 feet from the confined space ventilation exhausts.

d. **ATMOSPHERE HAZARDOUS FOR WORKERS – NOT SAFE FOR HOT WORK.** This category shall be included in the permit when:

- 1) There is danger of toxic poisoning due to the toxic materials, vapors, or gases that are present or may be generated due to the prevailing conditions or there is the danger of suffocation due to an oxygen deficiency, or
- 2) There is danger of fire or explosion due to the presence of flammable or explosive materials, vapors or gases, or when due to the prevailing conditions there is an oxygen enrichment or it may be generated, or
- 3) There is danger of fire or explosion, or danger due to toxic levels in the presence of hot work due to the existence of flammable, explosive, or reactive residues, vapors, or gases; or due to oxygen enrichment, or
- 4) There is danger of fire, explosion, or danger due to toxic levels in the presence of hot work because adjacent spaces have not been protected as required.

e. **INERT – NOT SAFE INSIDE FOR WORKERS – SAFE FOR HOT WORK OUTSIDE.** This category shall be used in certificates when:

- 1) An inert medium has been introduced into the confined space in the required concentration to achieve a non flammable atmosphere, and it shall be maintained continuously to ensure the appropriate inert atmospheres (less than de 8% oxygen),
- 2) The oxygen content in the space cannot maintain combustion or human life,
- 3) The required measures are taken to isolate the space and it is ensured that the isolation is maintained until the inert medium is eliminated, and
- 4) The required measures have been taken to ensure the proper elimination of the inert medium without causing an oxygen deficiency in the adjacent compartments or areas.

4-7. OPERATIONS

4-7.1. Hot Work Operations

- a. The **only person** authorized to issue all **initial permits** to enter and perform the following work in confined spaces shall be a Class I Competent Person, except for specific exceptions established in this Manual or by the Industrial Hygiene Section:
- 1) Hot work operations in tanks or confined spaces, or in spaces adjacent to such spaces which contain or have previously contained flammable substances.
 - 2) Hot work in pipelines, spiral joints, pumps, fittings, etc., connected to the spaces described in paragraph a.1 of this Section.
 - 3) Open flammable work or arc welding in rooms with machinery, engine rooms, bilges and similar areas where flammable substances and pressure systems may be found.
 - 4) Hot work done on any system or pipelines, spiral joints, pumps, fittings, or similar service systems containing flammable or toxic substances, or that are pressurized for their normal operation.
 - 5) Hot work in hollow structures such as drums, lined containers, faucets, cylindrical axles, pipes, bits, etc.
 - 6) Open flame work or arc welding in engine rooms or fuel tanks on any floating equipment, caissons, or lock gates.

- b. Class II, III, and IV Competent Persons may be authorized to issue, **not initial permits**, but **subsequent** permits for daily entry or monitoring, for hot work activities in the areas mentioned in paragraphs from a.1 to 6 of this Section, once a Class I Competent Person has issued an initial certification and provisions have been made to control or eliminate space hazards. Nonetheless, the following shall be required for this action:
- 1) Class II, III and IV Competent Persons must **understand**, to the satisfaction of a Class I Competent Person, the safety requirements of hot work to be performed in the confined space.
 - 2) Class II, III and IV Competent Persons to whom these duties are delegated shall conduct the initial inspection with the Class I Competent Person **who will delegate these duties to them.**
 - 3) The Class I Competent Person shall clearly establish in the permit the testing procedures and guidelines that shall be disseminated by means of instructions on the work process or standard operating procedures.
 - 4) The Class I Competent Person shall provide the necessary information and has determined that the Class II, III, or IV Competent Person to whom said duties have been delegated is, by virtue of his training and experience, is duly qualified to perform the specific tasks delegated to him, and that he clearly **understands** them to the delegator's satisfaction.
- c. Class II, III, or IV Competent Persons may be authorized to issue entry and hot work initial entry permits for the following work:
- 1) Hot or other work in confined spaces, other than that described in paragraph 4-7.1.a, and the enforcement of the safety requirements for hot work.
 - 2) Operations that comply with the provisions of paragraph 4-7.1.c.1, and that due to the nature of the operation do not generate significant levels of toxic or flammable substances that could produce conditions requiring the classification of the confined space as a Class I or Class II space.
 - 3) Confined space cleaning operations involving sandblasting, chipping, and drilling, provided said work is not done inside or within the limits of the spaces that have previously contained flammable substances.

4-7.2. Inspection or Maintenance Operations

- a. Only Class I Competent Persons may issue initial entry permits for inspection and mechanical maintenance in confined spaces that contain or have contained hazardous concentrations of toxic materials above Threshold Limit Values (TLV).

Also, they may not issue initial entry permits for confined spaces that contain or have contained flammable components.

- b. Class II, III and IV Competent Persons shall be authorized to issue initial confined space permits for all inspection and mechanical maintenance operations, if the space does not contain, nor has it previously contained, toxic materials, provided said spaces belong to Class III confined spaces.

4-7.3. Painting Operations

- a. Only Class I Competent Persons may issue initial entry permits for painting work, except for the exceptions granted to other Competent Persons.
- b. Class II Competent Persons may not issue initial entry permits for confined spaces that will be painted with paint having a flammability temperature of less than 37.7° Celsius or 100° Fahrenheit. Also, they may not issue initial entry permits for confined spaces that will be painted with products containing toxic materials with a TLV of less than 10 ppm (parts per million).
- c. Class III and IV Competent Persons may be authorized to issue entry permits and permits to monitor painting operations in confined spaces following the guidelines established by a Class I Competent Person, provided **they are delegated**. For this, the Class I Competent Person shall ensure that:
 - 1) The Competent Person to be delegated understands the hazards that may arise with paint or coating products to be used within the specific confined space.
 - 2) The space is a Class III confined space.
 - 3) The procedures for the delegation of functions described in Section 3-1.2 are complied by delegating the issuance of permits for subsequent entries or for periodic or continuous monitoring.

4-7.4. Tank Cleaning with Chemical Substances or Fuel

- a. Class I Competent Persons shall issue initial entry permits and monitor cleaning operations in the confined spaces of tanks with chemical substances or fuel, and may revise the standard operating procedures (see Chapter 5) to ensure that said operations are conducted safely and effectively; if they consider it appropriate, they shall make a delegation after the initial permit. Class I Competent Persons may not issue initial permits for cleaning tanks that have contained flammable, chemical substances or fuel.

- b. Class II, III, and IV Competent Persons shall be authorized to monitor confined space operations in tanks with chemical substances or fuel, and to issue subsequent daily entry permits, provided the Class I Competent Person has complied with the procedures for the delegation of functions described in Section 3.1.2.

4-8. CERTIFICATION OF CONFINED SPACES (Protocol)

- a. Unless the restrictions on hot work apply, a Class II, III, or IV Competent Person shall first test all confined spaces, and certify confined spaces he finds to be Class III (see Sections 1-3.3, 1-3.4, 4-7.1 and 4-7.2). If tests show that a confined space must be designated as Class II, a Class I Competent Person shall be called in to certify it. If tests show that the confined space can be designated as a Class I space, a Class I should be called in to certify it (for the conditions that correspond only to Class I Competent Persons, see Sections 1- 3, 1-4, and 4-7).
- b. At the request of the appropriate Competent Person, competent electricians shall inspect all classes of confined spaces to ensure they comply with the electrical requirements.
- c. All inspection or maintenance work inspection permits that do not involve hot work (with the exception of operations to clean tanks with chemical substances or fuel) shall be issued by a Class III or IV Competent Person.
- d. See Section 4-7 and Section 5-1 on the limitations of hot work and the first initial entry permit. When it is required that a Class I Competent Person issue a first initial entry permit, to the extent possible, the inspection and certification for such permit for subsequent days may be delegated to a Class III or IV Competent Person (see Section 3-1.2).
- e. A Class I Competent Person accompanied by a Class II, III, or IV Competent Person shall conduct a preliminary monitoring of painting operations in confined spaces (tanks, pipelines, cylindrical gates, etc.). Class II, III, or IV Competent Persons shall observe the specific features of the space, the location of sampling lines, and learn the safety considerations of the procedures for monitoring painting work that he should follow. To the extent possible, a Class II, III, and IV Competent Person may be delegated subsequent monitoring operations (see Section 3-1.2).
- f. Preliminary inspections of coal tar coating operations in confined spaces (lock gates, caissons, etc.) shall be done by a Class I Competent Person accompanied by a Class II, III, or IV Competent Person. Class II, III, or IV Competent Persons shall observe the specific features of the melting process, the place from which samples are collected, the configuration of the space, and the monitoring guidelines to be followed. To the extent possible, the subsequent monitoring shall be delegated to a Class III or IV Competent Person (see Section 3-1.2). It is very possible that it may not be necessary to continuously monitor the majority of the

projects once an agreement is reached on effective standard operating procedures that can reduce hazards to a minimum. The sampling and assessment protocols of Industrial Hygienists shall be sufficient to continue safe operations, if supervisors enforce the standard operating procedures.

- g. Operating Divisions shall make every possible effort to schedule the regular and practical training of their competent persons with the Class I Competent Person who is normally assigned to their area. Usually, these competent persons are already present during inspections as supervisors; with a little additional time invested to obtain practical experience, they may obtain the necessary basic knowledge to inspect confined spaces for the first or subsequent permits. These practices will reduce the continuous need for Class I Competent Persons to conduct inspections at various work sites every morning, and will improve the efficiency of the operations. Class I Competent Persons may be called in for consultation as work progresses.

CHAPTER 5

GUIDELINES FOR HOT WORK – PAINTING – CHEMICAL CLEANING

5-1. HOT WORK OPERATIONS

5-1.1. Precautions for Hot Work

- a. **Cleaning and Ventilation of Confined Spaces.** Testing must be done prior to starting hot work in a confined space, as well as the inspection, cleaning, and ventilation of the space, as required by the provisions of this Manual, as well as its certification as “Safe for Hot Work”. The space shall be cleaned and foreign flammable or combustible materials, such as wood, paper, rope, rags, etc. must be removed to a degree sufficient to eliminate any significant fire hazard. Combustible materials that cannot be removed from the confined space shall be properly protected.
- b. **Adjacent Spaces.** Prior to starting hot work, inspections and testing must be done as well as cleaning and ventilation, or creating inert atmospheres in the spaces adjacent to the confined space where hot work (over, under, and on all sides), according to Part 306 of the U.S. National Fire Protection Code (hereinafter referred to as NFPA).
- c. **Fire Prevention.**
 - 1) **Fire Surveillance** – A surveillance team shall be established at the work place when open flame or heat-producing work is being performed, such as welding, cutting, and hard soldering. Fire watches shall be trained on the nature of any fire that may occur and on the proper use of the fire extinction equipment available. A fire surveillance team shall also be stationed on the opposite side of the work site when hot work can increase the temperature of a wall, partition, or any other separating structure that could create a fire hazard on the opposite side of the structure. A communication system shall be established to allow the fire surveillance team to notify if hazardous conditions develop on the opposite side of the separating structures and signal that they need to stop the hot work. The fire surveillance team on the opposite side of the separating structure where hot work is performed shall also be provided fire extinction equipment appropriate for the hazard, and be trained on its use.
 - 2) **Fire Extinction Equipment** – Fire watches shall be furnished the proper fire extinction equipment as determined by the Competent Person (see the Material Safety Data Sheets, if available), and as shown on the Preliminary Planning Form. As a minimum, fire extinguishers must be provided for fires caused by dry chemicals to contain flames before their spread. The size and number of extinguishers to be provided will depend on the nature and quantity of the flammable or combustible substances present, and the fires that can occur. No

other type of fire extinguishers may be used in a confined space. It must be taken into account that in a confined space, the movement when handling a fire extinguisher can create hazards (such as slips and falls), or the suppression of oxygen levels.

d. **Hot Work in the Presence of Layers or Coatings of Surface Preservative Materials.**

- 1) **Hardened Layers of Preservative Materials** – The flammability of these layers shall be determined prior to starting hot work. When the flammability of a layer is not known, a Competent Person may conduct a test to determine its flammability. If scraped material is burned too quickly, the layers of preservative materials shall be considered to be highly flammable. The high flammable layers shall be removed away from the place where the hot work is being performed, at a distance sufficient to avoid the coating materials in the areas where they have not been removed, to catch fire or give off gases (because of a rise in temperature). The distance required to remove coating materials will vary depending on the material in question and the nature of the hot work, but in no case may it be less than 4 inches on all sides of the outside limits nearest to the hot work. Uncontrolled flame or heat shall not be used to remove flammable coating layers. Proper methods shall be used to prevent hot residues or sparks from falling on the flammable coating in the hot work area. Wetting the surrounding areas to reduce the potential of ignition may also be done, depending on the nature of the coating and the operation. Ventilation shall be provided (see Section 6-1.2).
- 2) **Toxic Layers of Preservative Materials** – Layers capable of releasing toxic vapors with the application of heat (check the Material Safety Data Sheets, if available) shall be removed at a distance sufficiently far from the hot work area to prevent the generation of toxic vapors or gases due to a rise in temperature of the surface of the layers that have not been removed. If there is not enough distance to avoid the generation of toxic vapors or gases, or if there is any doubt about it, workers shall be provided with the proper approved respiratory protection equipment. Ventilation to extract toxic vapors or gases from the confined space shall be provided.
- 3) **Soft and Greasy Layers of Preservative Materials** – Soft and greasy layers may pose more serious hazards than those of hard surface layers. Some soft layers may have much lower flammability points and produce gases at lower temperatures, and may burn more easily with hot residues or sparks. Some materials often become complicated because it becomes difficult to walk, stand, or maneuver on very slick surfaces, increasing the possibility of falling, letting lit torches fall on material that has not been removed, etc. Therefore, prior to performing hot work in a space covered with soft and greasy preservative materials, these should be removed away from the area where the hot work will be done at the distance the Competent Person may consider

prudent, to prevent them from giving off gases and burning up with the heat, sparks, hot residues, etc. **Testing shall be done and the space certified after completing the cleaning.**

e. Hot Work in the Presence of Scaling Work. Blisters, scales and similar conditions inside tanks that have contained flammable materials can, even after cleaning and ventilating them, retain flammable material residues. Any hot work in the presence of such conditions shall be assessed carefully to determine the proper procedures and control measures to be taken for the operations.

The following factors shall be considered:

- 1) The last material contained by the tank and the previous loads that could alter the characteristics of the existing residues.
- 2) The flammability point, or point at which residues burn, and their self-ignition temperature. Testing shall be done where necessary to establish this information.
- 3) The degree (depth, porosity, percentage of the surface covered, etc.) of scaling and blister formation.
- 4) The possibility of flames engulfing the entire confined space.

Prior to starting hot work, the space shall be completely cleaned and any scaling or blistering removed that may contain highly flammable residues (with flammability points of 100 degrees Fahrenheit [37.74 degrees Celsius] or less, such as gasoline, etc.). The area to be cleaned shall be of a minimum of 4 inches on all sides of the outside limit farthest away from the hot work. In all cases, the cleaned area shall be sufficient to prevent the surrounding areas from releasing gases, and the ignition of residues. The areas below the hot work shall be cleaned or protected with partitions, devices to collect sparks and hot residues, or similar measures. The areas around the hot work area must be dampened with water to reduce vaporization of the residues and the possibility of small fires and flames. **Fire surveillance teams shall be stationed with the proper equipment to extinguish any fire that may occur.**

f. Pipelines, Tubes, and Spiral Joints. Pipelines, tubes, spiral joints, or similar materials that service, enter, or exit a confined space shall be washed, blown, purged, or otherwise cleaned, and their safety certified prior to performing any hot work on them. While these materials remain untreated or not certified, **prominent signs or tags reading DANGEROUS ATMOSPHERE FOR HOT WORK, as well as the space certificate, shall include a note to such effect.** Valves on pipelines, tubes, or similar equipment shall be blanked and/or the pipelines disconnected to prevent an unexpected discharge or backflow of materials into the space.

g. Hot Work in the Presence of Pressurized Systems. Prior to starting any hot work, systems (such as hydraulic, freon, etc. systems) that may be affected by the hot work shall be depressurized. Pipelines, fittings, valves and other system components shall be protected from any damage that may result from contact with flames, arcing, hot residues or sparks. It must be carefully ensured that all contaminants inside the space, such as hydraulic fuel leaks, are cleaned and removed prior to doing hot work. In the presence of high temperatures, hydraulic fluids may decompose and produce highly toxic byproducts.

h. Gas Welding, Cutting, and Scraping.

- 1) **Compressed Gas Cylinders** – Compressed gas cylinders shall be transported, moved, and stored according to the Panama Canal Authority Safety and Occupational Health standards. Compressed cylinders or gas manifolds used in welding and cutting operations shall be placed outside the confined space, outdoors, and in an area not exposed to any fire, explosion, or emergency that may occur inside a confined space.
- 2) **Gas Welding and Cutting Equipment** – Gas welding and cutting equipment such as hoses, connections, torches, etc. shall be inspected, tested, operated, and maintained according to provisions, as appropriate.
- 3) **Gas Supply** – During periods in which the equipment remains unattended or will not be used over a substantial period, such as during coffee breaks, lunch breaks, shift changes, or from one day to the other, the gas supply cylinder or the manifold shall be turned off and the torches and hoses removed from the confined space. Open ended hoses shall also be removed immediately from the confined space when any other hoses, torches or other devices are removed.

i. Electric Arc Processes

- 1) **Electric Arc Units or Machines** – No electric arc units or machines shall be taken into a confined space, but placed outside it.
- 2) **Electric Arc Equipment** – Electric arc equipment shall be inspected, tested, operated, and maintained according to provisions, as appropriate.
- 3) **Electrode Holders** – Electrodes shall be removed from their holders, which shall be placed in a safe or protected place; the equipment power switch shall be turned off when electrode holders are to be left unattended or when they are not going to be used for a period such as coffee or lunch breaks. If they are to be left unattended for long periods, e.g., from one day to the other, electrode holders, cables, and other equipment shall be removed from the confined space and their power supply disconnected.

j. Inert Gas Processes. Whenever processes that include the use of inert gases are to be used, care should be taken to ensure that the oxygen in the confined space is not deficient. Adequate ventilation shall be provided to extract to a safe place the inert gases that have been discharged into the space during operations, and to ensure that the required oxygen levels are maintained. Hoses, connections, and fittings shall be inspected to ensure that there are no leaks present. The sources of compressed inert gases shall be placed outside the confined space and turned off at the source when the equipment will not be in use or will remain unattended. If the space will remain unattended for extensive periods, such as from one day to the other, the equipment shall be removed from the confined space, disconnected completely, and its gas supply turned off at the source. Appendix O contains a procedure for this type of work, which shall be coordinated with the Industrial Hygienist/ Marine Chemist. For more information, contact the Industrial Hygienist/ Marine Chemist in your area.

Hot Work in Containers of Enclosed (Hollow) Structures. – Prior to welding, cutting, or heating, the space shall be filled with water or cleaned of flammable substances, and ventilated. Any drums, containers, or hollow structures that have contained flammable substances shall be tested. Prior to applying heat to a drum, container, or hollow structure, a vent hole or opening shall be provided to release any pressure that may accumulate during the application of heat. Before starting any welding, cutting, heating, or hot soldering in structural spaces such as the heel of a keel, buoys, masts, booms, support beams, stanchions, or pipe railings, a Class I Competent Person shall inspect the object, and if necessary, conduct tests to detect any presence of flammable residues, liquids, or vapors. There is a procedure for this type of work in Appendix P of this document. For further information, contact the Industrial Hygienist/ Marine Chemist in your area. If there flammable residues, liquids, or vapors present, the object must be treated to render it safe (by cleaning, purging, or creating an inert or pressurized atmosphere). Objects such as those listed above shall also be inspected to determine whether they have non flammable liquids or water which, upon heating, could accumulate an excessive pressure. If it is established that these liquids are present, the area shall be ventilated or aired, or whatever any other method used to make the object safe during the application of heat. Coated containers shall be ventilated prior to and after welding, cutting, or hot work, to release any pressure that has accumulated during the application of heat.

Class II Competent Persons may not issue any permit for hot work in hollow structures or floating equipment, with the exception of miter gates and overhaul caissons being repaired at the Industrial Drydock Division (SII) or any other structure as determined by the Industrial Hygiene Section (ESSI).

5.2. APPLICATION OF PAINT AND COATINGS IN A CONFINED SPACE

5-2.1. Precautions during paint work. Material Safety Data Sheets (MSDS) shall be consulted when these products are to be used in confined spaces, and random samples sent to the laboratory for flammability point testing and other critical tests. This will ensure that no undue hazards are created because a product does not

comply with the appropriate specifications. The area must be ventilated to control hazards where operations with such materials are performed in confined spaces. Any employee who is continuously exposed to toxic paint solvents, whether hand applied or sprayed, shall be protected with respiratory protection equipment approved by the Industrial Hygiene Section.

5.2.2. Standard Operating Procedures for Painting in Confined Spaces. The following is a list of the standard operating procedures to be followed when painting in a confined space:

- a. The project supervisor shall obtain a Material Safety Data Sheet (MSDS) for every paint product and solvent to be used in the confined space. These sheets shall be consulted to determine the personal protection equipment to be used, as well as well as the proper safety practices.
- b. A Competent Person shall review the Material Safety Data Sheets (MSDS) and inspect the confined space regarding the safety of entrants involved in the painting operation. After carefully assessing the paint flammability point, volatility, and components, as well as the Lower Explosive Limit (LEL), the Competent Person shall determine the frequency of the tests to detect flammable vapors. Class II Competent Persons may be authorized to issue permits to enter and monitor painting operations in confined spaces, following the guidelines described in Section 5-2. Class II Competent Persons may not issue initial permits to enter confined spaces to be painted with paint with a flammability temperature of less than 37.7° Celsius or 100° Fahrenheit. Also, they may not issue initial permits to enter confined spaces that will be painted with products containing toxic materials with a Threshold Limit Value (TLV) of less than 10 ppm (parts per million).
- c. If there is any doubt about the flammable characteristics listed in the Material Safety Data Sheet (MSDS), a sample (one pint) of the paint or solvent shall be tested to determine its flammability temperature.
- d. The employee applying the paint shall:
 - 1) Wear coveralls of any of two types:
 - a- disposable (flame retardant, plus
 - b- 100% cotton.
 - 2) Wear the proper respirator.
 - 3) Wear the personal protection equipment recommended in the Material Safety Data Sheet (MSDS), as approved by the Competent Person.
 - 4) Mix paints outside the confined space, and take only the amount of paint recommended by the Competent Person to the confined space.

- e. Whenever possible, dilution and extraction ventilation (air intake and exhaust - push/ pull) shall be used. The location of the ventilation ducts will depend on the density of the vapor and the geometry of the space, etc.
- f. The following additional precautions shall be taken when flammable paints or solvents are used:
 - 1) Ventilation fans and spraying equipment (including hand applicators) shall have electrical isolation. All motors and control equipment shall be of the approved explosion proof type. Fan blades may not be made of iron, and portable air ducts shall also be made of non ferrous materials. All tools, buckets, and other equipment shall be spark proof. Paint brush and roller metal parts shall have insulation. Scaffolding must be mounted in such a way as to ensure that they will not generate sparks.
 - 2) A full face air line respirator with an emergency escape bottle with at least 5-minute capacity and the proper protective clothing shall be worn when painting with a spray gun.
 - 3) Sufficient extraction ventilation shall be provided to maintain the concentration of solvent vapors at less than ten (10) per cent of the lower explosive limit (LEL). A Competent Person shall conduct frequent tests to confirm the concentration, as decided by the Class I Competent Person. A Class I Competent Person must be called if the ventilation fails or the solvent vapor concentration increases to more than ten (10) per cent of the lower explosive limit, or if the situation recurs more than twice. If the concentration does not decrease when the painting is stopped, additional ventilation shall be provided to lower the concentration to ten (10) per cent of the lower explosive limit, and a Class I Competent Person shall be called.
 - 4) Air extraction conduits shall be discharged far from the work areas and the possible sources of ignition. Periodic tests shall be made to ensure that the extracted vapors do not accumulate in other areas.
 - 5) Ventilation shall be continued after the paint work is completed, or until the space or compartment is at an explosive limit lower than zero (0). The final determination as to whether the space or compartment is gas free will be made after the ventilation equipment has been turned off at least 10 minutes.
 - 6) The lighting of the space shall be of an approved explosion proof design, and of sufficient intensity to provide safe working conditions, per standard ANSI A11-1.
- g. Whenever possible, an additional access opening with a ladder shall be installed. All hoses and the equipment shall be confined to one (1) access opening. One (1)

access opening shall remain free from hoses and equipment, and shall be used as an emergency exit.

- h. No hot work, smoking, matches, or lighters shall be allowed at less than 50 feet of the work area while paint is being applied.
- i. A sign reading “**Atmosphere Hazardous to Workers Without Protection – Atmosphere Hazardous for Hot Work – No Smoking and No Exposed Flames at Less than 50 Feet**” shall be posted near the entrance of the work area. A fire extinguisher shall be kept immediately available.
- j. Paint may not be mixed in the confined space, and workers mixing paint shall wear the proper personal protection equipment (see the Material Safety Data Sheet – MSDS). **Paint, solvents, and cleaning materials shall be stored outside the confined space, far from entrances and in the direction of the wind.**
- k. An attendant shall be stationed at the entrance of the confined space with a self contained breathing apparatus fully charged and with positive pressure (SCBA), and lifelines to assist in case of an emergency. This assistant **shall not enter the confined space under any circumstance** (see Section 7-1. Attendant or Standby).
- l. When potentially hazardous work is being performed, continuous supervision shall be kept at the workplace.
- m. Prior to the painting operations, the supervisor shall explain to all workers the health and safety hazards they may encounter during the operations and the safety guidelines they shall follow.
- n. **Any crew member who refuses or repeatedly fails to comply with the safety regulations or procedures shall be removed from the work area. It is recommended that the appropriate disciplinary action be taken.**

5-3. CHEMICAL CLEANING OF CONFINED SPACES

Only Class I Competent Persons may issue initial entry permits for inspection and mechanical maintenance operations in confined spaces containing or that have contained hazardous concentrations of toxic materials. No Class II Competent Persons may issue permits for initial entry to confined spaces containing or that have contained hazardous concentrations of toxic materials over the Threshold Limit Values (TLV). Also, they may not issue initial permits for entry to confined spaces that contain or have contained flammable components.

5-3.1. Cleaning of Confined Spaces. Normally, a Competent Person does not have the responsibility of performing or supervising the cleaning of confined spaces. Usually, such duties are the responsibility of the appropriate operations personnel who is knowledgeable of the various cleaning methods to be employed in any circumstances, in order to properly

assess any hazards that can arise during the cleaning process, and the hazards that may exist upon completing the cleanup.

5-3.2. Responsibilities of Competent Persons. With regard to cleaning operations, a Competent Person is responsible for the following:

- a. Tests and space assessments.
- b. Prescribe the conditions to be achieved prior to authorizing entry for cleaning.
- c. Whenever it is necessary to enter to perform or complete the cleaning process, a temporary entry certificate shall be issued for cleaning, using the following category: Atmosphere Safe for Cleaning – NOT SAFE FOR HOT WORK (see Section 4-6.c.).
- d. Specify the conditions to be observed when entering for cleaning, such as ventilation, non sparking tools, etc.
- e. Whenever necessary, cooperate with the personnel responsible for the cleaning operations, to determine the safest and most effective cleaning methods.

5-3.3. Cleaning Methods. There are many different methods and techniques that can be used to clean a confined space effectively. It is not possible to prescribe a single method that will meet all the requirements of the diverse conditions that may be found. The cleaning method selected will depend on the nature of the space to be cleaned and the material that the space has contained. Cleaning methods compatible with the nature of the tank and of the materials it has contained must be used.

- a. The equipment to be used in the cleaning process (degreasers, immersion tanks, etc.) shall be cleaned according to the manufacturer's requirements.
- b. When sewer lines and storm drains must be decontaminated, it is recommended that they be flushed with large volumes of clean water.
- c. A proper ventilation can be used to effectively remove vapors from service tunnels and dry tunnels. When flushing with water is not feasible because there are water or liquid filtrations, pumping shall be done to remove the liquids that can create a hazard in the confined space, and then it must be ventilated.
- d. Boilers, condensers, evaporators, and vapor drums shall be cleaned according to the manufacturer's instructions and the applicable technical manuals and instructions.

5-3.4. Developing Cleaning Procedures. When no cleaning methods are included in the manufacturer's instructions, technical manuals, or other procedures, safety, health, and fire officers can develop and approve jointly a cleaning procedure.

Serious consideration shall be given to the impact the hazardous materials involved may have on the environment prior to making a final decision on how to discharge or dispose of cleaning materials and residues.

5-3.5. General Safety Precautions in Cleaning Operations. Good safety and health practices shall be observed in confined space cleaning operations. The following safety precautions shall apply:

- a. The proper protective equipment and clothing shall be furnished to workers entering confined spaces to perform gas detection testing and cleaning.
- b. The personal protection clothing and equipment shall be clean and kept in good condition for their use.
- c. The workers exposed to contaminants during cleaning operations must observe good hygiene practices.
- d. Sediment may contain flammable and toxic vapors or materials. Space tests may show that conditions are satisfactory. However, if the sediment is removed, such action can release toxic or flammable vapors. If workers come in contact with the sediment, they can become exposed to toxic contaminants. Adequate precautions shall be taken when workers enter spaces with sediment that may contain or has trapped toxic or flammable materials (see Section 3-1.2.).
- e. When air line respirators are used for chemical cleaning, there are flammable or toxic vapors, or they are released, an emergency bottle with a capacity of at least 5 minutes shall be worn.
- f. General safety precautions shall be taken to control other hazards such as slipping, tripping, or falling; or against electrical hazards, low heights, ladders, etc., according to the requirements in this Manual.

CHAPTER 6

HAZARD CONTROL AND SAFETY EQUIPMENT

6-1. HAZARD CONTROL METHODS

6-1-1. PURGES. Control of the environment in a confined space is done with purges or ventilation. The method to be used will depend on the potential hazards that may arise due to the product that had been stored or was being produced in the confined space, the suspected contaminants, the work to be performed, and the design of the space. Whenever purge or ventilation work must be done in a Class I or II confined space, fan controls shall be placed at a safe distance of the confined space and equipped with a fail proof warning device attached to the ventilator which shows whether it is on or off.

6-1.2. VENTILATION.

- a. **Introduction.** Confined spaces frequently contain flammable or toxic atmospheres in which the oxygen content is deficient or has been enriched. Ventilation is generally not enough to remove the contaminated air inside the space and replace it with fresh outside air. The lack of air exchange occurs particularly in confined spaces that have few access openings, and due to the configuration of the confined space. They can be effectively ventilated with devices that move the air and remove the contaminated air from the confined space, introducing fresh and breathable air and controlling the level of the hazards created by the contaminants in the space and those that are caused by the operations performed in it.
- b. **Basic requirements.** No single rule or group of rules can be established to cover all the ventilation requirements that apply to confined spaces. It should be recognized that the objective of the confined space ventilation is to:
 - 1) Remove the contaminated (flammable or toxic) air from the space and maintain safe concentration levels in terms of permissible exposure limits (PEL) or lower explosive limits (LEL), using the most suitable for one.
 - 2) Provide fresh, breathable air inside the space.
 - 3) Collect and remove contaminants generated inside the space, or dilute them to achieve safe concentration levels in terms of permissible exposure limits (PEL) or lower explosive limits (LEL).

These objectives can only be achieved with a comprehensive assessment of the requirements on the basis of the space involved, its content, and the operations to be performed in the space. Ventilation requirements may be determined on the basis of the aspects of the space and the operations. The assessment of the ventilation shall be based on the readings taken of the ventilation system or the space atmosphere, to ensure that safe conditions are achieved

and maintained. In this chapter, minimum requirements are established and guidelines are provided for the application of ventilation to confined spaces. Any specific inquiries must be made to the Industrial Hygiene staff in your area (ESSI).

- c. **Ventilation Prior to Entering or Working.** Confined spaces shall be ventilated prior to entering or performing any work, to the degree needed to reduce flammable and toxic substances to acceptable levels and provide the proper oxygen content inside the space.
- d. **Ventilation to Enter and Work.** Ventilation requirements to enter and work in the confined spaces depend on the nature of the space, its content, and the operations to be performed in it. The operations performed in a confined space any require the application of a single type of ventilation, such as general ventilation, or may require the application of two types, such as general ventilation combined with a local air extraction system. These principles shall be applied to comply with the objectives stated in paragraph b. of this Section.
 - 1) **General Ventilation** – General ventilation is often used interchangeably with air dilution. However, we refer to general ventilation as the action of removing or supplying breathable air, and to control climatization within the space, that is, ventilation to control heat.
 - 2) **Ventilation with Local Air Extraction** – A local air extraction system consists of an arrangement whereby the air intake (an opening with a duct or hood) is placed near the work location where contaminants are generated. A local air extraction system collects contaminants as they are generated, takes them to the system duct, and removes them from the work environment. To remove the contaminants generated at a single point, such as welding, or localized cleaning with solvents, local air extraction systems are the most effective.
 - 3) **Ventilation with Air Dilution** – This is done by blowing uncontaminated air into a space to dilute the contaminated air inside the space until an acceptable level is reached. Ventilation by air dilution is the dilution of contaminated air with uncontaminated air in a general area, room or building, for the purpose of controlling any health hazard or nuisance. Nonetheless, usually **ventilation by air dilution is not as satisfactory a control as ventilation with local air extraction.** However, circumstances arise occasionally for which ventilation with air dilution should be used if the operation or the process being carried out prohibits the use of local air extraction.

The use of ventilation with air dilution has the following limiting factors:

- The amount of the contaminant generated cannot be too high, or the air volume needed for the dilution will not be practical.

- Workers shall be far enough away from the place where the contaminant is generated, or it must be in a concentration sufficiently low so that the exposure of workers will not be higher than the Threshold Limit Values (TLV).
 - The contaminant must be of a low toxicity.
 - The evolution of the contaminant must be reasonably steady.

Ventilation with air dilution is rarely applied successfully to gases and dusts because:

- high toxicities often found demand air dilution in great quantities;
- the speed and rate at which they are generated are generally very high;
- it is very difficult, if not impossible, to obtain data on vapor production quantities. (Dust is formed when solid materials crumble, as in drilling, grinding, or sharpening. Vapor occurs when a metal or plastic is heated up and cooled down quickly as with welding, melting, or working with boilers).

When dilution is used to control vaporization of toxic or flammable substances and workers can be exposed, the atmosphere may be diluted to less than the permissible exposure limit (PEL) or the lower explosive limit (LEL), that is, the least of any of these two. If the atmosphere cannot be diluted to less than the PEL, workers shall be protected with personal protection equipment.

Unless sample testing and assessments clearly show that the contaminant concentrations are at acceptable exposure limits, workers shall be equipped with NIOSH certified respiratory protection devices that are appropriate for the exposure in question, as approved by the Industrial Hygiene Section.

- 4) **Ventilation with Air Dilution and Extraction (intake and exhaust - Push/Pull)** – This ventilation consists of introducing uncontaminated air into a space to dilute contaminants, combining it with local extraction of air using flexible ducts in the area with the highest generation of contaminants.
 - e. **Ventilation of Flammable Atmospheres.** Fans, ventilators, engines and other equipment used to ventilate atmospheres containing flammable or explosive vapors, emissions, mists, dusts, etc., shall be of an intrinsically safe design, with devices such as pressure air blast fans, vapor eductors or ejectors, etc. The equipment shall be duly isolated and grounded, as appropriate, to control the accumulation of electricity and discharges.
 - f. **Ventilation System Arrangements.** Ventilation systems shall be arranged so that they will provide the best air distribution possible throughout the entire space and the air shall be of a breathable quality to replace the contaminated air removed from the confined space.

- 1) **Air Circulation** – The location of the extraction duct intakes and the air exchange intakes for interchanging is extremely important to achieve a proper air distribution throughout the confined space. Very little is achieved by placing an extractor fan without a duct, or with a short duct on the top of a confined space with a single, deep opening (where replacement air enters the confined space through the same opening where the fan is located). What would happen would be a fan short circuit, as it would remove most of the replacement air coming into the space before it circulates throughout the space. In this case, the air distribution could be greatly improved by extending a duct from the extraction fan intake to the bottom of the space. Air distribution and circulation may be greatly improved when the replacement air and the extracted air are moved through separate openings inside the space.
- 2) **Replacement Air** – Replacement air that is fed into a space to replace contaminated air must be clean and shall contain normal breathable oxygen levels. Replacement air intakes shall not be located near air exhausts of extracted air or engine exhausts, as this may result in the recirculation of contaminated extracted air into the space. When the replacement air and extracted air are moved through the same opening, ducts must be provided to take the extracted air over a distance sufficiently far from the opening, so as to prevent the recirculation of contaminated air. The direction of the wind is a critical factor in preventing the recirculation of contaminated air.
- 3) **Extracted Air Exhaust Ducts** – Extracted air exhaust ducts containing flammable or toxic substances shall be vented to the outside atmosphere at a place where contaminants may be diluted and dispersed. Extracted air exhaust ducts may not be placed in areas where this air can contaminate adjacent spaces, accumulate or form pockets in low areas, or expose workers to noxious or dangerous atmospheres. The extracted air shall be discharged in the direction of the wind, far from air intakes and possible ignition sources. Certain systems may require the filtration of the extracted air (as in the case of sandblast cleaning), prior to discharging the air into the outside atmosphere. These systems shall be equipped with the proper filtering or separation devices, depending on the contaminant in question.
- 4) **Contaminants Lighter or Heavier than Air** – In a confined space, contaminants lighter or heavier than air tend to accumulate in a greater concentration in higher or lower areas, respectively. A certain amount of diffusion will disperse the contaminant in various degrees of concentration, but higher concentrations will occur at the highest or lowest portions of the space. Higher temperatures that occur with heat processes or through natural causes increase evaporation or convection, and cause vapors or gases to disperse or rise to the upper portions of the space. These characteristics must be considered when making ventilation arrangements and placing air extraction exhaust ducts and replacement air intakes. When contaminants heavier than

the replacement air are present, the air extraction exhaust must be located near the bottom of the space, and the replacement air inlet in the upper part of the confined space. When contaminants are lighter than air or when temperatures are very high, the system must be inverted, the extraction exhaust duct placed in the upper part of the space, and the replacement air intake placed at the bottom of the space. These arrangements will allow the ventilation system to collect and remove contaminants at their point of highest concentration, with a minimum dispersion of contaminants in the space.

g. **Ventilation Requirements for Specific Operations.**

1) **General -**

- a) This section describes the ventilation requirements for certain operations. Nonetheless, it should be pointed out that these requirements are minimal and only serve as a guide. The effectiveness of ventilation in order to reduce and maintain safe levels of flammable and toxic substances, and to provide the proper breathable air, may only be determined by taking appropriate samples of the atmosphere within the space. Compliance with the minimum ventilation requirements does not ensure, by itself, that there will not be hazards from flammable or toxic substances, as there can be many variables affecting any particular work situation. In many cases it may be necessary to use ventilation along with the appropriate respiratory protection apparatus. For example, ventilation with air dilution may be used to maintain flammable vapors at a concentration of 10% or less than the lower explosive limit (LEL). Ventilation provided may not be enough to dilute the contaminant until acceptable worker exposure levels are achieved, because normally a much higher volume of air is needed to dilute the values until the permissible exposure limit (PEL) is reached. In such cases, ventilation can be used to control flammable vapor concentrations and approved personal protection equipment can be used to protect workers from toxic exposure. Competent and qualified personnel and the Industrial Hygienist shall assess each work situation to ensure that the ventilation provided is achieving the desired effect.
- b) In certain cases, the structural configuration of a confined space prevents the safe ventilation to extract a flammable or toxic contaminant, and then it becomes necessary to reduce the scope of the work to keep the generation of contaminants within acceptable levels.

A Competent Person shall conduct tests, take readings, and make the corresponding assessments, according to the nature of the operation and the contaminants. The ventilation provided in any operation shall be acceptable when tests and the assessment show that the ventilation provided is sufficient to maintain the prescribed levels of clean and breathable air and the proper levels of lower explosive limits (LEL) and the permissible exposure limits

(PEL). Class II, III, or IV Competent Person shall ventilate the confined space prior to any access, even though instrument readings show normal conditions.

2) **The ventilation requirements for welding, cutting, brazing, and hard soldering** shall be as follows:

- a) **Local extraction ventilation:** When welding, cutting, brazing or similar operations are conducted in confined spaces, ventilation with local extraction shall be provided when possible, in order to collect and remove contaminants at the point where they are generated.

Toxic material exposure limits shall not be higher than the permissible exposure limits (PELs). Workers shall be equipped with NIOSH certified respiratory protection apparatus approved by the Industrial Hygiene Section and appropriate for the exposure, unless tests and assessments of samples clearly establish that the contaminant concentrations inside the zones where workers breathe are within the permissible exposure limits (PEL).

When the operation has highly toxic metals or other materials, it is possible that a greater air flow is needed to ensure that contaminants are properly collected, as well as to provide a higher air dilution. Whenever workers must work with highly toxic materials, they shall be always equipped with respiratory protection apparatus approved by the Industrial Hygiene Section, as even the slightest interference or trouble in the ventilation system can cause a significant exposure to workers. These toxic materials include, among other, the following:

- Lead
- Mercury
- Beryllium
- Cadmium (the use of air line respirators is mandatory)
- Zinc
- Chromium
- Fluoride compound
- Cleaning and degreaser compounds, stainless steel with chemical flux, iron dust, protected metal arc welding, or metal arc welding with inert gas.
- Halogenated hydrocarbons

b) **Ventilation with Air Dilution:**

(1) When ventilation with local extraction cannot be supplied due to the location, configuration, or nature of the space or similar restrictive factors, air dilution ventilation shall be provided. In such circumstances, workers shall be furnished with NIOSH certified respiratory protection adequate for the exposure and approved by the Industrial Hygiene Section, except when testing and assessments of the samples clearly establish that the concentrations of contaminants are within the acceptable exposure limits.

(2) The air dilution ventilation rates shall be based on the requirements of

parts 1910 and 1915, 29 Code of Federal Regulations and the Ventilation Manual for Industrial Hygienists of the American Conference of Government Industrial Hygienists (ACGIH).

- 3) **Painting, Coating, Use of Solvents** – Frequently, paint, cleaning solvents, liquid solvents for paints and preservative coatings, and similar materials are flammable or toxic. Whenever operations in which such materials are used are performed in confined spaces, ventilation shall be used to control hazards. Generally, the contaminants that these types of operations generate disperse over a wide area instead of at a fixed generation point. In such operations, local extraction ventilation is not as effective to control contaminants. If possible, ventilation with air dilution and extraction (intake and exhaust [push-pull] shall be used).
 - a) **Ventilation up to Permissible Exposure Limits (PELs):** Whenever air dilution and extraction ventilation is used to control exposure to toxic substances, ventilation shall be designed to lower contaminant levels to 25% or to less than the established permissible exposure limits (PELs). Due to the nature of the ventilation problems in confined spaces, as described in paragraph g.l) of this section, workers shall be equipped with NIOSH certified respiratory protection apparatus approved by the Industrial Hygiene Section; unless the tests and industrial hygiene assessments done to the samples clearly show that contaminant concentrations have remained steadily and reliably within acceptable levels.
 - b) **Ventilation up to Lower Explosive Limits:** Whenever sufficient air flow cannot be steadily and reliably provided to reduce contaminants to the established permissible exposure limits, air dilution and extraction ventilation shall be provided up to 10% or less than the lower explosive limit (LEL) of the material in question. Workers shall be equipped with the appropriate NIOSH certified equipment approved by the Industrial Hygiene Section. Ventilation shall be continuous during operations and shall remain continuous after operations cease, until the flammable materials have evaporated and the space is gas free. After the ventilation system has been turned off for at least 10 minutes, a final test of the space shall be made. Frequent testing shall be made during the operations to ensure that no flammable atmospheres are being generated. Operations shall be stopped and the workers removed from the space when flammable vapor concentrations are more than 10% of the lower explosive limit (LEL). Operations may not be resumed until the ventilation deficiencies have been corrected, or the application rate has been adjusted to keep flammable vapors at less than 10% of the permissible exposure limit (LEL). To do this, it must be recognized that in operations such as spray painting, flammable concentrations will exist to a certain degree within the space in a cone shape from the spray nozzle. The existence of these

flammable concentrations within the spray cone is not a reason to stop operations. The type of operations and the effect of the ventilation system in the total atmosphere inside the space shall be considered. Whenever it is found that there are flammable concentrations at significant distances outside the spray cone, the ventilation system shall be suspected and the measures described above must be taken.

- c) **Ventilation Flow Rates:** In order to maintain the levels of permissible exposure limits (PELs) or the 10% of the lower explosive limits (LELs), the air dilution and extraction ventilation flow rates shall be determined and calculated according to the ACGIH Industrial Ventilation Manual.
- 4) **Abrasive Cleaning:** Contaminants produced by abrasive cleaning in confined spaces cannot be controlled reasonably with ventilation. Workers involved in these operations shall be equipped with NIOSH certified respiratory protection apparatus and other personal protection equipment approved by the Competent Person, in coordination with the Industrial Hygiene Section. Ventilation shall be provided with sufficient air flow to remove suspended dust particles, which shall also increase visibility within the space.

6-1.3. Cleaning. It may be necessary to decontaminate a space by cleaning it to render it safe for workers. A Class I or II Competent Person must review and authorize procedures and processes used to clean the interior or a confined space. The prescribed method will depend on the product in the space. If possible, the initial cleaning shall be made from the outside. Due to the fact that the cleaning process itself can generate additional hazards, the protective equipment for each work shall be prescribed as required by the contaminant and the cleaning agent. A continuous and frequent monitoring is required during this process to determine whether the flammable mixes and hazardous contaminant concentrations have been adequately diluted prior to entering (see Section 5-3.).

6-1.4. Inert atmospheres. The atmosphere in a confined can be rendered inert by introducing inert or non flammable gas into the space in sufficient quantities that may displace oxygen and vapor in the space and reduce the oxygen content to a level that is not capable of maintaining combustion. This process is used to achieve safe conditions within a space for the purpose of performing hot work in the outside limits of the space. It is only permitted in emergency conditions, or when the normal cleaning of the confined space cannot be done. It shall not be used in spaces containing highly volatile materials such as gasoline, aviation gas, JP-4 or similar materials with a flammability point of 100 degrees Fahrenheit (37.74 degrees Celsius) or less. This is a highly hazardous work situation and it is mandatory that a Competent Person supervise it and maintain continuous monitoring.

6-1.5. Isolation of Confined Spaces (LOCKOUT/ TAGOUT SYSTEM). Prior to any entry, confined spaces (with the exception of Non Written Permit Spaces) shall be isolated from every adjacent or connected spaces and energy systems or sources. The isolation of the space from energy sources means that they shall physically blocked from any real or potential source of energy. These sources may be:

- power from energized circuits, static charges, batteries or capacitors,
- mechanical energy in the form of levers, gears, axles, blades, springs, etc.
- heat energy from steam systems, heaters, or hot surfaces, and
- pneumatic or hydraulic systems.

Isolation requires a careful assessment to identify potential hazards in the confined space and in adjacent spaces, systems, and sources of energy. An inspection shall be made to locate and identify all isolation devices to determine which of the switch(es), valve(s), or other energy devices apply to the equipment that must be locked.

Physical isolation may be achieved by means of one of four methods:

- a. **Physical Disconnection.** The disconnection of mechanical connections or transmission mechanisms (belts, gears, or chains), or the removal of actuation switches or of the valves or sections of electrical, pneumatic, or hydraulic systems.
- b. **Blanking.** The absolute closing of a pipe, line, duct, or compartment to prevent the passage of any material (solid, liquid, or gaseous) by fastening a solid plate, blind, or cap at the point where these systems enter into the confined space. Blanking shall be capable of withstanding the maximum working pressure of the system, be equipped with a gasket on the pressure side to ensure a leak proof seal, and be made of a material that will not react to chemical substances. Blanking valves shall be locked in their off position and an identification tag placed on them. Pumps and compressors feeding the system shall be locked to prevent accidental actuation. The entry permit shall include a listing of every blanking to be done in specific confined spaces.
- c. **Double Block and Bleed.** Isolate the confined space from pipeline systems, locking the valves nearest to the lines at the entrance and exit of a confined space, and completely opening a drain in the line between the two closed valves to the atmosphere outside the confined space.
- d. **Lockout System.** The placement of a lock or locking device (see Appendix A) on an energy isolation device, according to established procedures, to ensure that the energy isolation device and the equipment is being controlled, and that it may not be operated until the locking device is removed. The locking device is used to prevent the unexpected energizing or startup of machinery or equipment, or the release of stored energy that may injure workers. Employees who must lock a system or device shall be issued padlocks for such purposes, and shall be the **only** persons holding the keys to open such locks. If persons from different groups or occupations operating independently need to lock the same system or device, a multiple lock device shall be used, and each employee shall remove only his lock

when completing his task. When the last lock is removed, this employee (if qualified) shall be the one to activate the system again or the one who will notify a qualified person that the system may be activated again. Normally, only the person who locks a system or device is authorized to remove the lock. In the event an employee seems to have forgotten to remove his lock and there is the immediate need to reactivate the system or locked device and it is not possible to contact the employee, the supervisor of the employee whose lock has not been removed shall check that no one will be adversely affected with the reactivation of the system or device, shall fully inspect the system or device to ensure that it is in a condition to be operated, and then may cut the padlock to reactivate it. **TAGS SHALL BE PLACED ON ALL LOCKS.**

- e. **Tags.** When any of the above mentioned isolation techniques is used, tags shall be placed at the points of operation of the system or device being deenergized, and it shall not be energized again until the tag and lock are removed. The employee who places the lock shall complete all the spaces on the tag. Prior to placing the tag, the spaces on how to DEENERGIZE the system or devices used to lock it must be filled out. The spaces on how to REENERGIZE the system or device shall be completed after the tag is removed. The name of the supervisor who ordered the DEENERGIZATION and the REENERGIZATION of the device shall appear on the tag with the IP number of the employee who placed the tag and the lock. After completing the work, the tags that have been removed shall be returned to the supervisor who assigned the work. **TAGS ARE NOT SUBSTITUTES FOR THE ISOLATION TECHNIQUES DESCRIBED IN PARAGRAPHS FROM a. TO d. ABOVE.**

The tag shall warn about the hazardous conditions that could occur if the machine or the equipment is energized (see Appendix A), and shall include a notation such as the following: **DO NOT TURN ON, DO NOT OPEN, DO NOT CLOSE, DO NOT ENERGIZE, DO NOT OPERATE.**

Employees shall be trained on the following tagging limitations:

- Tags are merely warning means placed on energy isolation devices, and do not offer the physical restriction that locks provide.
- When a tag is placed on an energy isolation device, it shall not be removed without the authorization of the authorized person responsible for it, and may not be disregarded, ignored or otherwise annulled.
- To be effective, tags shall be legible and understandable to all authorized employees, affected employees, and to all other employees whose work operations are or may be in the area.
- Tags and the means to fasten them shall be made of materials that will withstand environmental conditions at the work site.

- Tags may give a false sense of safety, and their purpose needs to be understood as part of the general energy program.

- Tags shall be fastened firmly to energy isolation devices, in such a manner that they will not be inadvertently or accidentally loosened during use.

A Competent Person shall determine whether additional procedures are needed when the confined space is in a double walled construction, and such procedures shall be written into the entry permit.

In continuous systems where is not possible to totally isolate the system or devices (in sewers, service tunnels, etc.), specific procedures in writing shall be used to protect them against hazards that are normally prevented by isolation.

6-2. SAFETY EQUIPMENT

6-2.1. Inspection, Testing and Certification of Safety Equipment. The designated supervisor shall inspect, test (as appropriate), and certify whether the safety protection equipment is in good working condition. The safety protection equipment shall include, among other things, personal equipment to protect the eyes and face, head, ears, feet, body and hands; and the respiratory protection to breathe safely in any dangerous atmosphere that may be found.

6-2.2. Work Equipment and Tools. Equipment and tools needing certification must have been certified by accredited testing agencies.

The potential for explosion greatly increases when spark proof tools and explosion proof equipment are not used or are badly maintained. The potential for electrocution also increases when low voltage switches and ground fault circuit interrupters (GFCI) are not used. The designated supervisor shall carefully inspect, test, and approve all work equipment and the tools to be used in a confined space. The work team shall comply with the following requirements:

- a. Spark proof manual tools shall be kept clean and in good condition.
- b. Electrical tools, equipment, and flashlights shall be approved according to Subpart 11.2, Section 11 of the Safety and Occupational Health Handbook of the Panama Canal Authority, and shall be equipped with a ground fault circuit interrupter (GFCI). Prior to using electrical equipment in a confined space, a Competent Person shall check all ground connections.
- c. All certified cords, tools, and electrical equipment shall be of the heavy type and shall have heavy insulation. Prior to using them in a confined space, they shall be visually inspected to detect any defect.

- d. Whenever there are flammable liquids present, air tools shall be used. Their use reduces the risk of explosion, although it does not eliminate it. Tool reheating, (drilling), sparks that are produced by hitting (percussion), grinding, sharpening, or accumulated electrostatic discharges which arise with the flow of compressed air, are all situations that can cause explosions.
- e. Internal combustion engines shall not be operated in confined spaces without venting sealed exhaust pipes outside, in the direction of the wind and away from the confined space. If internal combustion engines are to be used in a confined space, such as those on cranes or forklifts, the Competent Person shall monitor the atmosphere continuously to ensure that carbon monoxide levels do not exceed the Threshold Limit Values (TLV).
- f. Lighting in confined spaces where flammable vapors are present shall be of a certified explosion proof design. Lights may not be hung from electrical cords, unless they are specifically designed for such purpose. Work area lighting shall be sufficient to provide safe working conditions, per standard ANSI A11-1. In no circumstance shall matches or open flames be used to light a confined space.
- g. Compressed gas cylinders shall never be taken to a confined space, and when they are not in use, the cylinder valve shall remain closed. The exception to this rule are cylinders that are part of self contained breathing apparatus (SCBA) or resuscitation equipment. Flammable gas hoses shall be removed when persons who have used them have abandoned them at confined space work sites, and they shall be bled outside the confined space prior to returning them there.
- h. Ladders shall be properly installed or shall be of a permanent type that provides the same degree of safety as required by Subpart 10.1, Section 10 of the Safety and Occupational Health Handbook of the Panama Canal Authority.
- i. Proper scaffolding shall be designed to withstand the maximum load expected (with a safety factor of 4), equipped with traction type boards and meeting the requirements of Section 10 of the Safety and Occupational Health Handbook of the Panama Canal Authority.
- j. Power lines, joints, and appurtenances shall be according to Subpart 5.4, Section 5 of the Safety and Occupational Health Handbook of the Panama Canal Authority.
- k. Only hose lines and components with insulation may be used that are designed specifically for liquid or compressed gas at their corresponding working pressure, and these systems shall have a pressure relief valve outside the confined space.
- l. All equipment used in a potentially flammable atmosphere shall be certified as explosion proof or intrinsically safe for use in the atmosphere in question.

6-2.3. Safety Equipment and Personal Protective Clothing. An entry permit shall include a list of the necessary personal protection equipment to be used in a confined space, as approved by the Competent Person. To determine the reliability of personal protection equipment, the designated supervisor shall consider the following four critical factors:

- Selection
- Adequate Adjustment
- Proper Use
- Maintenance

The designated supervisor is responsible for ensuring that all authorized persons entering the confined space:

- Know their personal protection equipment, such as lifelines to remove persons, respirators, and the clothing required to enter and exit the confined space safely;
- Be provided with the necessary personal protection equipment and know how to use it properly;
- Know the necessary outside barriers to protect entrants from outside hazards, and the proper use of such barriers.

a. **Personal Protection Equipment.** The following items are normally used to protect persons against traumatic injury, among other: safety glasses, safety hats, safety shoes, and protective clothing. These implements shall be approved by the Safety Division of the Panama Canal Authority.

- 1) **Eye and Face Protection** – Persons who use corrective eyeglasses are provided corrected safety glasses or flat lens type glasses. Safety goggles are also required if there are eye irritating chemical substances, vapors, or dusts, and a shield should be worn that covers the entire face as well as the eyes if they are exposed to hazards, as when scaling or cutting rivets. During welding operations, the special goggles or face shields required for welding shall be as approved by the Industrial Hygiene Section.
- 2) **Head Protection** – Hard hats shall protect the head of workers from impact or the penetration of falling objects and high voltage shock and burns.
- 3) **Feet Protection** – To protect feet, shoes supplied by the Panama Canal Authority or an equivalent shall be worn. In addition to protection against falling objects, protection against any other hazard that the Competent Person identifies shall be provided. Safety shoes in potentially explosive atmospheres shall be of non sparking material or wrapped in cotton fabric.
- 4) **Body Protection** – Workers entering a confined space shall wear clothing that covers them completely, as approved by the Competent Person. To protect against toxic or irritant materials, gloves and clothing made of impervious

rubber or similarly impervious material shall be worn. If there is a danger of suffering from heat exhaustion in a confined space, clothing certified to provide protection against exposure to these hazards shall be worn. Body protection shall be provided according to the operations, such as welding (flame proof), riveting (heat resistant), and abrasive cleaning (abrasion resistant), to ensure personal safety.

- 5) **Hearing Protection** – This type of protection is required when noise levels are more than 85 dBA. Emergency alarms shall be equipped with a strobe light, in case the noise levels interfere with the ability to hear the alarm. See the Hearing Protection Standard.
- 6) **Respiratory Protection** – A Competent Person shall determine the type of protection, according to the conditions and results of confined space tests and the work to be performed; in case of any doubt, consult the Industrial Hygienist in your area. For a Respirator Selection Guide, see Appendix K. Respirators shall be those approved by the Industrial Hygiene Section, and they must be adjusted. See the Respiratory Protection and Breathable Air Standard of the Panama Canal Authority.
- 7) **Hand Protection** – If hands are exposed to rough surfaces or sharp edges, the degree of protection may be from canvas gloves to metal mesh gloves, depending on the material to be handled. Impervious rubber gloves or those of a similar material shall be used to protect hands against toxic or irritant materials. Protective gloves shall be used when employees must handle objects at temperatures of more than 60 degrees Celsius (140 degrees Fahrenheit). When a flow through the body of electric current of more than 5 milliamperes due to contact with energized electrical equipment, workers shall wear insulated gloves that have been visually inspected prior to each use. Rubber gloves shall be worn when a voltage of more than 5,000 volts is present.
- 8) **Other Protective Measures** may include safety nets used to protect employees working 10 feet (3 meters) above ground, or on inclines, when other measures are not practical. Life vests shall be worn by workers when they are exposed to fall into liquids 4 feet (1.2 meters) or more deep. When hot work requires the use of electric power, insulating mats or rugs shall be installed.

CHAPTER 7

EMERGENCY READINESS

7-1 ATTENDANTS (STANDBYS)

7-1.1. Selection. A person assigned as attendant or standby for work in a confined space must be fully knowledgeable of the work to be performed, the safety precautions that must be taken, the inside of the confined space and its related hazards, the personnel working in the confined space, their duties and the work sites to which they are assigned, the emergency and rescue procedures, and who to call in case of an emergency. In Class III confined spaces, the attendant may be the person certified to administer cardiopulmonary resuscitation (CPR) and first aid, and shall be immediately available at the work site. Otherwise, the attendant must know who the person is who is certified to administer CPR and first aid, and where to find him promptly.

7-1.2. Duties.

- a. **Number of entrants.** The attendant shall maintain a continuous and exact count of all persons who are in the confined space.
- b. **Hazard Recognition.** An attendant must know and be capable of recognizing the potential hazards of confined spaces, and shall watch the activities that take place inside and outside the confined space to determine if it is safe for entrants to remain in the space.
- c. **Communication.** Attendants shall:
 - 1) Maintain an effective and continuous contact with authorized entrants, at the time they enter. Radio communication, signal lines, or other methods may be used, and prior to entering, such methods and signals shall be established.
 - 2) Order authorized entrants to evacuate the confined space immediately when the attendant or standby:
 - a) Detects a condition that is not permitted by the entry permit;
 - b) Observes strange behaviors by persons due to exposure to a hazard (attendants must keep on hand the Material Safety Data Sheets - MSDS being used or expected to be used in the confined space, and know the signals that something is wrong. He shall make Material Safety Data Sheets available to rescue personnel, in order to facilitate the procedures to mitigate the fire or hazard, treat injuries, and provide the proper safety protection);
 - c) Detects a situation outside the space which might endanger persons

entering the confined space;

- d) Observes an uncontrolled hazard within a confined space in the systems connected to it;
 - e) The attendant is watching the entrance in more than one confined space and must focus his attention on the rescue of persons in one of these spaces;
 - f) The attendant may **NEVER** abandon his work station. (These attendants may be used to pass tools and materials inside and outside of the confined space, and to coordinate the work being done outside the space. Nonetheless, attendants may not abandon the vicinity of the entrance, nor stop communicating with the entrants.)
- 3) Call rescue or emergency services, as soon as the attendant determines that the authorized entrants need to escape the hazards in the confined spaces; and
- 4) Take the following actions as necessary, when unauthorized entrants approach or enter a confined space while workers are entering or performing their work;
- a) Warn unauthorized persons that they may not enter the space;
 - b) Request unauthorized persons to leave immediately if they have entered the confined space; and
 - c) Inform authorized entrants and any other persons designated by the supervisor of the work or by the Competent Person, if unauthorized persons have entered the confined space.
- d. **Rescue.** The work supervisor shall ensure that attendants:
- 1) Do not enter the confined space to attempt the rescue of entrants;
 - 2) Make proper use any type of rescue equipment provided and perform any other assigned rescue and emergency duties without entering the confined space;
 - 3) Know the emergency and rescue procedures, how to initiate the rescue, how to call to obtain rescue, and assist by providing information to rescue personnel, instead of participating in the rescue activities within the confined space.

NOTE

No one who is not a member of a duly trained and equipped rescue team may attempt a rescue. A well trained attendant who is a qualified rescue team member shall call

immediately to request help. The attendant shall wait until the rescue team arrives or until there is an observer or another attendant to take his place.

7-2. EMERGENCY AND RESCUE PROCEDURES

The emergency and rescue procedures shall be prepared starting with the planning stage of the confined space operations.

Prior to starting work in confined spaces, the members of the on plant response crew (previously rescue teams) shall be thoroughly trained on emergency procedures. Instructions shall include at least a practice drill.

The Emergency and Contingency Management Division of the Panama Canal Authority is the main rescue unit for confined space work. During the preparation stage and preliminary orientation, designated supervisors shall inform the Emergency and Contingency Division through their Northern and Southern District stations, about the place and the nature of the work that is planned to be performed in the confined spaces. Thereafter, at the beginning of each shift, designated supervisors shall notify the Emergency and Contingency Division about the work to be performed.

At the places where management considers that the response time of the Emergency and Contingency Division would be too much to adequately respond in a rescue, a response crew (previously rescue team) shall be appointed from among the crew or other personnel who are in the vicinity of the confined space work. Prior to the start of work, the response crew shall be assigned specific tasks and will become familiar with the response team (for rescue and emergencies) to be used and shall undergo response procedure drills. Procedures recommended by the Emergency and Contingency Division shall be followed even when a response crew has been designated for the project or task.

The members of the on plant response crew shall be trained as established by the Emergency and Contingency Division.

7-3. EMERGENCY AND RESCUE TEAM

The following additional personal safety equipment is needed to rescue workers from confined spaces and must be kept immediately available:

- a. Lifeline
- b. Flashlight
- c. Radio, when there is no telephone
- d. Self Contained Breathing Apparatus (SCBA), or air line respirator with escape bottles (at least two sets), when the following circumstances exist:

- 1) Conditions causing immediate danger to life or health
- 2) Cleaning of petroleum, oil, or lubricant tanks
- 3) Painting operations
- 4) Solvent cleaning operations
- 5) In remote or isolated work sites
- 6) When the Competent Person determines that it is necessary.

APPENDIX A

GENERAL DEFINITIONS

Activated: Connected to an energy source, or a source with residual or stored energy.

Atmosphere: All gases, vapors, mists, and dusts contained in a confined space.

Attendant or Standby: An employee assigned to remain very close outside the entrance to a confined space, and keep in communication with the persons working inside it (see Section 7-1).

Blanking or blinding: the absolute closure of a pipe, line, or duct, by fastening a solid plate that completely covers the bore, extending it at least to the outside edge of the flange to which it is fastened; capable of withstanding the maximum pressure to which it may be subjected.

Certification: A statement in writing issued by an expert, certifying that testing has been done in a confined space, that said space has been assessed, and that it has been determined that it is safe to work in it. There are two certification documents: the Planning Form prior to entry (see Appendix F) and the entry permit (see Appendix G).

Cold work: Any work that does not involve fire, live flames, arcing, sparks, or other ignition sources, or the heating of metals or other mediums to a temperature equal or higher than 400 degrees Fahrenheit with means are not flames, fire, sparks, or other similar ignition sources.

Combustible Dust: Dust that can explode or burn when subjected to an ignition source or extreme heat.

Confined space: It is an enclosed space that:

- a. Is large enough and so configured that an employee can bodily enter and perform work in it.
- b. Has limited or restricted means for entry or exit, and therefore it is difficult to escape from it in an emergency.
- c. Is not designed for continuous occupancy.
- d. Does not have natural ventilation.
- e. Has one or more of the following characteristics:

1. Contains or is known to be capable of containing a dangerous atmosphere (such as a toxic, explosive, or oxygen deficient atmosphere). See *Dangerous atmosphere* in this Appendix.
2. Contains a material that can engulf an entrant.
3. Has an internal configuration such that an entrant could be trapped or suffocated by inwardly converging walls or by a floor which slopes downward and tapers to a smaller cross-section; or
4. Contains any other recognized grave safety or health hazard.

See Section 1.2.3 entitled Confined spaces aboard floating equipment

Classes: See Appendix C

Examples: See Appendix D

Dangerous atmosphere: An atmosphere that exposes workers to the risk of death, disability, injury, or acute illness caused by one or more of the following causes:

- a. A gas, vapor, or flammable mist.
- b. An atmospheric concentration of oxygen below 19.5 per cent or over 21 per cent.
- c. An atmospheric concentration of any toxic substance whose permissible exposure limit, established in the regulations, may be exceeded.
- d. A combustible dust in the air at a concentration that obscures vision at a distance of five feet (1.52 m.) or less.
- e. Any atmospheric condition recognized as imminently dangerous for life or health.

Whenever an air contaminant is present in the atmosphere of the space for which OSHA has not determined the permissible exposure limit, OSHA recommends that employers consult other sources of information, such as the manufacturer's Material Safety Data Sheet, that comply with Standard 1910.1200 on Hazard Communication, as a guide to establish the acceptable environmental conditions of entry for their employees.

Double block and bleed: The closure of a line, duct, or pipe by closing and locking or tagging two in-line valves and by opening and locking or tagging a drain or vent valve in the line between the two closed valves.

Emergency: Any occurrence or event inside or outside of the confined space that could endanger entrants (including any hazard control or surveillance team problem).

Energy Source: Any electric, mechanic, hydraulic, pneumatic, thermal, or other type of energy source.

Engulfment: The effect or action of a finely divided liquid or solid substance of surrounding and capturing a person.

Entry: Entering or initially opening a confined space. It is considered that a person has entered it whenever any part of his face has crossed the bay of the confined space opening.

Entry Permit: A written certification that it is safe to enter a confined space for a given purpose, during a specific period, and in the conditions described in the permit (see Certification, above, and Section 1-6 and Appendixes F and G).

Executing Unit: The organization's unit in charge of performing work in a confined space.

Expert: (See Section 1-4). For the purpose in question, the term "expert" means a person capable of recognizing and assessing the exposure of workers to hazardous substances and other unsafe conditions, and who possesses the knowledge to specify the necessary protection and precautions to ensure worker safety.

Expert Electrician: A qualified electrician trained in the special requirements of work in confined spaces and certified by the Manager, Safety Division.

Filling: The process of filling a space with liquid in order to remove a flammable mixture of vapor and air.

Fire Watch: An employee assigned to watch the work for fire protection. He shall always be alert, be trained properly on the use of the recommended fire extinction procedures, and take immediate action in case a fire occurs.

Hot Work: For the purposes of work in confined work spaces, hot work involves the following: all flame heating; welding; torch cutting; hard soldering; cutting and welding with carbon electrode; or any work producing heat by any means at 400 degrees F. or more, as well as work that produces a source of ignition, such as drilling, abrasive blasting (sandblasting), chipping, crushing, or heating the space; or when flammable materials or atmospheres exist, other sources of ignition such as sparks, tools, or equipment producing arcing, static discharges, friction, impact, flames or live embers; or proof lamps, devices, engines, or equipment that are not explosion proof, etc.

Hot Work Permit: A written authorization to perform hot work.

Imminently hazardous for life or health: Any condition that is an immediate threat to life, may have an irreversible or grave effect on health, may cause eye injury or irritation, or other conditions that may obstruct can escape from a confined space.

Inerting: Displacement or dilution of the atmosphere in a confined space by an inert, non flammable and non reactive gas, to render an atmosphere non combustible, non flammable and non chemically reactive. NOTE: There cannot be human life in inert atmospheres, even when they are not toxic. Therefore, all inert atmospheres represent an imminent danger to life or health.

Isolation: The physical separation of a confined space from adjacent compartments, connected machinery; connected electrical, liquid, or gas lines; or any other source of energy or contamination.

Limit: The outside edge or limit of a confined or enclosed space, such as the outside walls of a fuel tank. The limit spaces are the spaces contiguous to an enclosed or confined space, which limit it in all directions (over, under, and on all sides).

Lockout: The placing of a lock or other locking device on an energy isolation device, according to the established procedures, to ensure that such device and the controlling equipment are not activated until the lock is removed.

Lockout device: A positive means, such as a key or combination type lock, to secure an energy isolating device in the safe position and prevent the energizing of a machine or equipment.

Lower or Upper Explosive Limit: Explosive or flammable limits. The degree of concentration of a material expressed in percentages, corresponding to the volume of material contained in the air, that burns or explodes when lit. These concentration limits are known as Lower Explosive Limit (LEL) and Upper Explosive Limit (UEL). Concentrations below the lower explosive limit are too weak to ignite, while concentrations that exceed the upper limit are too rich to ignite.

Non Written Permit Space: Some confined spaces do not represent a hazard for those who enter it for the purpose of **conducting an inspection or performing routine maintenance tasks**. If after a single on site assessment of the atmospheric, electrical, mechanical and other physical hazards normally found in confined spaces, a Class I or II expert determines that the confined space is not dangerous for entry to perform inspections or routine maintenance tasks, the space can be designated in writing as a non written permit space. This means that an entry permit or a planning form is not required prior to entry, except the work to be performed can create a dangerous atmosphere or condition (see Section 1-3.5). Such spaces must be marked with a sign (see Appendix H).

Normal Environmental levels: These levels show that the atmosphere in the confined space has been ventilated and that the air does not contain flammable or toxic substances, that it has an oxygen level that agrees with outside conditions (20% to 21%) and poses very little risk of generating a hazardous condition. All subsequent tests must be done after ventilation has been stopped at least for 10 minutes.

On plant rescue team: A group or two or more employees designated and training to perform confined space rescues on the site.

Owner Unit: The unit where the confined space is located.

Oxygen deficient atmosphere: An atmosphere containing less than 19.5% oxygen per volume.

Oxygen enriched atmosphere: An atmosphere containing an oxygen concentration higher than 21% per volume.

Permit: (or Certificate) A document issued by any expert, certifying in writing that the work shown on it can be performed safely in a specific confined space and in the conditions shown on the permit (see Entry Permit and Certification in this annex, Section 1-6, and Appendixes F and G).

Permitted Exposure Limit: The concentrations of substances in the air to which a worker may be exposed during a normal work shift, or during a 40 hour work week without suffering adverse effects. The legal values according to OSHA, or the weighted time– value average, according to the exposure guidelines of the American Conference of Government Industrial Hygienists.

Potential flammable hazard: Any atmosphere containing flammable gas vapor at more than 10% of its lower explosive limit, or solid substances (dust) in concentrations that pose a fire or explosion hazard.

Purge: To remove or dilute a dangerous atmosphere in a confined space, until a safe level is reached.

Rescue lifeline: A line or rope tied on one end to the wrist straps, or to the chest or full body harness being worn by a worker entering a confined space, and tied on the other end to an anchoring point or to a forklift outside the space.

Respirator: An approved device designed to protect the user from the inhalation of hazardous materials.

Tagout: A conspicuous warning signal, such as a tag and the means to fasten it, that may be safety attached to an energy isolation device according to the established procedure, to show that the isolation device or the equipment it controls may not be activated until the lock and tag are removed.

Toxic Substance: A substance capable of producing poisoning by inhalation, ingestion, or skin contact.

Unattended Entry: The entry of one or more persons to a confined space, without attendant or assistant. For the purposes of this definition, it is considered an unattended

entry, independently of the number of persons entering and occupying the confined space simultaneously. **ENTRY IS NOT PERMITTED alone into a confined space, unless it is a Non Written Permit Space** (see Section 1-3.5).

Written Permit Required Confined Space (Permit Space): A confined space for which an employer has determined that an entry permit is needed, because it contains a dangerous atmosphere or other exposure hazard caused by mechanical, electrical, physical, or chemical agents that exist or are reasonably expected to exist within the space.

APPENDIX B

ABBREVIATIONS

ACGIH:	American Conference of Government Industrial Hygienists
ANSI:	American National Standards Institute
CFR:	Code of Federal Regulations
DASHO:	Designated Agency Safety and Health Officer
DOT:	U.S. Department of Transportation
EPA:	Environmental Protection Agency
IDLH:	Imminently Dangerous to Life or Health
LEL:	Lower Explosive Limit
LFL:	Lower Flammability Limit
MESA:	Mine Safety Administration
MSDS:	Material Safety Data Sheet
MSHA:	Mine Safety and Health Administration
NIOSH:	U.S. National Institute of Occupational Health and Safety
NFPA:	National Fire Prevention Association
OSHA:	Occupational Safety and Health Administration
PEL:	Permissible Exposure Limit
POL:	Petroleum – Oil – Lubricant
PPE:	Personal Protection Equipment
PPM:	Parts per million
SCBA:	Self Contained Breathing Apparatus
TLV-TWA:	Threshold Level Value – Time weighted average
UEL:	Upper Explosive Limit
UFL:	Upper Flammability Level

APPENDIX C

CONFINED SPACE CLASSIFICATION TABLE

PARAMETERS	CLASS I	CLASS II	CLASS III
Characteristics	Imminently dangerous for rescue procedures. Requires the entry of more than one fully equipped person with life support equipment. To maintain communications, an additional attendant stationed inside the confined space is required.	Dangerous, but does not pose an imminent threat to life. For rescue operations, the entry of not more than one person fully equipped with vital support equipment is required. Visual or hearing communication with workers shall exist.	Potential danger. Does not require modification of work procedures – normal rescue procedures – direct communication with workers from the outside of the confined space.
Oxygen	Less than 16% or more than 22%.	Between 16% and 22%	19.5% to 21%
Flammable characteristics	10% or more than the lower flammability limit or lower explosive limit.	From 2.1% to 10% of the lower flammability limit or the lower explosion level.	**2% or less than the lower flammability limit or the lower explosive limit.
Toxicity	*Imminently dangerous for life or health	Higher than the contamination level, according to the appropriate regulations, less than *imminently dangerous to life or health.	Without contaminants, according to the appropriate regulations. (Carbon dioxide is at normal atmospheric levels.)

*Imminently dangerous for life or health – according to the NIOSH Register of Toxic and Chemical Substances, the Material Safety Data Sheets of the manufacturer's chemical data, the Industrial Hygiene Guide and other recognized authorities.

**Class III and IV experts may only issue permits when a confined space has already been reduced to normal environment levels.

APPENDIX D

EXAMPLES OF CONFINED SPACES AND POSSIBLE LOCATIONS

TYPE	EII	MRR	EID	EIL	EIM	MRL	EIE
1. Screwed on compartments on floating equipment	X	X	X	-	-	X	X
2. Fuel tanks	X	X	X	X	X	X	-
3. Empty spaces	X	-	X	X	X	X	-
4. Double bottoms	-	-	X	-	-	-	-
5. Water Tanks	X	X	-	X	-	-	-
6. Storage tanks	X	-	X	X	X	-	-
7. Caissons	-	-	-	-	X	-	-
8. Gates	-	-	-	-	-	X	-
9. Underground passageways	-	-	X	-	X	-	-
10. Tunnels	X	-	X	X	X	X	-
11. Drum gates	-	-	-	X	-	-	-
12. Wells	X	-	X	X	X	X	-
13. Sewers	X	-	X	X	X	X	-
14. Access wells	X	-	X	X	X	X	-
15. Holes	X	-	X	X	X	X	-
16. Sumps	X	X	X	X	X	X	-
17. Drains	X	-	-	-	X	-	-
18. Pump stations	X	-	-	X	X	-	-
19. Transformers	X	-	X	X	-	X	-
20. Boilers	X	-	X	X	-	-	-
21. Condensers	X	-	X	X	X	-	-
22. Conduits	X	-	X	X	X	-	-
23. Lock gates	-	-	-	X	-	-	-
24. Ventilation and exhaust ducts	X	-	X	X	X	-	-
25. Refrigeration Compartments	X	-	X	-	X	-	-
26. Deposits	X	X	X	X	X	-	X
27. Covered spaces more than 4 feet deep	X	-	X	X	-	-	X

- * SII = Industrial Division
- * MRR = Transit Resources Division
- * EIP = Dredging Division
- * EIL = Electrical Division
- * EIM = Maintenance Division
- * MRL = Locks Division
- * EIE = Engineering Division

APPENDIX E

CONFINED SPACE ELECTRICIAN SPECIALIST

1. Qualifications required for a Confined Space Electrician Specialist:
 - a. Must be an Electrician, grade MG-10 or over.
 - b. Must have in depth knowledge of the hazards of his occupation, the Panama Canal Authority confined space policy, the Manual on Safe Practices in Confined Spaces, and other pertinent regulations on electrical hazards in confined spaces.
 - c. Must know the applicable splicing and grounding procedures.
 - d. Must have an in depth knowledge of the lockout and tagout procedures authorized by the Panama Canal Authority and his Division.
 - e. Must be certified by the Safety Division as a Confined Space Electrician Specialist.
2. Safety Division Certification:
 - a. Each operating division (with the exception of the Maintenance Division) shall have its own confined space electrician. Division Managers shall propose candidates to the Safety Division, and the Maintenance Division shall use the Electrical Division's electrician.
 - b. The Industrial and Safety Training and Development Section shall give a course on confined spaces and a written examination for confined space electrician specialists at the end of the course. Candidates shall also attend a one day orientation given by the Safety Division on the Manual on Safe Practices in Confined Spaces, which shall not be necessary for electricians already certified as Class III or IV experts.
 - c. The Manager, Safety Division, on the recommendation of the Industrial and Safety Training and Development Section, shall issue a certification as confined space electrician specialist.
3. Procedures and guidelines for the inspection of electrical equipment and installations in confined spaces.
 - a. The confined space electrician specialist shall confirm that all electrical equipment and lines installed permanently within the confined space are disconnected, tagged, and locked, if possible.
 - b. The confined space electrician specialist is responsible for the inspection of all portable electrical equipment used in the work area. All cords, tools, and portable electrical equipment shall be classified to work with industrial

use or heavier insulation (Ref. ART 400, Table 400-4 NEC), and be visually inspected prior to their use in a confined space. Cables and equipment shall be tested and tagged.

- c. The electrician specialist shall inspect the confined space at least once a day while work is being performed in it. Whenever the permanently installed electrical equipment is disconnected and moved elsewhere, the electrician specialist shall inspect the equipment and the area prior to reconnecting the equipment and cables.
- d. The electrician specialist shall ensure that all exposed bus bars within the confined space are disconnected, tested, and grounded prior to starting work in the space. If it is not possible to disconnect them, exposed bus bars shall be covered with adequate rubber sheets, and a barrier set up to keep workers away from bus bars.
- e. The electrician specialist shall inspect the lighting systems to ensure that the system has been carefully connected to prevent a breakdown in an individual lighting element such as a burned bulb, from leaving the area in total darkness.
- f. An electrician specialist shall ensure that paint guns and the electrical equipment, including transformers, generators, dryers, welding equipment or distribution devices are properly connected to a grounding system. If there is no grounding system available, a grounding rod shall be used and placed as close as possible to the service entrance, which shall also be grounded. All equipment shall be checked to verify that it is properly connected.
- g. The electrician specialist shall ensure that all tools, equipment, etc., comply with the requirements established to prevent sparks and other forms of ignition within confined spaces containing potentially explosive or flammable atmospheres.

**APPENDIX F
PANAMA CANAL AUTHORITY**

**PRELIMINARY PLANNING PRIOR TO ENTRY TO A CONFINED SPACE
FORM**

Location of Confined Space: _____

Work to be performed: _____

Start: _____ A.M./P.M End _____ A.M./P.M.
Day/Date/Time Day/Date/Time

Work Unit or Contractor Firm: _____

TYPE OF HAZARDOUS WORK

Combustion Hazards

Welding, _____
Burning _____
Open Flame _____

Spark Production

Scaling _____
Grinding _____
Other _____

Sandblasting _____
Drilling _____

OTHER EXPECTED HAZARDS

- | | | | |
|---|---|---|---|
| <input type="checkbox"/> Toxic Materials
CO PPM | <input type="checkbox"/> Chemical Cleaning | <input type="checkbox"/> Deactivation of a process in the vicinity | <input type="checkbox"/> Pressurized Systems |
| <input type="checkbox"/> Corrosive Materials | <input type="checkbox"/> Inert Gases | <input type="checkbox"/> Internal Combustion Engine inside the Confined Space | <input type="checkbox"/> Leaks |
| <input type="checkbox"/> Flammable Materials | <input type="checkbox"/> Paint | <input type="checkbox"/> Operation of Equipment Without Safety Guards | <input type="checkbox"/> Tightening Pressure Joints |
| <input type="checkbox"/> Spilled Materials | <input type="checkbox"/> Spark Generating Operations | <input type="checkbox"/> Work on Equipment Without Safety Guards | <input type="checkbox"/> Place Blind Cover |
| <input type="checkbox"/> Hot Work Process or Equipment | <input type="checkbox"/> Work Near Energized Equipment | <input type="checkbox"/> Disconnecting and Sealing | |
| | <input type="checkbox"/> Deactivation or Disconnection of Lines and Equipment | | |

SAFETY PREPARATIONS

PERSONAL SAFETY *Identify User (see below)

- | | |
|--|--|
| <input type="checkbox"/> Protection against _____ | <input type="checkbox"/> Electrician Gloves |
| <input type="checkbox"/> Self Contained Breathing Apparatus | <input type="checkbox"/> Rubber Gloves |
| <input type="checkbox"/> Air Line Respirator | <input type="checkbox"/> Welding/ Sandblasting Gloves |
| <input type="checkbox"/> Dust Respirator | <input type="checkbox"/> Shower/ Eyewash |
| <input type="checkbox"/> Vapor Respirator | <input type="checkbox"/> Safety Shoes |
| <input type="checkbox"/> Organic Respirator | <input type="checkbox"/> Ladders / Secured Equipment / |
| <input type="checkbox"/> PEL Respirator | <input type="checkbox"/> Rescue Lifeline / Harness |
| <input type="checkbox"/> Fabric Neck Protector | <input type="checkbox"/> Two Escape Routes |
| <input type="checkbox"/> Coveralls | <input type="checkbox"/> Rescue Equipment |
| <input type="checkbox"/> Skin Cream | <input type="checkbox"/> Evacuation Instructions |
| <input type="checkbox"/> Safety Goggles | <input type="checkbox"/> Communication Type |
| <input type="checkbox"/> Face Shield | <input type="checkbox"/> Emergency Number |
| <input type="checkbox"/> Hearing Protectors | |
| <input type="checkbox"/> Safety Helmet / Welder's Safety Hat | |
| <input type="checkbox"/> COMMENTS | |

EQUIPMENT ISOLATION

- Tagout and Lockout
 - Disconnecting and Sealing
 - Protecting against Outside Hazards
 - Stop Transfer
 - Roping Around Area
 - Erect Barricades
 - Block Accesses
- ELECTRICAL SAFETY**
- Inspection of Electrical Equipment
 - Explosion Proof Equipment
 - Spark Proof Tools
 - Spark proof Containers and Protector to
 - Remove Fuses
 - Circuit Lockout
 - Arc Welding Protection
 - Grounding Protection
 - Proper Grounding

EQUIPMENT CLEANING

- Steam
- Filling and Draining
- Remove Residues

VENTILATION

- Local Ventilation
- Push/ Pull for its Dilution
- General Ventilation

FIRE SAFETY

- Fire Screen
- Keep Area Damp
- Close Sewer Openings
- Warning Signs
- Chemical Dust Extinguisher
- Water/ Fire Hose

W=Welder, E=Employee, A=Attendant, P=Painter, S=Sandblasting, and O= All confined space entrants

Name of employees entering the confined space: _____

Name of person remaining as an attendant: _____ Name of Fire Watch: _____

Name of employees certified to administer CPR or First Aid: _____

Emergency numbers: FIRE: _____ HOSPITAL: _____ POLICE: _____

¿Have entrants and waiting personnel received instructions and explanations regarding the confined space entry and rescue procedures? No _____

COMMENTS: _____

Have the Material Safety Data Sheets (MSDS) been reviewed? Yes _____ No _____

_____ Designated Work Supervisor _____ Competent Person _____ Class _____ Date _____

Original (White): To be Posted at the Entrance of the Confined Space
1st. copy (Pink): Competent Person
2nd. copy (Yellow): Designated Work Supervisor

**APPENDIX G
PANAMA CANAL AUTHORITY
CONFINED SPACE ENTRY PERMIT**

Space to be entered:

Location

Requested by:

Work to be performed:

Certification Categories				Permit Issuance
Atmospheres safe for workers-NOT SAFE FOR HOT WORK				Date:
Atmospheres safe for painting-NOT SAFE FOR HOT WORK				Time:
Atmospheres safe for cleaning- NOT SAFE FOR HOT WORK				Permit Expiration
Atmospheres safe for workers – Safe for hot work			Mandatory Fire Watch	Date:
Inert ' NOT SAFE inside for workers. Atmospheres safe for hot work				Time:

Air Monitoring: All testing shall be documented

Time	Acceptable Conditions	Results	Results	Results	Results	Results	Results	Results	Results	Results	Results	Results
Oxygen	19.5-21.9%											
% LEL												
LEL PPM												
Location												

Instrument: Model S/N Dates: Last calibration Last Verification

Comments:

MONITRONG AUTHORITY DELEGATION TO CLASS I COMPETENT PERSON / SUBSEQUENT ENTRIES (only for the use of Class I Competent Person)

MONITORING: YES NO See the above sections on the conditions and comments on monitoring parameters and procedures. Time interval:

SUBSEQUENT ENTRIES: YES NO Expiration of Subsequent Entry Delegation: Date: Time:

NOTE All support documents of the Confined Space Preliminary Entry Planning Form and the Entry Permits shall be attached.

1. Delegated to (name in print):	Date:	Time:
Signature:	I. P. No.:	Tel. No.:
2. Delegated to (name in print):	Date:	Time:
Signature	I. P. No.:	Tel. No.:
3. Delegate to (name in print):	Date:	Time:
Signature:	I. P. No.:	Tel. No.:

DESIGNATED WORK SUPERVISOR: I, (name in print) _____ shall comply with all the precautionary measures and use the equipment shown on the Confined Space Preliminary Entry Planning Form and the Entry Permit. I understand that this Entry Permit shall be null and void if the scope of the work is changed or if hazardous materials not included in the entry certificates are introduced. In the event there are physical or atmospheric changes affecting the work area described above, all work shall be stopped and the undersigned Confined Space Competent Person shall be notified.

Signature: I. P. No. Tel. No.:

CONFINED SPACE COMPETENT PERSON: I, (name in print) _____ have reviewed the Confined Space Preliminary Entry Planning Form and all the pertinent documents, have inspected and examined the space, and have verified the effectiveness of all the necessary provisions to control or eliminate hazards. Therefore, I authorize the entry to perform the work.

Signature: Competent Person Class: I. P. No.: Tel. No.: Pager No.:

Original (white): To be posted at the entrance of all Confined Spaces 2nd copy (yellow): Designated Work Supervisor
 1st. Copy (pink): Competent Person

ANNEX H

TAGGING AND POSTING OF SIGNS AT CONFINED SPACES

1. All warning signs at confined spaces shall be printed in English and Spanish. Symbols shall also be used if they exist. Workers who cannot read the tags and posted signs shall be informed about hazardous areas and the instructions printed on the signs.
2. All entrances to a confined space shall have signs. Signs shall include the following information, but shall not be limited to it:



The word “DANGER” shall appear in white letters over a red oval inside a black rectangle. The sign letters shall be written in black letters over a white background.* *

3. When a specific work is performed, or when it is necessary to use specific safety equipment, the requirement shall be added to the sign text in large letters, for example:

DO NOT ENTER WITHOUT A RESPIRATOR

DO NOT ENTER WITHOUT BEING TIED TO A LIFELINE

HOT WORK PERMITTED

HOT WORK NOT PERMITTED

4. Emergency procedures shall be posted in conspicuous locations in the area next to the confined space. Fire and emergency medical services telephone numbers shall be included on the Entry Permit and posted on the telephone from which emergency calls will be made.

5. The following information shall be posted on the spaces that do not require an entry permit:

CAUTION

Espacios No Sujetos a Permiso Escrito
ENTRADA SOLO PARA TAREAS DE INSPECCION Y MANTENIMIENTO DE RUTINA
Se requiere permiso de entrada al espacio confinado si el trabajo a realizarse conlleva:
trabajo caliente, pintura con aerosol, o el uso de materiales peligrosos.
Inicie ventilación ___ minutos antes de entrar
NO ENTRE SIN AUTORIZACION

Non Written Permit Spaces
ENTRY ONLY FOR INSPECTION AND ROUTINE MAINTENANCE TASKS
A Confined Space Entry Permit is required if the work to be performed
involves hot work, aerosol painting, or the use of hazardous materials.
Initiate ventilation ___ minutes prior to entry.
DO NOT ENTER WITHOUT AUTHORIZATION

The word “CAUTION” must be written in yellow lettering over a black rectangular background. The letters shall be written in black, over a yellow background.*

APPENDIX I

CALIBRATION RECORD GUIDELINES

1. Instrument Branch, e.g., Gastech
2. Model number, e.g., 3220
3. Instrument serial number
4. Page number
5. Date - Month/Day/Year
6. Time
7. Name of the person verifying the calibration values or performing the calibration
8. I.P. number of the above mentioned person
9. Lower explosive limit (LEL) reading*
10. Parts per million reading*
11. Oxygen verification - zero environmental air
12. Carbon monoxide reading*

* NOTE ON ITEMS 9, 10 and 12 ABOVE:

DO NOT PERFORM A CALIBRATION if the reading is more or less (+-) 10% of the calibration standard after the sample bag is connected.

Example: If the normal lower explosive level being used is 45% and its reading is between 40.5% and 49.5% (+ -), DO NOT PERFORM A CALIBRATION. Write down only the reading for Nos. 9. or 10. in the event it is parts per million, and for No. 12 for carbon monoxide.

13. Inspection to detect filtrations – search for bad connections or filtrations with hoses, testers, or filters.
14. Alarm inspections.
15. Battery inspection (load)
16. Lower explosive limit recalibration values**
17. Recalibration values of parts per million**
18. Recalibration values of CO parts per million**

** NOTES ON ITEMS Nos. 16, 17 and 18 ABOVE:

If the readings of Nos. 9, 10 or 12 are MORE (+) or LESS (-) 10 % of the normal value, the instrument SHALL BE CALIBRATED. These values must be included in Nos. 16, 17 or 18, respectively.

NOTE: INSTRUMENTS SHALL BE CHECKED, and if necessary CALIBRATED DAILY.

APPENDIX J

RESPIRATOR SELECTION GUIDE – FILTERS / CARTRIDGES

TABLE R – 1

HAZARDS	FILTERS / CARTRIDGES		
	North Series 700	MSA Ultratwin Full Shield	3 M Series 6000
Ammonia, Methylamines	PPE-RES-00036	PPE-RES-00079	PPE-RES-00019 C
Asbestos	PPE-RES-00037	PPE-RES-00082	PPE-RES-00021 C
Fiberglass dusts, smoke, mists	PPE-RES-00042 CA PPE-RES-00039 *	PPE-RES-00082	PPE-RES-00021 C
Organic vapors	PPE-RES-00034	PPE-RES-00087	PPE-RES-00023 C **
Organic vapors, dust, mists, enamel paint, lacquer paint	PPE-RES-00034 C PPE-RES-00044 F PPE-RES-00041 R	PPE-RES-00087 C PPE-RES-00086 F PPE-RES-00080 R	PPE-RES-00023 C PPE-RES-00020 F PPE-RES-00027 R
Organic vapors, dust, smoke, mists	PPE-RES-00038		PPE-RES-00023 C PPE-RES-00021 F PPE-RES-00022 R
Organic vapors, pesticides	PPE-RES-00034 C PPE-RES-00040 F PPE-RES-00041 R		PPE-RES-00023 C PPE-RES-00020 F PPE-RES-00027 R
Organic vapors, highly toxic particulates, and pressure paint cartridges (spray)	PPE-RES-00038 F		
Organic vapors, acid gases (chlorine, hydrogen chloride, sulfur dioxide)	PPE-RES-000345 **	PPE-RES-00088	PPE-RES-00026 C
Chlorine, mercury vapors			PPE-RES-00025 C

C – Cartridge
F - Pre-filter

CA – Complete assembly
R – Retainer and support

** Good for formaldehyde
* Replacement assembly filter

Notes:

1. For conditions immediately dangerous to life and health (IDLH), self contained breathing apparatus of the pressure demand type (SCBA).
2. The required respiratory protection is:
 - Half face respirators, up to 10 times the Maximum Permissible Limit (MPL).
 - Full face respirators, up to 50 times the Maximum Permissible Limit
 - Respirators with air supply line, up to 1000 times the MPL or a concentration of any unknown substance.
3. There are also disposable type respirators:
 - PPE-RES-00008, good for protection against dust, smoke, and mists.

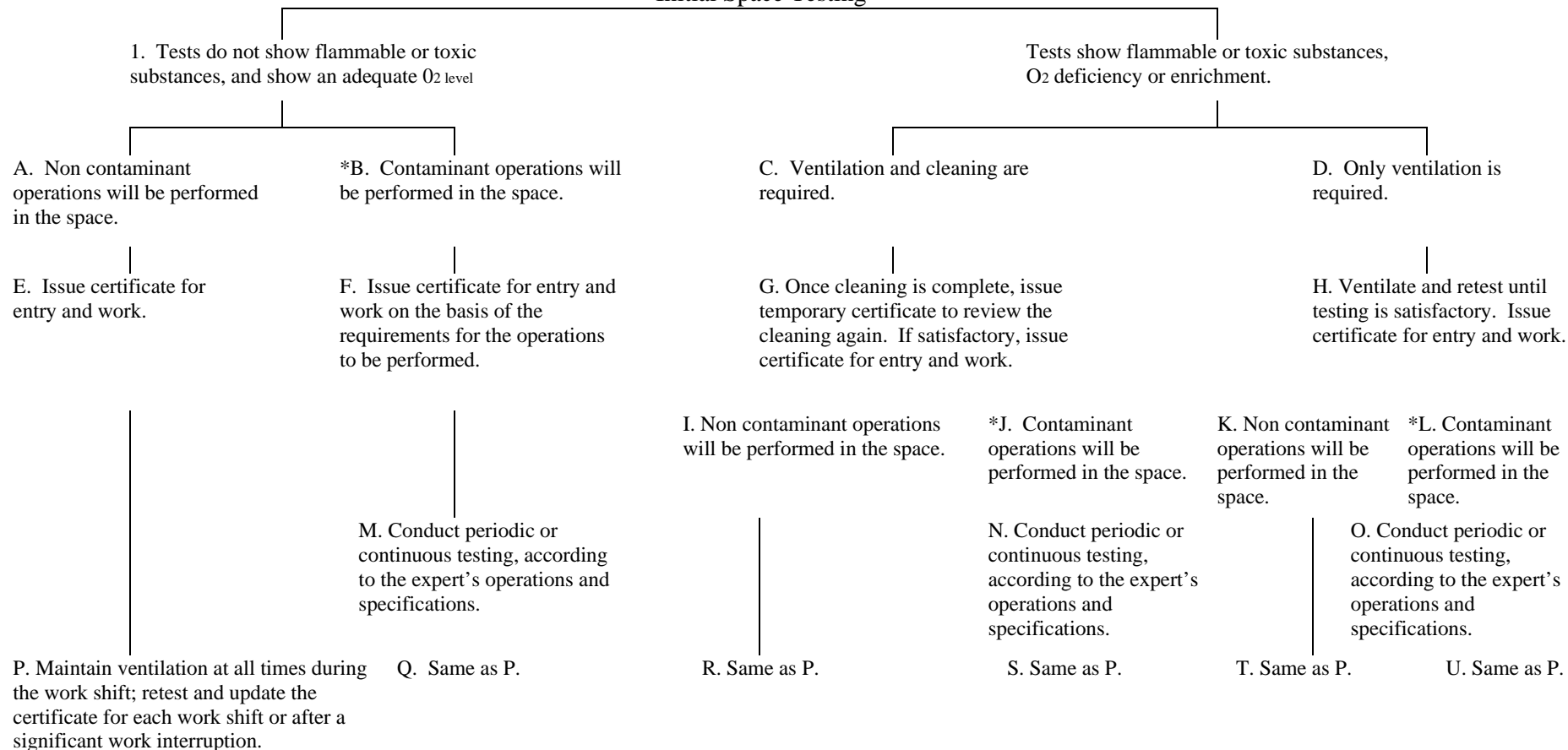
**RESPIRATOR SELECTION GUIDE
BASIC RESPIRATOR ASSEMBLIES
TABLE R – 2**

BRAND	SIZE				
	SMALL	MEDIUM	LARGE	SIMPLE	AIR LINE
3 M	PPE-RES-00028	PPE-RES-00029	PPE-RES-00030	PPE-RES-00008	
NORTH	PPE-RES-00031	PPE-RES-00032	PPE-RES-00033		
MSA	PPE-RES-00101	PPE-RES-00100* PPE-RES-00093	PPE-RES-00099 PPE-RES-00092		PPE-RES-00009* PPE-RES-00010*

Notes:

1. Parts and accessories are listed in the Warehousing (MROW) catalog under Class PPE.
 2. Air line respirators shall be used for confined space work..
 3. For IDLH conditions, positive pressure demand SCBA or a combination of same shall be used, stock numbers PPE-RES-00054 for 60 minutes and PPE-RES-00056 for 30 minutes.
 4. The Ultralite respirator is incompatible with the full face respirator and Ultraview air line respirator.
 5. The plain 3M respirators are not certified to provide protection against asbestos fibers. For MPL protection respirators, the stock numbers provided form an assembly.
- * Full assemblies.

Initial Space Testing



* Contaminant operations are those that introduce, or have the potential of introducing, confined space hazards which include hot work, finishing with spray gun, coatings, solvents, inert gases, and other flammable materials and toxic displacements, O₂ deficiency or enrichment.

APPENDIX L

BIBLIOGRAPHY

1. PCC Confined Space Policies, 1985.
2. Georgia Power Company Safe Work in Confined Spaces Corporate Policy.
3. Georgia Power Company_Construction Safe Work Procedures for Closed Vessels.
4. ANSI Z 88.2 – 1980 and Z 117.1 – 1977 Standards.
5. ANSI A11-1-1965 Standard and their 1970 amendments.
6. U.S. Navy Technical Systems Command Manual – Engineering Without Gases Program, October 15, 1982.
7. ESS Memorandum for the Record of December 26, 2002 regarding Class II Competent Person.
8. Accident Prevention Aboard Vessels at Sea and in Ports. International Labor Organization, 1996.
9. NFPA 306, August 2, 2001 version.
10. Recommendation 72, Safe Practices in Confined Spaces, September 2000, International Association of Classification Societies (IACS)
11. Respiratory Protection Standard (2600ESS-205)
12. Hazardous Materials Communication Standard (2600ESS-201)
13. Breathable Air Standard (2600ESS-210)
14. Hearing Conservation Standard (2600ESS-215)

**APPENDIX M
PANAMA CANAL AUTHORITY
SAFETY DIVISION - SAFETY DIVISION – Industrial Hygiene Section**

**Confined Space Work Program
Field Work Tutoring Form for Class IV Enclosed Space Competent Persons**

Class IV Competent Person: _____

IP Number: _____

Class I Competent Person Advisor: _____

Completion date of Class IV Competent Person Course:

Course Subjects:	Date:											
1. Use of Gastechtor, model # _____												
2. Calibration of Gastechtor												
3. Use of Gastechtor Log												
4. Review of inspection techniques												
5. Review of Pre-entry form												
6. Preparation of entry permit												
7. Safety talk for entrants												
8. Monitoring and assessment of enclosed space to verify compliance with entry permit												
9. Use of Material Safety Data Sheets												
10. Selection of ventilation type												
11. Provide confined space services approximately once a month												

Field Work Tutoring completion date: _____

Approved Qualification? YES NO

Class I Competent Person Signature

Class IV Competent Person Signature

I make this Competent Person designation based on the need of these services for our operations, and on my knowledge of the designee's reliability and dedication.

Signature of Division Manager

Appendix O

HOT WORK PROCEDURES WITH INERTING OPERATIONS

1.0 PURPOSE

The purpose of this procedure is to provide the minimum requirements and conditions to determine when a structure or compartment must be inerted, as well as the process to be followed by the Marine Chemist.

2.0 SCOPE

This procedure applies to the Industrial Hygiene Section, Safety Division.

3.0 REFERENCES

Calibration Guidelines for Gas and Vapor Detection Equipment.
NFPA 306: Standards for the Control of Gas Hazards on Vessels

4.0 DEFINITIONS

4.1 Marine Chemist Certificate: A Marine Chemist permit is a written statement by the Industrial Hygienist – Marine Chemist regarding the manner and form of these guidelines, providing the minimum requirements and conditions to perform hot work. This statement establishes the condition in which the Industrial Hygienist – Marine Chemist found the confined space at the time of the inspection.

4.2 Hollow Structure: Rudders, masts, guardrails, bitts, bumpers, handrails, tanks, balance keel, guards, pontoons, and other.

4.3 Inerting: The process of introducing a non flammable medium in a space to reduce the oxygen level to below the necessary to maintain combustion. The medium may be a non flammable gas (or gas mix), or water.

4.4 LEL – Lower Explosive Level: The minimum flammability level, the minimum concentration required of a flammable gas or vapor for combustion to occur. At a lower level, the mix will be too diluted. Flammability is measured in LEL percentages. 100% of the LEL is exactly the concentration required for the combustible of a sample to occur.

4.5 IH-MC – Industrial Hygienist / Marine Chemist

4.6 Hot Work – Activities that produce sparks or high temperatures, such as, but not limited to, welding riveting, heating, and torch cutting.

5.0 RESPONSIBILITIES

The Industrial Hygienist – Marine Chemist is responsible for conducting the specific responsibilities contained in paragraph 7.0 PROCEDURES.

6.0 REQUIREMENTS

Comply with the safety standards established by the Panama Canal Authority.

7.0 PROCEDURES

<u>Responsible Party</u>	<u>Step Number</u>	<u>Description of Activity</u>
IH-MC	7.1	Once the service request has been received, calibrate the measuring equipment. Use the calibration guide and proceed to the request area.
IH-MC	7.2	Discuss the scope of the work with the supervisor.
IH-MC	7.3	Determine the most feasible medium to perform the inerting.
IH-MC	7.4	If the medium is water, proceed with 7.5; otherwise, proceed to step 7.10.
IH-MC	7.5	Authorize the filling of the space with water up to a level of 3 feet over the point where the hot work will be performed.
IH-MC	7.6	With a gas meter, determine the flammability level (LEL) in the space over the three feet of water.
IH-MC	7.7	Record the LEL % values obtained on Form 4213. If the level of explosiveness is higher than 10% LEL, proceed to step 7.8; otherwise, proceed to step 7.9.
IH-MC	7.8	Authorize ventilation of this space until the flammability level is at a maximum of 10%
IH-MC	7.9	Grant a Marine Chemist Certificate. End the inspection.

<u>Responsible Party</u>	<u>Step Number</u>	<u>Description of Activity</u>
IH-MC	7.10	Authorize the introduction of inert gas. The gas shall be introduced at one end of the structure and removed on the other end, so that it may cover the entire space to be inerted.
IH-MC	7.11	Using a gas meter, determine the oxygen level at the end where the inert gas enters. Keep the flow of inert gas until the oxygen level is at a maximum of 8% if the contents of the space were hydrocarbons. For any other type of product, check NFPA 304.
IH-MC	7.12	Record the last oxygen level value.
IH-MC	7.13	Reduce the flow of inert gas until only a small positive pressure can be maintained in the space.
IH-MC	7.14	Grant the hot work permit.
IH-MC	7.15	Keep measuring the oxygen throughout the entire hot work.
IH-MC	7.16	If the oxygen levels increase over 8%, stop the hot work immediately.
HI-MQ	7.17	Determine the cause of the increase in oxygen, and once corrected, go back to step 7.15
HI-MQ	7.18	End the inspection.

8.0 FLOW CHART

It is not required.

9.0 RECORDS, REPORTS, FORMS

9.1 Gas and Vapor Detection Equipment Calibration Record Form 4213.

Appendix P

PROCEDURES FOR HOT WORK IN HOLLOW STRUCTURES

1.0 PURPOSE

The purpose of this procedure is to provide minimum requirements and conditions to determine whether a floating equipment or hollow structure is safe for hot work.

2.0 SCOPE

This procedure applies to the Industrial Hygiene Section, Safety Division.

3.0 REFERENCES

- 3.1 Confined Space Manual
- 3.2 Gas and Vapor Detection Equipment Calibration Guide
- 3.3 NFPA 306: Standards for the Control of Gas Hazards on Vessels
- 3.4 Inerting Procedures

4.0 DEFINICIONES

4.2 Marine Chemist Certificate: A Marine Chemist permit is a written statement by the Industrial Hygienist – Marine Chemist regarding the manner and form of these guidelines, providing the minimum requirements and conditions to perform hot work. This statement establishes the condition in which the Industrial Hygienist – Marine Chemist found the confined space at the time of the inspection. See Appendix Q.

4.2 Hollow Structures: Rudders, masts, guardrails, bits, bumpers, handrails, tanks, balance keel, guards, pontoons, and other.

4.3 Adjacent Spaces: The spaces in all directions from the space where the hot work will be performed; this includes contact points, corners, diagonals, covers, tanks, and bulkheads.

4.4 Inerting: The process of introducing a non flammable medium into a space to reduce the oxygen level to below the necessary to maintain combustion. The medium may be a non flammable gas (or gas mix), or water.

4.5 LEL – Lower Explosive Limit: The minimum flammability level, the minimum concentration required of a flammable gas or vapor for combustion to occur. At a lower level, the mix will be too diluted. Flammability is measured in LEL percentages. 100% of the LEL is exactly the concentration required for the combustion of a sample to occur.

4.6 HI-MC: Industrial Hygienist / Marine Chemist

4.7 Hot Work: Activities that produce sparks or high temperatures, such as, but not limited to, welding, riveting, heating, and torch cutting.

5.0 RESPONSIBILITIES

The Industrial Hygienist – Marine Chemist is responsible for conducting the specific responsibilities contained in paragraph 7.0 PROCEDURES.

6.0 REQUIREMENTS

Comply with the safety standards established by the Panama Canal Authority.

7.0 PROCEDURES

<u>Responsible Party</u>	<u>Step Number</u>	<u>Description of Activity</u>
IH-MC	7.1	Once the service request has been received, calibrate the measuring equipment. Use the calibration guide and proceed to the request area.
IH-MC	7.2	Discuss the scope of the work with the supervisor. If the work involves a hollow structure, proceed to step 7.3. If it does not, go to 7.12.
IH-MC	7.3	If it is a hollow structure with internal compartments that are not continuous, proceed to step 7.4. Otherwise, proceed to step 7.5.
IH-MC	7.4	Authorize the drilling of holes with an air drill using oil to cool the surface, on each opposing end.
IH-MC	7.5	If the hollow structure has any type of internal coating or combustible residue, proceed to step 7.6. Otherwise, go to step 7.7.
IH-MC	7.6	Assess the possibility of inerting the hollow structure by using the inerting procedure. If this is not possible, authorize the cleaning of residues and / or coatings.

<u>Responsible Party</u>	<u>Step Number</u>	<u>Description of Activity</u>
IH-MC	7.7	With a gas meter, determine the levels of oxygen, explosiveness, carbon monoxide, and hydrogen sulfide. Record the values on Form 4213.
IH-MC	7.8	If the concentration of gases in the hollow structure is higher than 10 % LEL, or the oxygen level is less than 16%, proceed to step 7.9. Otherwise proceed to step 7.10.
IH-MC	7.9	Authorize ventilation of the hollow structure with air during 30 minutes, and go back to step 7.7.
IH-MC	7.10	Grant a Marine Chemist Certificate by completing form 4213. Write down the exact scope of the work, the recommendations for the use of personal protection. Also, keep a continuous air flow throughout the hot work.
IH-MC	7.11	End the inspection.
IH-MC	7.12	Visually verify the presence of combustible materials where the hot work will be performed.
IH-MC	7.13	Determine the levels of flammable gases in all the spaces adjacent to hot work locations. Record the values on Form 4213.
IH-MC	7.14	If the adjacent spaces are free from residues, coatings, grease, gases, insulation, diesel, oils or other combustible or flammable materials, proceed to step 7.15. Otherwise, go to step 7.16.
IH-MC	7.15	Authorize the cleaning of any combustible or flammable material, as established in NFPA 306. Any insulation or coating shall be cleaned 6 inches around the location of the hot work.
IH-MC	7.16	Identify any equipment that could be affected during the hot work, such as, but not limited to, machinery, engines, electrical equipment, and power lines.

<u>Responsible Party</u>	<u>Step Number</u>	<u>Description of Activity</u>
IH-MC	7.17	Determine the necessary supplies to prevent any damage to this equipment, for example, the use of sheets, disconnecting, etc. Do not grant a permit if combustible substances have not been removed and measures have not been taken to prevent the loss of property.
HI-MQ	7.18	Grant a Marine Chemist Certificate by completing Form 4213. Write down exactly what the scope of the work is, the recommendations and use of the required personal protection, and keep a Fire Watch.
HI-MQ	7.19	End the inspection.

8.0 FLOW CHART

It is not required.

9.0 RECORDS, REPORTS, FORMS

9.1 Equipment calibration record –Form 4213.

