Guidelines for Confined Space Entry On Board Tank Ships in The Petroleum Industry

API RECOMMENDED PRACTICE 1141
FIRST EDITION, MARCH 1994

American Petroleum Institute
1220 L Street, Northwest
Washington, D.C. 20005

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Manufacturing, Distribution and Marketing Department

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FOREWORD

This recommended practice was prepared under the auspices of the API General Committee on Marine Operations. It is intended for use by API member companies and others to develop confined space entry procedures for work on board tank ships.

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Suggested revisions are invited and should be submitted to the director of the Manufacturing, Distribution and Marketing Department, American Petroleum Institute, 1220 L Street, N.W., Washington, D.C. 20005.

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Guidelines for Confined Space Entry On Board Tank Ships in the Petroleum Industry

SECTION 1—GENERAL

1.1 Scope

This recommended practice provides guidance for safely entering and working in confined spaces on board tank ships in the petroleum industry. The work procedures and recommendations described in this recommended practice are based on a consensus among marine operators of the essential elements needed in a confined space entry program to prevent accidents, injuries, and illnesses. In addition, marine operators recognize that with the evolution of ship design more numerous, and potentially less accessible, confined spaces will be found on board tank ships, particularly those with double hull and double bottom construction.

The concepts presented in this recommended practice are intended to aid the user in preparing detailed procedures for safely performing work in confined spaces. The types of confined spaces and their hazards will vary, but the fundamentals presented should be applicable, perhaps with modifications, to all confined spaces that may be encountered on board tank ships.

These guidelines are not applicable to the following situations:

a. Entry into confined spaces under emergency situations.
b. Hot work in confined spaces (that is, any work involving sources of ignition sufficiently high to cause the ignition of a flammable gas mixture).
c. Tank ships that have been certified "Safe for Workers" by a marine chemist (see NFPA 306).

This recommended practice does not address the specific requirements of port authorities or federal, state, or local governments. In addition to these guidelines, users should refer to applicable port authority, federal, state, and local regulations pertinent to specific circumstances.

1.2 Conformance to API Environmental Mission and Guiding Principles

This recommended practice has been reviewed to determine if it conforms to API's Environmental Mission and Guiding Principles.[1] It has been determined that because this recommended practice directly addresses safety and environmental issues, it does conform to API's Environmental Mission and Guiding Principles. The following guiding principles have been determined to be especially relevant to this practice:

- To operate our plants and facilities, and to handle our raw materials and products in a manner that protects the environment, and the safety and health of our employees and the public.
- To make safety, health, and environmental considerations a priority in our planning, and our development of new products and processes.
- To advise promptly, appropriate officials, employees, customers and the public of information on significant industry-related safety, health, and environmental hazards, and to recommend protective measures.

1.3 Definitions

The following terms are used in this recommended practice:

1.3.1 A *tank ship* is a tank vessel propelled by power or sail.

1.3.2 *Confined spaces* are enclosures with known or potential hazards that have a restricted means of entrance and exit. These enclosures are not normally occupied by people or well ventilated. Examples of confined spaces on board tank ships include cargo, ballast, and fuel tanks; cofferdams; duct keels; and spaces between decks or between cargo tanks and the outer hull (double hulls or double bottoms). Pumprooms have some of the characteristics of confined spaces although they are intended for human entry. Under these guidelines, pumprooms are treated separately from other confined spaces.

1.3.3 An electrical circuit or part of a circuit is *intrinsically safe* if any spark or thermal effect produced normally (that is, by breaking or closing the circuit) or accidentally (for example, by short circuit or earth fault) is incapable, under prescribed test conditions, of igniting a prescribed gas mixture. This definition is consistent with the *International Safety Guide for Oil Tankers & Terminals.*

1.3.4 Electrical equipment is defined and certified as *explosionproof* (flameproof) when it is enclosed in a case that is capable of withstanding an explosion within it of a hydrocarbon gas/air mixture or any other specified flammable gas mixture. It must also prevent the ignition of such a mixture outside the case either caused by spark or flame from the internal explosion or as a result of the temperature rise of the case following the internal explosion. The equipment must

[1] *Charter and Bylaws of the American Petroleum Institute*, American Petroleum Institute, Washington, D.C., April 3, 1991.

operate at such an external temperature that a surrounding flammable atmosphere will not be ignited thereby. This definition is consistent with the *International Safety Guide for Oil Tankers & Terminals.*

1.3.5 *Lower explosive limit* (LEL) or *lower flammable limit* (LFL) is the concentration of a hydrocarbon gas in air below which there is insufficient hydrocarbon to support and propagate combustion. A *lean atmosphere* is an atmosphere where the hydrocarbon content is below the lower explosive limit. This definition is consistent with the *International Safety Guide for Oil Tankers & Terminals.*

1.3.6 *Upper explosive limit* (UEL) or *upper flammable limit* (UFL) is the concentration of a hydrocarbon gas in air above which there is insufficient air to support and propagate combustion. An *overrich atmosphere* is an atmosphere where the hydrocarbon content is above the upper explosive limit. This definition is consistent with the *International Safety Guide for Oil Tankers & Terminals.*

1.3.7 A *qualified person* refers to a trained and experienced licensed officer, knowledgeable about work in confined spaces and capable of supervising work in confined spaces. A qualified person is familiar with the following:

a. The tasks to be performed.
b. The potential hazards that may be encountered in confined spaces, including oxygen content, concentration of flammable materials in the atmosphere, and toxic materials.
c. The safety and health requirements for confined space work.
d. The entry permit program in place.
e. The procedures for rescue operations.

1.3.8 A *standby* refers to a person who meets the following requirements:

a. Familiar with the tasks to be performed.
b. Capable of positively identifying all persons in the confined space at all times.
c. Capable of and responsible for maintaining communication with the persons who have entered a confined space and with the officer of the watch.
d. Capable of and responsible for initiating rescue operations by notifying the officer of the watch.
e. Dedicated to operating as a standby without conflicting duties.

1.3.9 A confined space may be designated "*Safe for Workers*" if it meets the following conditions:

a. The atmosphere's oxygen content is at least 19.5 percent and not greater than 22 percent by volume.
b. The concentration of flammable materials in the atmosphere is less than 1 percent of the lower explosive limit (LEL).
c. All toxic materials in the atmosphere associated with cargo, fuel, tank coatings, inerting media, or fumigants are within the permissible concentrations at the time of the inspection.
d. The residues or materials associated with the work authorized by the permit will not produce hydrocarbon or toxic materials higher than the permissible levels under the existing atmospheric conditions.

If the conditions of Items a, b, c, and d do not all exist, then the confined space shall be designated "*Not Safe for Workers.*" A confined space that is designated "Not Safe for Workers" should not be entered.

1.3.10 A *vapor* is a gaseous form of a substance that at room temperature and atmospheric pressure is in a solid or liquid state. A common example of vapor is gasoline. The process whereby a liquid changes to a gas is called evaporation; a solid-to-gas transformation (such as dry ice going from a white solid to colorless carbon dioxide gas) is called sublimation.

1.3.11 *Gas* is the physical state of matter where the substance in question will completely fill in a uniform manner a container of any size. The gas state is the normal condition (at room temperature and atmospheric pressure) of nitrogen, hydrogen, and oxygen.

1.3.12 *Toxicity* is the inherent capability of a substance to cause harm to a living organism.

1.3.13 *Threshold limit value* (TLV) is a term created by the American Conference of Governmental Industrial Hygienists (ACGIH). It refers to airborne concentrations of substances and represents conditions under which it is believed that nearly all workers may be repeatedly exposed to day after day without adverse health effects. Because of the wide variation in individual susceptibility, however, a small percentage of workers may experience discomfort from some substances at concentrations at or even below the threshold limit value; a smaller percentage of workers may be affected more seriously by the aggravation of a pre-existing condition or by the development of an occupational illness. TLVs are based on the best available information collected from industrial experience, experimentation, human and animal studies, and where possible, a combination of the three. TLVs, as issued by the American Conference of Governmental Industrial Hygienists, are recommended for use as convenient indicators of toxicity and should be used as guidelines for safe practice. Three categories of threshold limit values are specified as follows:

a. The *threshold limit value time-weighted average* (TLV-TWA) is the time-weighted average concentration of a substance for a normal 8-hour workday and a 40-hour work week, to which nearly all workers may be repeatedly exposed to day after day without adverse health effects.
b. The *threshold limit value short-term exposure limit* (TLV-STEL) is the concentration of a substance to which workers

may be exposed to continuously for a short period of time without suffering from (1) irritation, (2) chronic or irreversible tissue damage, or (3) narcosis of a sufficient degree to increase the likelihood of an accidental injury, impair a self-rescue, or materially reduce work efficiency, and provided that the TLV-TWA is not exceeded. TLV-STEL is not a separate independent exposure limit; rather it supplements the TLV-TWA limit where there are recognized acute effects from a substance whose toxic effects are primarily of a chronic nature. Short-term exposure limits (STELs) are recommended only where toxic effects have been reported from high short-term exposures in either humans or animals. A short-term exposure limit (STEL) is defined as a 15-minute TWA exposure that should not be exceeded at any time during a workday even if the 8-hour TWA is within the TLV-TWA. Exposures above the TLV-TWA up to the STEL should not be longer than 15 minutes and should not occur more than four times per day. There should be at least 60 minutes between successive exposures in this range. An averaging period other than 15 minutes may be recommended when this is warranted by observed biological effects.

c. The *threshold limit value-ceiling* (TLV-C) is the concentration of a substance that should not be exceeded during any part of the working exposure. For irritating substances, such as ammonia (NH_3), only the TLV-C is relevant.

1.4 Referenced Publications

The following publications, standards, and codes are cited in this recommended practice:

ACGIH[2]

Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices

API

RP 2003 *Protection Against Ignitions Arising out of Static, Lightning, and Stray Currents*

NFPA[3]

306 *Control of Gas Hazards on Vessels*

325M *Fire Hazard Properties of Flammable Liquids Gases, and Volatile Solids*

NIOSH[4]

Recommended Standard for Occupational Exposure to Hydrogen Sulfide

OCIMF[5]/ICS[6]/IAPH[7]

International Safety Guide for Oil Tankers & Terminals

OSHA[8]

29 *Code of Federal Relations* Part 1910

1.5 Supplementary Information

In addition to the publications specifically referenced in 1.4, the latest edition or revision of the following publications provide information supplementary to the text of this recommended practice.

ANSI[9]

Z88.2 *Practices for Respiratory Protection*

Z117.1 *Safety Requirements for Working in Confined Spaces*

API

Publ 2207 *Preparing Tank Bottoms for Hot Work Safe Tank Cleaning*[10]

DOT[11]

46 *Code of Federal Regulations* Part 197

[2] American Conference of Governmental Industrial Hygienists, 6500 Glenway Avenue, Building D-7, Cincinnati, Ohio 45211.

[3] National Fire Protection Association, Batterymarch Park, Quincy, Massachusetts 02269.

[4] National Institute for Occupational Safety and Health. The *Recommended Standard for Occupational Exposure to Hydrogen Sulfide* is available from the National Technical Information Service, 5285 Port Royal Road, Springfield, Virginia 22161.

[5] Oil Companies International Marine Forum, Portland House, Stag Place, London SW1E SBH, England.

[6] International Chamber of Shipping, 30/32 Mary Axe Street, London EC3A 8ET, England.

[7] International Association of Ports and Harbors, Kotohira-Kaikan Building, 2-8, Toranomon 1-Chome Minato-Ku, Tokyo 105, Japan.

[8] Occupational Safety and Health Administration, U.S. Department of Labor. The *Code of Federal Regulations* is available from the U.S. Government Printing Office, Washington, D.C. 20402.

[9] American National Standards Institute, 1430 Broadway, New York, New York 10018.

[10] The audiovisual training program, *Safe Tank Cleaning*, is available from Howell Training Company, 5201 Langfield Road, Houston, Texas 77040.

[11] Department of Transportation. *The Code of Federal Regulations* is available from the U.S. Government Printing Office, Washington, D.C. 20402.

SECTION 2—ADMINISTRATIVE CONTROLS

2.1 Written Procedures and Guidelines

Tank ship fleet managers or operators should issue and maintain written procedures and designate the authority and responsibility for controlling the entry into and the work performed in confined spaces.

The written procedures should ensure that the appropriate precautions and procedures are established for the following:

a. To create an entry permit program.
b. To familiarize personnel with the potential hazards that may be present in confined spaces.
c. To train personnel to use safeguards for controlling those hazards.
d. To provide for qualified supervision of confined space work to ensure that the work is conducted safely.
e. To provide for standby personnel capable of initiating rescue operations.
f. To establish emergency plans of action.

2.2 Administrative Standards

The administrative standards for issuing a confined space entry permit should include the following procedures:

a. Establishing that personnel entering the confined space are trained for entry and are aware of the potential hazards associated with entry.
b. Means are provided to continuously ventilate and monitor the atmosphere while personnel are inside the confined space.
c. A standby person is stationed at the entrance to the confined space.
d. An intrinsically safe communication system is in existence between the standby person at the entrance, persons within the space, and the officer on watch.
e. A qualified person is available to supervise the operation.
f. A confined space entry permit is issued and signed.
g. A copy of the signed confined space entry permit must be available at the entrance to the space before any person enters the space.
h. The permit must include an expiration time (up to a maximum of 24 hours from the time of issue).
i. The permit must include a notation that it becomes void if any of the permit requirements are breached.
j. The permit must include an indication of potential hazards that may be encountered in the space.
k. A list of the names of the persons in the confined space must be available at the entrance to the space and must be updated whenever persons enter or leave the space.
l. A ship log entry must be made when the permit has been issued, when persons enter the confined space, and when the permit operation is completed.
m. A copy of the permit should be retained in the ship files.

2.3 Authority for Initiating Entry

No confined space should be entered without the issuance of a permit signed by the master or chief mate, the qualified person(s) in charge, and all personnel entering the confined space.

SECTION 3—CONFINED SPACE HAZARDS ON TANK SHIPS

3.1 General

The work in confined spaces can be performed safely provided that adequate precautions and procedures are followed. Lacking these safeguards, injury and property damage may result from the following:

a. Oxygen deficiency.
b. Fire and explosions.
c. Toxic substances.
d. Physical hazards.

To achieve the best protection against these hazards, procedures should be designed, using the guidelines provided in this recommended practice and any specific company procedures, to assess the hazards present in each confined space entry operation.

3.2 Oxygen Deficiency

Until proved otherwise by atmospheric testing, each confined space must be presumed to be deficient in oxygen. For purposes of this recommended practice, an atmosphere containing less than 19.5 percent oxygen is to be considered oxygen deficient. Uncontaminated breathing-quality air contains 20.9 percent oxygen at sea level. Experience has shown that the most common cause of injuries and fatalities in confined space operations is the entry into oxygen-deficient confined spaces. In most instances, these spaces were either improperly tested or were not tested at all prior to entry.

Oxygen deficiency can be caused by several factors, including the following:

a. Displacement of oxygen by other gases or vapors (for example, cargo vapor, inert gas, exhaust gases, or combustion products).
b. Chemical action of oxygen with steel to form Fe_2O_3 (rust). This process is extremely common in voids, cofferdams, chain lockers, and other infrequently entered, poorly ventilated spaces.
c. Biological action in potable or ballast water tanks and sewage systems. Depending on the contents of the confined space, this process may evolve various toxic gases.

Oxygen deficiency can result from the displacement of air by inert gas. When used to render tank ship spaces inert, inert gas has a maximum oxygen concentration of 8 percent, which is insufficient to support life.

3.3 Fires and Explosions

Fuel (flammable vapors and gases), air (oxygen), and heat (an ignition source) are necessary for a fire or an explosion. No fire or explosion can occur unless all three elements are present. A fire can be thought of as a combustion process in which the flame front travels at less than the speed of sound. In an explosion, the flame front propagates supersonically. Mixtures of hydrocarbon vapor and air can be ignited only if the fuel-to-air ratio is in the explosive range. Atmospheres containing over 22 percent oxygen indicate a possible chemical reaction or a leaking oxygen source. Such an atmosphere increases the range of flammable mixtures and is "Not Safe for Workers."

The lower explosive limits (LEL) and the upper explosive limits (UEL) for various vapors and gases can be found in NFPA 325M.

Other classes of materials that can promote fires include the following:

a. Strong oxidizing substances: These substances liberate oxygen readily on contact with combustible material. An example is calcium hypochlorite, which is used in potable water treatment.
b. Pyrophoric material: These substances, such as sodium or potassium, ignite in the presence of oxygen.
c. Self-reactive substances that undergo a self-accelerating, exothermic reaction when a critical temperature is reached. This reaction may produce large volumes of rapidly expanding gases and have the potential for generating a blast or pressure wave. These reactions may also take place at temperatures below the critical temperature if other materials, such as catalysts, are present.

Static electricity can arise during tank loading operations, tank washing, or tank ventilation prior to entry. The first two areas (loading and washing) are beyond the scope of this recommended practice. API Recommended Practice 2003 addresses hazards inherent in loading, and the *International Safety Guide for Oil Tankers & Terminals* gives a complete description of precautions to be employed before and during tank washing operations and ventilation.

3.4 Toxic Substances

Toxic substances can cause injury, acute or long-latency (chronic) illness, or death, depending on individual susceptibility, concentration and duration of exposure, and the characteristics of the toxic substance. A toxic substance can be harmful if it passes into the body by inhalation (the primary route of exposure for many substances), ingestion, or skin and eye contact. It can affect the tissue at the point of contact or organs remote from the point of contact.

Irritants are substances that cause transient, but possibly painful, injuries that heal without scars and produce no known aftereffects. Many hydrocarbons and polar solvents, such as alcohol, are irritants.

Closely related to irritants are sensitizers. These chemicals cause an acute allergic reaction. However, removing the individual from exposure generally mitigates the effects. But subsequent exposure to the chemical, even at levels far below the original exposure, can cause a violent, possibly life-threatening, sensitization reaction. Examples of sensitizers are the isocyanates, such as methylene bisphenyl diisocyanate (MDI) and toluene diisocyanate (TDI).

Corrosives are substances that destroy tissue and leave permanent scars. Examples of corrosive substances include acids and caustics.

Acutely toxic substances are those that by a single dose or short-term exposure cause symptoms ranging from a simple headache or nausea to disablement or death. Hydrogen sulfide is an example of an acutely toxic chemical. Exposure to low concentrations is sufficient to cause adverse health effects.

Chronically toxic substances are those that may produce physiological impairment with a long latency period (such as cancer) or gradual progression of a disease process (such as, chronic obstructive pulmonary disease or, in some cases, reproductive effects). For example, benzene, although it may also have acute effects, is a chronic bone marrow and liver toxin.

Toxicity information about specific substances should be sought from the employer, the suppliers of the materials, and the local, state, or federal governments. Allowable levels of exposure are not fixed, but change from time to time as the volume of evidence points to various health effects that may result from exposure to toxic substances. Some of the more common current U.S. exposure limits are summarized below. These exposure limits reflect the lower of limits established by the Occupational Safety and Health Administration or the recommended limits (threshold limit values) set by the American Conference of Governmental Industrial Hygienists (ACGIH):

a. Benzene	1 part per million
b. Toluene	50 parts per million

c. Xylene (o-, m-, p-) 100 parts per million
d. Total hydrocarbons 300 parts per million
e. Hydrogen sulfide 10 parts per million

Because of these hazards, no tank ship confined space should be entered unless atmosphere testing to evaluate exposure to toxic substances has been accomplished. Safety and health considerations for some toxic substances that may be encountered in a tank ship confined space entry are provided in Appendix A.

3.5 Physical Hazards

In addition to the atmospheric hazards inherent in confined space operations, physical hazards may also be present. Marine operators should consider the following types of physical hazards when planning for and conducting confined space operations:

a. Slip, trip, or fall hazards:
   1. Slippery walking and working surfaces.
   2. Wastage of steelwork and structural members.
   3. Inadequate illumination.
   4. Lack of handrails, midrails, toeboards, and barriers.
   5. Inadequate clearances.
b. Electrocution hazards:
   1. Power tools.
   2. Lights.
   3. Tank light cables or similar systems.
c. Flooding:
   1. Liquid entering confined spaces through cargo tank penetrations.
   2. Inadvertent flooding of a tank.
d. Heat and cold stress (commonly aggravated by humidity).
e. Noise, such as from blowers. (Hearing protection may be required for personnel working in the vicinity of these machines.)
f. Falling objects:
   1. Tools, parts, flashlights, and other objects.
   2. Staging materials.
   3. Tank covers or hatch covers that are improperly secured.
g. Other hazards:
   1. Discharge of steam, high pressure air, water, or chemicals into confined spaces.
   2. Inadequate or faulty personal protective equipment.
   3. Inclement weather:
      a. Lightning.
      b. High winds.
      c. Extreme temperatures.
   4. Lack of familiarity with the confined space.

Physical hazards should be evaluated prior to undertaking any work in confined spaces.

SECTION 4—PRE-ENTRY CONSIDERATIONS

4.1 Identification of Hazards

The conditions necessary for safe work in a confined space will vary depending on the nature and location of the work, the configuration of the confined space, and the service of or conditions in the confined space. The qualified person should assess the potential hazards associated with the entry and should incorporate the necessary safeguards into the work plan.

Confined space entry should be avoided, when possible, during severe weather conditions or when the tank ship is underway in pilotage waters.

4.2 Permit

A signed permit meeting the criteria defined in Section 2 and Section 6 of this recommended practice shall be issued before any person enters a confined space. A copy of the permit shall be kept at the entrance to the confined space while the work is in progress. The qualified person should accept or assign responsibility for maintaining the conditions of the permit while the work is in progress.

4.3 Isolation

The confined space to be entered should be secured from service. The space should be completely isolated from any other space or system that may contain harmful substances. The following actions to secure the confined space from service should be taken:

a. Flush all pipelines leading into or through the confined space with clean water, including normally isolated sections, such as between sluice valves.
b. Provide double valve segregation or insert blanks on all pipelines connected to the space.
c. Valves leading directly to the confined space should be secured, tagged, and, if possible, locked out with a written warning that the valve is not to be opened. Power sources to these valves should be secured, tagged, and, if possible, locked out.

To ensure that isolation is maintained the following precautions should be taken:

a. No movement of any liquid or hazardous vapors, such as inert gas, is allowed in or through the confined space while

persons are inside. This includes movement of liquids or hazardous vapors in piping passing in or through the confined space.

b. Except during prerepair activities (steel gauging, cleaning), all cargo and ballast handling should be prohibited while persons are in a confined space that contains cargo pipes or ballast pipes that pass through any other cargo tank. During prerepair activities, extra care must be taken to ensure that concurrent activities never threaten the safety of those in the confined spaces.

Cargo tanks both adjacent and diagonally adjacent to the confined space being entered should be either "Safe for Workers"; or should be purged with inert gas until the tank contains 8 percent or less oxygen, then maintained at a slight positive pressure.

When entering cargo tanks that have previously contained a high hydrogen sulfide (H_2S) content cargo, the pipelines passing through the confined space should be filled with clean ballast water and should remain filled for the duration of the entry.

4.4 Atmospheric Control and Ventilation Prior to Entry

Except for noninerted cargo tanks and for measuring or sampling, never open or ventilate a confined space until the atmosphere has been tested and found to be lean by a qualified person. If the atmosphere is found to be in the explosive range or overrich or contains unexpected hydrocarbons for which the space is intended, follow the emergency procedures in 4.5.

Prior to entry, the confined space must be ventilated. An appropriate means of ventilating the confined space should be used to ensure that hazardous gases are dispersed and that a sufficient oxygen atmosphere is maintained. The ventilation should continue throughout the duration of the entry.

When ventilating cargo or ballast tanks, an officer should supervise the installation of fans and should ensure that only properly grounded hoses are used with water-driven fans. During ventilation, all openings to the confined space should be clearly marked and, if necessary, roped off to prevent injury, personnel exposure, and exposure to possible ignition sources. During ventilation of cargo tanks that have been designated "Not Safe for Workers," keep all external doors and ports closed, institute a no-smoking policy, if conditions warrant, and put air conditioning systems on recirculate.

It is recommended for double hull and double bottom vessels in a light or partially loaded condition that after ventilation of the double hull ballast tanks such tanks be filled with water to the bottom of the inner skin and discharged to remove any gas pockets before entering, especially if such tanks do not have purge pipes.

Cargo tanks that have been maintained under an inert atmosphere must never be allowed to reach the explosive range during ventilation. Following tank washing, each tank that will be entered should be purged with inert gas until the tank contains less than 2 percent hydrocarbon by volume and 8 percent or less oxygen. Once the tank is purged, ventilation may begin.

4.5 Emergency Procedures for Inerting and/or Ventilating a Confined Space with an Explosive or Overrich Atmosphere or Which Contains Unexpected Hydrocarbons for Which the Space is Intended

If at any point a confined space is found to have an atmosphere in the explosive range, an overrich atmosphere, or hydrocarbons are encountered that are unexpected, the following emergency procedures should be initiated:

a. Secure the confined space.
b. Isolate the affected area from nonessential personnel.
c. Isolate the affected area from any possible ignition sources.
d. Close all external doors and ports, institute a no-smoking policy, and put air conditioning equipment on recirculate.
e. Place fire equipment on standby and make the foam system ready for use.
f. Do not open the confined space except to test the atmosphere for percent of the lower explosive limit (%LEL). Do not ventilate.
g. Advise the home office and make plans for the following:
   1. Inerting and/or ventilating.
   2. Entering the confined space.
   3. Methods by which the hydrocarbons may be controlled and the repairs be made.
h. Depending on the tank's atmosphere and in consultation with the home office, perform one of the following two procedures:
   1. If the atmosphere is in the explosive range or overrich and if inert gas can be applied, the affected tank should be purged with inert gas until the tank contains less than 2 percent hydrocarbon by volume and 8 percent or less oxygen.
   2. If the atmosphere is lean, ventilate the affected tank with air until it is "Safe for Workers."

4.6 Pre-entry Atmosphere Testing

The atmosphere in the confined space must be tested in as many locations and levels from the deck as possible before entry is permitted. The testing should be accomplished by the use of approved gas testing equipment that has been calibrated within 24 hours of its use or that has been calibrated according to the manufacturer's instructions. A record of the

calibration and the maintenance of gas testing equipment should be maintained.

Pre-entry atmosphere tests must include the following:

a. Percent oxygen ($\%O_2$).
b. Percent lower explosive limit (%LEL).
c. Toxic vapors.

After ventilation is completed, fans should be secured for a minimum of 20 minutes before conducting the pre-entry atmosphere tests. Never purge or ventilate any confined space during pre-entry testing. Once testing is complete, the ventilation must resume before the space can be entered.

Test results must indicate that the space is "Safe for Workers" before inspecting the confined space to confirm entry conditions. If the confined space is suspected of containing toxic materials that cannot be measured with the equipment available on board, the home office should be contacted for further advice.

4.7 Standby Personnel

The standby should be familiar with the hazards of the confined space and should be capable of determining when rescue assistance may be required. If an emergency arises, the standby will perform the following actions:

a. Do not enter the confined space.
b. Report the emergency with as much detail as possible to the officer of the watch.
c. Stay by the entrance to the confined space until the emergency squad leader is on the scene and the rescue operations are underway.
d. Prevent entry by any other person until the rescue operation is organized.
e. Report the details of the emergency to the emergency squad leader.
f. Assist with rescue operations as directed.

A system of communication should be established between the standby, those entering the confined space, and the officer on watch. The communication system should be tested before persons enter the confined space. Testing should include the designation of a predetermined emergency signal.

4.8 Illumination

Access to and within the confined space should be adequately illuminated. Tank lights and portable lights should be in good condition and explosionproof. Hatch covers should be removed to maximize illumination and ventilation.

SECTION 5—PERSONAL PROTECTIVE EQUIPMENT

5.1 General

In addition to hard hats, gloves, coveralls, safety shoes, safety glasses or goggles, appropriate fall-arresting devices, and explosionproof flashlights, the following equipment is recommended for use in confined spaces:

a. For the qualified person conducting the initial entry to confirm that tank entry conditions are "Safe for Workers":
   1. An intrinsically safe radio.
   2. Gas detectors capable of monitoring for $\%O_2$, %LEL, and toxic materials.
   3. An emergency escape capsule or self-contained breathing apparatus.
   4. A respirator and appropriate cartridges, if the potential exists for the presence of toxic vapors.
b. For persons working in confined spaces that have been tested and confirmed to be "Safe for Workers":
   1. An intrinsically safe radio (one per team).
   2. Gas detectors capable of monitoring for $\%O_2$, %LEL and H_2S (one per team), as appropriate.
   3. Respirators and cartridges as appropriate for conditions.
c. For standby personnel at the tank entrance:
   1. Self-contained breathing apparatus.
   2. Appropriate rescue equipment ready for use.
   3. A sufficient number of emergency escape capsules.

5.2 Calibration and Maintenance

Portable gas detection equipment shall be appropriate for use in explosive atmospheres. All equipment should be calibrated and maintained according to the manufacturer's recommendations. The self-contained breathing apparatus and emergency escape capsules must be fully charged.

SECTION 6—PERMITTING AND ENTRY

6.1 General

A sample confined space entry permit and instructions for its use are provided in Appendix B to this recommended practice. The permit should be completed prior to entry into a confined space. A copy of the completed permit should be posted at the entrance to the confined space in which the work is taking place.

6.2 Initial Entry Inspection to Confirm Entry Conditions

An initial confined space entry inspection must be undertaken by a qualified person to confirm the confined space as "Safe for Workers." This inspection must be done after a permit has been issued and before any other worker enters the tank. During the initial inspection the qualified person must do the following:

a. Wear personal protective equipment as outlined in Section 5.
b. Continuously sample the confined space atmosphere directly ahead for $\%O_2$, %LEL, and toxic materials by using a draw pump in various locations and levels. See pre-entry considerations in Section 4.
c. Visually inspect the confined space for residues or materials that may produce an explosive atmosphere, result in oxygen deficiency, or expose workers to toxic materials.

6.3 Safety Meeting

After the confined space entry permit has been issued and the initial inspection to confirm entry conditions has been completed, a safety meeting should be held. The meeting should include all persons who will enter the confined space, the standby person, and the qualified person who will supervise the work. At a minimum, the following concerns should be addressed during the safety meeting:

a. Type of work that will be performed in the confined space.
b. Potential hazards of entry.
c. Personal protective equipment to be used.
d. Physical configuration of the confined space.
e. Monitoring of the confined space atmospheric conditions.
f. Rescue procedures and signals.

6.4 Work Procedures

During entry all personnel should be aware that work procedures may affect the atmospheric conditions in the confined space. For example, during entry, no toxic or flammable substance, such as cleaning solvents, should be introduced into the confined space without the prior approval of the qualified person.

During entry, the atmosphere must be continuously monitored for %LEL, $\%O_2$, and suspected toxics, such as H_2S. The results must show that the confined space is "Safe for Workers." In addition, periodic tests will be done by a qualified person at least once an hour for the first four hours, and thereafter, once a shift, including the beginning of each new workday.

SECTION 7—SPECIAL CONSIDERATIONS FOR PUMPROOMS

The pumproom is normally considered a restricted, but not confined, space and an entry permit should not be necessary as long as the precautions in this section are taken.

Prior to pumproom entry, ventilation fans should be running for at least 30 minutes. Prior to entry, the pumproom should be remotely tested "Safe for Workers" in the same manner as any confined space (see 4.6), except that the pumproom ventilation may remain on during the tests. In addition, continuous atmosphere monitoring and periodic atmosphere tests must be conducted in accordance with 6.4 during entry. If the present or previous cargo contained high levels of H_2S, additional precautions, including the use of emergency escape capsules and personal H_2S monitors, should be considered. Persons entering the pumproom should use personal protective equipment as listed in 5.1.

APPENDIX A—SAFETY AND HEALTH CONSIDERATIONS

A.1 General

Potential health effects can result from exposure to any chemical. The health effects are dependent on the toxicity of the chemical and on the concentration and length of exposure to the chemical. Everyone should minimize their exposure to workplace chemicals. The following general precautions are suggested:

a. Minimize skin and eye contact with chemicals.
b. Minimize the breathing of vapors.
c. Keep chemicals away from the mouth; can be harmful or fatal if swallowed or aspirated.
d. Keep containers closed when not in use.
e. Keep work areas as clean as possible and well ventilated.
f. Clean spills promptly and in accordance with the pertinent safety, health, and environmental regulations.
g. Observe the established exposure limits and use proper protective clothing and equipment.

Note: Information concerning safety and health risks and proper precautions with respect to particular materials and conditions should be obtained from the employer, the manufacturer, or the material safety data sheet.

A.2 Example Health and Safety Information

A.2.1 XYLENE

Health effects can result from exposure to xylene via contact with the skin and eye, breathing of vapors, swallowing, or aspirating. Xylene exhibits local irritant properties that may be manifested by dermatitis of the skin, stinging of the eye, nose, and throat or respiratory tract irritation. An acute exposure to xylene, above the permissible exposure limits, may result in adverse systemic effects, including effects on the central nervous, cardiovascular, respiratory, or gastrointestinal systems. Some indications of a systemic effect may include a headache, fatigue, disturbed vision, dizziness, confusion, numbness of the hands and feet, heart palpitations, anorexia, and gastrointestinal or respiratory difficulties. A significant overexposure to xylene may lead to coma and death.

There also may be long-term (chronic) health effects of varying severity from exposure to xylene.

A.2.2 BENZENE

Health effects can result from exposure to benzene via contact with the skin and eye, breathing of vapors, swallowing, or aspirating. Benzene exhibits local irritant properties that may be manifested by dermatitis of the skin, stinging of the eye, nose, and throat or respiratory tract irritation. An acute exposure to benzene, above the permissible exposure limits, may result in adverse systemic effects including effects on the central nervous system or the hematological system. Some indications of systemic effect may include confusion and dizziness, tightening of the leg muscles, or pressure over the forehead that progresses to a state of excitement. A significant overexposure to benzene can result in coma and death.

There also may be long-term (chronic) health effects of varying severity from exposure to benzene.

A.2.3 TOLUENE

Health effects can result from exposure to toluene via contact with the skin and eye, the breathing of vapors, swallowing, or aspirating. Toluene exhibits local irritant properties that may be manifested by dermatitis of the skin, the stinging of the eye, nose, and throat or respiratory tract irritation. An acute exposure to toluene, above the permissible exposure limits, may result in adverse systemic effects, including effects on the central nervous, cardiovascular, respiratory, or gastrointestinal systems. Some indications of a systemic effect may include a headache, fatigue, disturbed vision, dizziness, confusion, numbness of the hands and feet, heart palpitations, anorexia, and gastrointestinal or respiratory difficulties. A significant overexposure to toluene can lead to coma and death.

There also may be long-term (chronic) health effects of varying severity from exposure to toluene.

A.2.4 HYDROGEN SULFIDE

A.2.4.1 General

Chemical name:	Hydrogen sulfide.
CAS number:	7783-06-4.
Synonyms:	Sulfereted hydrogen, hydrosulfuric acid, dihyrogen sulfide.

A.2.4.2 Physical Data

Chemical family:	Inorganic sulfide.
Chemical formula:	H_2S.
Normal physical state:	Colorless gas, slightly heavier than air. Vapor density (specific gravity) at 59°F (15°C) and 1 atmosphere = 1.189.
Ignition temperature:	500°F (260°C).
Boiling point:	-76.4°F (-60.2°C).
Melting point:	-117.2°F (-82.9°C).
Flammable limits:	4.3 to 46 percent by volume in air.
Solubility:	Soluble in water and oil; solubility decreases as the fluid temperature increases.
Combustibility:	Burns with a blue flame to produce sulfur dioxide (SO_2).

Odor and warning properties: Hydrogen sulfide has an extremely unpleasant odor, characteristic of rotten eggs, and is easily detected at low concentrations. However, due to the rapid onset of olfactory fatigue and paralysis (inability to smell) ODOR SHALL NOT BE USED AS A WARNING MEASURE.

A.2.4.3 Exposure Limits

The Occupational Safety and Health Administration's (OSHA) permissible exposure limit (PEL) for hydrogen sulfide is 10 parts per million at the eight-hour time weighted average (TWA) or 15 parts per million at the short-term exposure limit (STEL) as averaged over 15 minutes. Refer to 29 *Code of Federal Regulations* 1910.1000, Table Z-1-A (check latest revision). The American Conference of Governmental Industrial Hygienists (ACGIH) recommends a threshold limit value (TLV) of 10 parts per million (eight-hour TWA) and a STEL of 15 parts per million averaged over 15 minutes. Exposure at the STEL should not be repeated more than four times per day with at least 60 minutes between successive exposures at the STEL. The NIOSH *Recommended Standard for Occupational Exposure to Hydrogen Sulfide* should be consulted for additional detailed information. CHECK FOR THE LATEST EDITIONS AND WITH THE EMPLOYER CONCERNING EXPOSURE LIMITS FOR PARTICULAR CIRCUMSTANCES.

A.2.4.4 Physiological Effects

INHALATION OF HYDROGEN SULFIDE AT CERTAIN CONCENTRATIONS CAN LEAD TO INJURY OR DEATH (refer to Table A-1). Hydrogen sulfide is an extremely toxic, flammable gas that may be encountered in the production and processing of gas well gas, high-sulfur-content crude oil, crude oil fractions, associated gas, and associated waters. Since hydrogen sulfide is heavier than air, it can collect in low places. It is colorless and has a foul, rotten-egg odor. In low concentrations it is detectable by its characteristic odor. However, smell cannot be relied upon to forewarn of dangerous concentrations because exposure to high concentrations (greater than 100 parts per million) of the gas rapidly paralyzes the sense of smell. A longer exposure to lower concentrations has a similar desensitizing effect on the sense of smell. Excess exposure to hydrogen sulfide causes death by poisoning the respiratory system *at the cellular level*. There is some indication in acute poisoning cases that the presence of alcohol in the blood aggravates the effects of hydrogen sulfide. At low concentrations (10-50 parts per million) hydrogen sulfide is irritating to the eyes and the respiratory tract. Closely repeated short-term exposures at low concentrations may lead to irritation of the eyes, nose, and throat. The symptoms from repeated exposures to low concentrations usually disappear after not being exposed for an appropriate period of time. Repeated exposures to low concentrations that do not produce effects initially can eventually lead to irritation. It should be well understood that the sense of smell may be rendered ineffective by hydrogen sulfide, which can result in an individual failing to recognize the presence of dangerously high concentrations.

Note: The National Institute for Occupational Safety and Health (NIOSH) has examined the criteria for respirator tests and sources of respirator leakage and has recommended that positive pressure, supplied air, or self-contained breathing apparatus, as appropriate, with a full face piece, be worn by anyone exposed to an atmosphere containing hydrogen sulfide concentrations above the permissible exposure limit value. *The use of air-purifying respirators (canisters) for protection against hydrogen sulfide is not recommended.*

Note: In the medical community there are differences of opinion whether a person with a perforated eardrum can become overexposed to toxic substances via the ear, even when wearing the proper breathing apparatus, and whether they should be excluded from working in an hydrogen sulfide environment.[12] Theoretical calculations by Richard Ronk and M. K. White[13] have led the authors to conclude that tympanic membrane (eardrum) defects do not significantly compromise respiratory protection against hydrogen sulfide and that individuals with perforated tympanic membranes should not be excluded from work in a hydrogen sulfide environment. The validity of these calculations is supported by the absence of case reports of hydrogen sulfide poisoning due to tympanic membrane defect.

Ronk and White also concluded that the wearers of positive pressure, supplied air, or self-contained breathing apparatus with a full face piece, (as recommended by the National Institute for Occupational Safety and Health) who have a tympanic membrane defect and a concurrent tympanomaxillary shunt or a patulous eustachian tube (the tube remains open) may experience the sensation of an outward air flow that can be annoying.

The U.S. Occupational Safety and Health Administration (OSHA) may address this subject in future revisions of its respiratory protection standard (29 *Code of Federal Regulations* 1910.134), check the latest revision for compliance requirements.

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[12]Compare Poda, George A., "Hydrogen Sulfide Can be Handled Safely," *Archives of Environmental Health*, Volume 12, 795-800, June 1966.

[13]Ronk, Richard and White, M. K., "Hydrogen Sulfide and the Probabilities of Inhalation Through a Tympanic Membrane Defect," *Journal of Occupational Medicine*, Volume 25, No. 5, 337-340, May 1985.

Table A-1—Concentration and Typical Characteristics Regarding Hydrogen Sulfide Exposure

Note: Data in Table A-1 are approximate values for guidance. There are published data that show slightly different values.

Concentration in Air				Typical Characteristics Regarding Hydrogen Sulfide Exposure[b]
Percent by Volume	Parts per million by Volume	Grains per 100 Standard Cubic Feet	Milligrams per Cubic Meter[a]	
0.000013	0.13[c]	0.008	0.18	Obvious and unpleasant odor generally at 0.13 ppm and quite noticeable at 4.6 ppm. As the concentration increases, the sense of smell fatigues and the gas can no longer be detected by odor.
0.001	10	0.63	14.41	Unpleasant odor. Possible eye irritation. Note: OSHA permissible exposure limit (PEL) [8-hour time-weighted average (TWA)] (29 *Code of Federal Regulations*, Part 1910.1000, Table Z-1-A) and ACGIH recommended threshold limit value (TLV) (8-hour TWA).[d]
0.0015	15	0.94	21.61	Note: OSHA and ACGIH short-term exposure limit (STEL) as averaged over 15 minutes, refer to 29 *Code of Federal Regulations*.
0.002	20	1.26	28.83	Burning sensation in eyes and irritation of the respiratory tract after 1 hour or more exposure.
0.005	50	3.15	72.07	Loss of sense of smell after about 15 or more minutes exposure. Exposure of 1 hour may lead to headache, dizziness, and/or staggering.[e] Pulmonary edema reported following extended exposure to greater than 50 ppm.[f] Exposure at 50 ppm or greater can cause serious eye irritation or damage.
0.01	100	6.30	144.14	Coughing, eye irritation, loss of sense of smell after 3-15 minutes. Altered respiration, pain in eyes, and drowsiness after 15-20 minutes, followed by throat irritation after 1 hour. Prolonged exposure results in a gradual increase in the severity of these symptoms.
0.03	300	18.90	432.40	Note: Concentration considered immediately dangerous to life or health (IDLH).[g] Refer to DHHS Number 85-114, NIOSH *Pocket Guide to Chemical Hazards*, Fifth Edition.[h]

Table A-1— Concentration and Typical Characteristics Regarding Hydrogen Sulfide Exposure (cont.)

Note: Data in Table A-1 are approximate values for guidance. There are published data which show slightly different values.

Concentration in Air				Typical Characteristics Regarding Hydrogen Sulfide Exposure[b]
Percent by Volume	Parts per million by Volume	Grains per 100 Standard Cubic Feet	Milligrams per Cubic Meter[a]	
0.05	500	31.49	720.49	Unconsciousness after short exposure, cessation of breathing if not treated quickly.[i] Dizziness, loss of sense of reasoning and balance. Victims need prompt artificial ventilation and/or cardiopulmonary resuscitation (CPR) techniques.
0.07	700	44.08	1008.55	Unconscious quickly. Breathing will stop and death will result if not rescued promptly. Artificial ventilation and/or cardiopulmonary resuscitation (CPR) is needed immediately.
0.10+	1000+	62.98+	1440.98+	Unconsciousness at once. Permanent brain damage and death may result. Rescue promptly and apply artificial ventilation and/or cardiopulmonary resuscitation (CPR).

[a]Based on 1 percent hydrogen sulfide – 629.77 grains/100 standard cubic feet (SCF) at 14.696 pounds per square inch absolute and 59°F (101.kPa and 15°C).

[b]Hydrogen sulfide has physiological effects on humans. These effects vary from person to person. FOR ADDITIONAL INFORMATION, CONSULT THE EMPLOYER AND RESEARCH THE MATERIAL SAFETY DATA SHEET (MSDS).

[c]There are wide variations in reported odor thresholds for hydrogen sulfide. A U.S. Environmental Protection Agency draft report states a range for the odor threshold of 0.1–0.2 parts per million (refer to Review Draft: "Health Assessment Document for Hydrogen Sulfide," EPA/600/8–86/026A, August 1986). A Petroleum Association for Conservation of the Canadian Environment (PACE) report, "Review of Ambient Hydrogen Sulfide Standards in Canada," Number 85–5, December 1985, cites an odor threshold range of 0.005–0.05 parts per million from the National Resources Council of Canada (1981) at Table 3.1 (page 3–10). The PACE document also cites reports of wider ranges of odor threshold from 0.0005.–1.4 parts per million at Table 4.1 (page 4–4).

[d]TLV is a trademarked term of the American Conference of Governmental Industrial Hygienists (ACGIH). Refer to *Threshold Limit Values and Biological Exposure Indices for 1988–89* and companion documents available from ACGIH, 6500 Glenway Avenue, Building D–7, Cincinnati, OH 45211. Check latest editions.

[e]PACE Report, supra footnote c, Table 3–1, page 3–10.

[f]EPA Draft Review Document, supra footnote c, page 1–2.

[g]IDLH levels, for the purpose of breathing apparatus selection, represent the maximum concentration from which, in the event of respirator failure, one could escape within 30 minutes without experiencing any escape–impairing or irreversible health effects. NIOSH considers 300 parts per million or more to be the IDLH concentration for hydrogen sulfide.

[h]Available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

[i]PACE Report, supra footnote c, Table 3.1, page 3–10.

APPENDIX B—SAMPLE CONFINED SPACE ENTRY PERMIT

1	Vessel	Space to be entered	Date/time
2	Previous content (last three if cargo space)	Purpose of entry	Permit expires
3	Oxygen content (%) (19.5%–22.0%)	Manufacturer/serial no.	Meter calibrated (date)
4	Combustible gas (% LEL) (< 1%)	Manufacturer/serial no.	Meter calibrated (date)
5	Toxicity (ppm) (indicate toxin, exposure limit, and reading)	Type of test	Manufacturer/serial no.
6	Toxicity (ppm) (indicate toxin, exposure limit, and reading)	Type of test	Manufacturer/serial no.
7	Toxicity (ppm) (indicate toxin, exposure limit, and reading)	Type of test	Manufacturer/serial no.
8	Toxicity (indicate toxin, exposure limit, and reading)	Type of test	Manufacturer/serial no.
9	Date/time of tests (lines 3-8)		
10	Confined space preparation (for example, washing)		
11	Confined space isolation (for example, blanks inserted, tagout/lockouts used)		
12	Ventilation procedures used		
13	Confined space ventilation commenced (date/time) 1. Must be continuous when persons are in compartment. 2. Must be stopped for atmospheric testing.		
14	Illumination provided (yes/no)		
15	Standby person at confined space entrance (name) Standby person equipped with: 1. Two SCBAs 2. Communication equipment (for example, walkie/talkie) 3. Rescue equipment		
16	Communication established between: 1. Standby and persons entering confined space (yes/no) 2. Standby and officer of the watch (yes/no)		
17	THIS CONFINED SPACE HAS BEEN EVALUATED AND IS "SAFE FOR WORKERS" (yes/no)		
18	Qualified person (name and signature)	Master or chief mate (name and signature)	
19	I HAVE READ AND UNDERSTAND THE CONTENTS OF THIS PERMIT, INCLUDING THE NEED TO WEAR PROTECTIVE CLOTHING AND EQUIPMENT		

Name	Signature	Name	Signature
Name	Signature	Name	Signature
Name	Signature	Name	Signature
Name	Signature	Name	Signature
Name	Signature	Name	Signature

20	IF ANY OF THE ENTRY CONDITIONS NOTED ON THIS PERMIT ARE NOT MET, THE PERMIT IS VOID AND ALL PERSONNEL MUST EVACUATE THE CONFINED SPACE

Line 1

Identify the vessel on which the confined space entry will take place.

Identify the specific confined space that will be entered and in which work will be undertaken.

Enter the date and time of permit issuance. The permit cannot be issued until all the required preparation steps have been accomplished and the information has been entered on the permit. The permit will automatically expire 12 hours after the date and time of issuance or at the time specified on Line 2 of the permit, whichever occurs first.

Line 2

Record the previous content of the confined space to be entered. If the confined space is a cargo space, enter the last three contents.

Indicate the reason that the confined space is being entered. This information is important to ensure that entry is necessary and that alternatives to entry have been considered.

Enter the time that the permit expires. Unless a shorter time is recorded, the permit will automatically expire 24 hours after its issuance. A 12–hour time limit has been established to encourage confined space entry to be accomplished during daylight hours.

Line 3

Enter the measured oxygen content of the confined space to be entered. Acceptable oxygen content of the confined space must be greater than or equal to 19.5 percent and less than or equal to 22.0 percent.

Enter the manufacturer's name and the serial number of the oxygen meter used to take the oxygen content measurement.

Enter the date the oxygen meter used was last calibrated. The meter should be calibrated according to the manufacturer's instructions.

Line 4

Enter the measured combustible gas content of the confined space to be entered. Acceptable combustible gas content is less than 1 percent of the lower explosive limit.

Enter the manufacturer's name and the serial number of the combustible gas indicator used to take the measurement.

Enter the date the combustible gas indicator used was last calibrated. The indicator should be calibrated according to the manufacturer's instructions.

Lines 5–8

Enter in lines 5–8 the reading of the test instrument for any toxins detected, such as H_2S, benzene, and so forth. Enter both the acceptable exposure limits and the readings for these tests. Exposure limits may be achieved through the use of appropriate respiratory protection equipment by all persons entering the confined space.

Enter the type of test instrument used for the test.

Enter the name of the manufacturer and the serial number of the test instrument used.

Line 9

Enter the date and time that the tests in lines 3–8 were conducted.

Line 10

Provide a description of the steps taken to prepare the confined space for entry.

Line 11

Provide a description of the steps taken to isolate the confined space from adjacent spaces and to prevent the entry of materials through pipelines or other lines in the confined space that may be hazardous to workers.

Line 12

Provide a description of the procedures used to ventilate the confined space.

Line 13

Record the date and time ventilation was begun.

Line 14

Record whether illumination is adequate. Adequate illumination may be achieved through natural light or through artificial light of the appropriate explosionproof type.

Line 15

Enter the name of the designated standby person.

Line 16

Record the establishment of communication between the standby and persons entering the confined space and between the standby and the officer of the watch.

Line 17

Review the preparations made and recorded on the confined space entry permit to enter the confined space, and make a determination whether the confined space is "Safe for Workers."

Line 18

Record the name of the qualified person and have the qualified person review and sign the confined space entry permit.

Record the name of the vessel's master or chief mate and have the master or chief mate review and sign the confined space entry permit.

Line 19

Record the name of each person who will enter the confined space.

Each individual who will enter the confined space shall review the permit and indicate by signing their name that he or she has read and understood the contents of the permit.

Line 20

All personnel responsible for or participating in confined space work should be aware of the circumstances that may result in an unsafe condition in the confined space. If any of the entry conditions noted on the permit are breached, the permit is void and the confined space should be evacuated.

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