BO 5100.18
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BASE ORDER 5100.18

From: Commanding General
To: Distribution List

Subj: Confined Space Entry Program

Ref: (a) NavSea 56470-AA-SAF-010 Naval Sea Systems Command Gas Free Engineer Program
(b) OSHA 29 CFR 1910

Encl: Sample Gas Free Engineer Tags

1. Purpose. To establish policy assign responsibility, disseminate information and provide guidelines for the implementation of the installation confined/enclosed space entry program.

2. Background. The hazards associated with confined space entry are not always readily apparent or suspected by workers who must enter these spaces. In an effort to minimize exposure to hazards and to prevent mishaps, all confined spaces will be assumed to contain the most unfavorable conditions and entry is prohibited until space has been "certified" safe by the Gas Free Engineer.

3. Action. Commanding Officer's/Organizational Commander's will take action necessary to ensure compliance with the provisions of this order.

4. Applicability. Having received the concurrence of the Commanding Generals, 2d Marine Division; 2d Force Service Support Group (REIN), FMFLant, and 6th Marine Amphibious Brigade, FMF; the Commanding Officers, Naval Hospital, and Naval Dental Clinic, this Order is applicable to those commands.

5. Certification. Reviewed and approved this date.

DISTRIBUTION: A

SAFD (10)

CONFINED SPACE ENTRY PROGRAM

CHAPTER 1

POLICY, SCOPE, RESPONSIBILITY, DEFINITIONS, ACTION

CHAPTER 1

POLICY, SCOPE, RESPONSIBILITY, DEFINITIONS, ACTION

1000. POLICY

1. It is the intent of this instruction to set forth mandatory precautionary procedures that must be followed prior to work operations involving entry into, work in or hot work in or on a confined/ enclosed space.

1001. SCOPE

1. This program applies to all Command members of the Camp Lejeune Complex.

1002. RESPONSIBILITY

1. The Installation Gas Free Engineer (GFE) is certified by the Commanding General and is responsible for administering the GEE/confined space entry program under the cognizance of the Base Safety Office.

1003. DEFINITIONS

1. Gas Free Engineer (GFE) an individual qualified in accordance with section 2-4-1 of reference (a), certified by the Commanding General and responsible for the administration and technical aspects of the activity GFE Confined Space Entry Program.

2. Gas Freeing - Operations performed in testing, evaluating, removing or controlling hazardous materials or conditions within or related to a confined or enclosed space which may present hazards to personnel entering or working in, on, or adjacent to the space.

3. Confined Space - A space which by design, has limited and restricted opening for entry and exit, and a lack of natural ventilation and which could contain or produce hazardous contaminants or oxygen deficiencies or enrichment. Confined spaces are not intended for normal continuous personnel occupancy. In non-maritime activities this includes spaces such as fuel storage tanks, process vessels, boilers, furnaces, sewers, utility tunnels, vaults and similar spaces. In maritime activities this includes space suvh as fuel tanks, cofferdams, double bottoms, etc.

4. Closed Space/Compartment - Any spaces which are not well ventilated such as storerooms, cold rooms, blisters, double bottoms etc. Also, spaces which are normally occupied but which have been vacated, close and/or sealed.

5. Enclosed Space - A space, which by its nature or design, is of such a shape, depth, or other feature that natural ventilation or the natural movement of air is restricted. Such spaces include open top storage tanks, degreasers, dip tanks, pits, trenches and similar spaces.

6. Hot Work - Hot work, for the purpose of gas free engineering, includes: all flame heating, welding, torch cutting, braxing, carbon arc gouging, or any work which produces heat, by any means, of 400^{o}F or more; or in the presence of flammables or flammable atmosphers, other ignition sources such as spark or arc producing tools or equipment, static discharges, friction, impact, open flames or embers, non-explosion-proof lights, fixtures, motors or equipment, etc.

7. Explosive or Flammable Limits - The range of concentration of a material, expressed in percent in air, which will burn or explode if ignited. Limiting concentrations are termed the Lower Explosive (flammable) Limit(LEL) and the Upper Explosive Limit (UEL). Concentrations below the LEL are too "lean" to react, while concentrations above the UEL are too "rich" to react.

8. Explosion-Proof - An apparatus, device or equipment that is tested and approved for use in hazardous atmospheres (flammable/explosive) as defined in the National Electric Code.

9. Fire Point - The temperature at which a sufficient amount of vapor is given off to form an ignitable mixture with air.

10. Flash Point - The lowest temperature at which a sufficient amount of vapor is given off to form and ignitable mixture with air.

11. Flammable Liquids - Any liquid having a flashpoint below 100°F. (37.8°C.) or higher, the total of which make up 99 percent or more of the total volume of the mixture.

12. Hazardous Substance/Atmosphere - A substance or atmosphere which by reason of being explosive, flammable, toxic, oxidizing, irritant, corrosive or otherwise harmful is capable of causing serious injury, death or property damage.

13. Ignition - The act or action of igniting a substance or the means where by a material is ignited.

14. Ignition Temperature (Point) - The minimum temperature required to initiate self-sustained combustion independent of external ignition sources or heat.

15. Immediately Dangerous To Life or Health (IDLH)- Atmosphere or conditions which may reasonably be expected to become immediately dangerous to life or health due to the presence of flammable or explosive vapors at or in excess of 10% of the lower Flammable Limit, oxygen content less than 16% or greater than 22%, toxics which exceed a level from which a person could escape within 30 minutes without impairing symptoms or irreversible health effects or any combination therof.

16. Inerting - A process wherby and inert or non-flammable gas is introduced into an atmosphere to such a degree that the flammable vapor-oxygen content of the atmosphere is reduced to a level which will not burn or explode.

17. Initial Testing - Testing conducted on a confined or enclosed space when the space is first opened after a period of closure or service, such as the first tests conducted on a fuel tank when the tank has been inservice and must be taken out of service for repair.

18. Initial Certification - The certificate issued by GFE personnel as a result of the initial testing.

19. Intrinsically Safe - An item or equipment which by design does not have or is not capable of producing sufficient levels of energy to cause ignition.

1004. ACTION

1. Officers, Directors, and Managers. Management personnel, including department directors, division officers or managers, section heads and personnel occupying similar positions, who have under their control, spaces, operations, or personnel falling under the provisions of the order, shall ensure that:

a. The provisions, procedures, and requirements contained in this order and those of reference (a) and (b) are complied with.

b. Gas Free Engineering (GFE) personnel perform all prescribed testing, apply all required controls and ascertain that spaces have been certified safe for the prescribed operations prior to commencement of such operatins.

2. Supervisory personnel. Supervisors shall be familiar with the provisions of this order as they relate to personnel or operations under their supervisory control. They shall act positively to eliminate any potential hazards existing in operations under their control and shall:

a. Explain to all employees under their immediate supervision the nature of the hazards associated with the operations and the precautions necessary to control such hazards.

b. Strictly enforce observance of the safety and health requirements of this order and pertinent referenced standards and regulations.

c. Promptly report to their immediate superior andy unsafe conditions or procedures and, where warranted by the severity of such conditions, cease all operations until corrective action has been effected.

3. Operating Personnel. All persons in confined or enclosed space entry or work are responsible for fully understanding and strictly observing the safety standards, regulations, and procedures applicable to such work. Further, each person shall:

a. Contact the Gas Free Engineer (GFE) extension 5725/3891 prior to entering or work on 6onfined or enclosed space as set forth 2007.1 of this order!

b. Report to their immediate supervisor any procedure, conditions, and equipment that is believed to be unsafe.

c. Warn others believed to be endangered by failure to observe applicable procedures or precautions or of any hazard they are aware of.

d. Follow all guidelines/instructions issued by the Gas Free Engineer (AGFE) regarding confined space entry/work.

4. Base Safety Officer will:

a. Provide Gas Free Engineering Services to the Command.

b. Offer training classes to all personnel required to enter/work in confined spaces.

c. Administer the Gas Free Engineering/confined space entry program.

CHAPTER 2

Safety Precautions and Procedures, Sample GFE Certificate, Sample GFE Tags

CONFINED SPACE ENTRY PROGRAM

CHAPTER 2

SAFETY PRECAUTIONS AND PROCEDURES

2000. GENERAL

1. The policies of the Department of Navy regarding gas free engineering for operations involving entry into or work in, or adjacent to confined or enclosed spaces are concerned with safety and health of personnel and the protection of Navy equipment and facilities. Personnel entering or working in or on confined/enclosed spaces may encounter a number of potentially serious hazards, such as:

a. Lack of sufficient oxygen to support life

b. Excessive oxygen levels which increase the danger of fire or explosion.

c. Presence of flammable or explosive atmospheres or materials

d. Presence of toxic atmosphere or materials

These hazards are not always readily apparent, detectable by odor, or visually obvious. Therefore all confined/enclosed spaces shall be considered to contain the most unfavorable and unsafe conditions, and entry into, work on or in such spaces is prohibited until test have been conducted to ensure that safe conditions exist and the space is certified by the Gas Free Engineer or Assistant Gas Free Engineer.

2. Refernce (a), NavSea Gas Free Engineer Manual is the basic Navy guidance for confined space entry and is the primary source of standards used in promulgating this order.

a. The procedures for rescue in confined spaces as set forth in reference (a) shall be followed.

2001. SAFETY PROCEDURES

1. A Gas Free Engineer Certificate is required in the following areas:

a. Entry into a confined or enclosed space which contains, or has previously contained, hazardous concentrations of toxic materials.

b. Entry into spaces immediately adjacent to spaces described in a. above.

c. Hot work in spaces, or withing or on the boundary of such spaces, which contain or have previously contained flammables.

d. Hot work on pepes, coils, pumps, fittings, etc., connected to spaces described in c. above.

e. Hot work in machinery rooms, engine rooms, bilges and similar areas where flammbables and pressurized systems are likely to be present.

f. Hot work on, or adjacent to, any system, or pipe lines, coils, pumps, fittings or appurtenances servicing such systems, which contain flammables or toxics or are pressurized in normal operation.

g. Hot work on hollow structures such as drums, jacketed vessels, booms, kegs, pipes, bitts, boilers, etc.

h. Operations which, by the nature of the operation, generate significant levels of toxics or flammables, and which have the capability of producing hazardous conditions.

i. Entry into any confined or enclosed space for inspection or work.

2. Length of certification will be determined by the GFE or AGFE but will never be longer than 8 hous. The determination for

periodic or continuous monitoring will be annotated on the gas free certificate. Special instructions including the proper personal protective equipment, respirator, ventilation requirements, etc. will also be noted.

3. Procedures. The testing and examination of confined or enclosed spaces will involve certain steps as a matter of routine:

a. Tests for oxygen content shall be conducted first utilizing an approved oxygen meter. Oxygen levels less than 20% or greater than 22% represent potentially dangerous situations and personnel entry will not be permitted.

b. Test for combustible vapors with an approved combustible gas indicator. Navy safety standards require that combustible atmospheres be maintained at or below 10% of the lower explosive limit. However, due to the many variables involved with testing instruments and the frequent inability to obtain finite readings, any reading observed on the combustible gas indicator will be considered as evidence of potentially unsafe conditions and no work will be permitted in the area.

c. Tests for presence of specific toxics dependent upon the nature of the space and it contents. (All monitoring equipment used to test for combustible atmospheres or to measure oxygen levels will be maintained by and under the direct control of the Gas Free Engineer.)

4. The Gas Free Engineer shall establish the frequency and type of tests for periodic or continuous monitoring. The following types of operations shall be carefully evaluated for periodic or continuous monitoring:

a. Hot work which has the potential of generating hazardous concentrations of toxics.

b. Hot work in the presence of preservatives, see page of flammables from seams, rivets and similar operations.

c. Application of preservatives, paints, epoxies, etc. Which may involve hazardous concentrations of toxic or flammable vapors.

d. cleanin operations, sludge/solvent/degreaser removal, etc. which may produce or cause release of hazardous concentrations of toxic or flammable vapors.

e. Any similar operations which possess the potential for producing or releasing toxic, flammable or asphyxiating atmospheres or material into the space.

5. Upon completion of testing, inspection evaluation, space cleaning and/or ventilation as appropriate, a gas free engineering certificate shall be issued. The categories of certificates are as follows:

a. Not safe for personnel

Not safe for Hot Work

b. Safe for Personnel

Not safe for Hot Work

c. Safe for Personnel

Safe for Hot Work

(1) A copy of the GFE Certificate will be posted at the entrance to the space being tested

2002, Personal protective equipment. Personnel entering or working in confined or enclosed spaces shall be provided with and required to use personal protective equipment appropriate to the operations and exposure.

1. Respiratory Protection. Only respiratory protective equipment which has been NIOSH approved shall be utilized for Gas Free operations. Such equipment shall be utilized only for the purpose and exposures for which the equipment was tested and approved. Approved equipment is listed in AMERICAN NATIONAL STANDARD ANSI 288.2

a. A careful evaluation of all exposures or potential exposures must be made before proper respiratory protective devices can be determined. Such evaluations shall include as a minimum:

(1) Types of contaminants present or likely to be present or generated (dusts, mists, fumes, vapors, etc.).

(2) Concentration of contaminants present.

(3) Appropriate permissible exposure limits of the contaminants (threshold limit values, ceiling values, ceiling values,etc.).

(4) Immediately Dangerous To Life or Health (IDLH) values of contaminants.

(5) Oxygen levels present.

b. Respiratory protective devices tested and approved by NIOSH in accordance with the provisions of 30 CFR Part 11 include the following:

(1) Self contained breathing apparatus - may be closed circuit, open circuit pressure demand types.
These units are tested and approved for entry into or escape from atmospheres which are IDLH. Type "C" or "CE" supplied air respirators when equipped with a self-contained emergency air supply are also tested and approved for emergency entey into atmospheres which are IDLH.

(2) Supplied air respirators, including hose masks with and without blowers, and airline respirators with respirable air supplied from a compressor or cylinder. These devices are tested and approved for atmospheres which are NOT IDLH.

(3) Gas masks with canisters, which remove specific contaminants such as ammonia from the air drawn into the unit by the breathing action of the user, are tested and approved for atmospheres which are NOT IDLH and which contain adequate oxygen to support life.

(4) Cartridge or filter type respirators, which remove contaminants such as dusts, mists, fumes, vapors, etc., from air drawn into the respirator by the user, are tested and approved for atmospheres which are NOT IDLH and have sufficient oxygen to support life. These devices are capable of providing protection only against specific contaminants in limited concentrations. Therefore, caution must be exercised to ensure the correct respirator and cartridge is selected for use, and that concentrations of contaminants do not exceed the approved capacity of the device.

(5) Pressure demand respiratory devices are the most desirable for use in hazardous atmospheres since these units maintain a positive pressure within the facepiece at all times, thereby minimizing the possible entry of toxics from the atmosphere. Demand-only type devices develop a positive pressure in the facepiece on exhalation of the user and a negative pressure on inhalation. Therefore, toxics may enter the facepiece, due to poor fit or seal, during the inhalation cycle.

c. The activity respiratory protection program shall incorporate gas free engineering personnel and operations and other personnel and operations involving entry or work in or on confined or enclosed spaces.

2. Breathing air. Breathing air supplied to respiratory protective devices such as self-contained breathing apparatus, hose mask, or supply line air mask, shall as a minimum, meet the specifications requirements for Grade B or Grade D breathing air, as appropriate, as stated in 29 CFR 1910.134d.

a. Air intakes for blowers, compressors, ventilation make-up air, etc., shall be located where vapors, exhaust gases, particulate matter, and other contaminants will not be drawn into the systems or int confined or enclosed spaces.

b. Where compressors are utilized to provide air for breathing purposes, the provisions fo NAVFACINST 11300.24 (current revision) shall be observed.

c. All additional pertinent provisions of Federal Specification Bb-A01023a shall be observed in providing compressed aid for breathing purposes.

d. Spaces with restricted access and hazardous atmospheres: More than one means of access shall be provided to a confined or enclosed space which has a hazardous atmosphere, or where the work conducted within the space may generate a hazardous atmosphere, except where the structure or configuration of the space makes this impractical.

e. Blocked access: When the Ventilation duct (non-breakaway type) blocks an access to a confined or enclosed space which can be

serviced by multiple accesses, at least two alternative means of access shall be immediately available. Where breakaway ducting is used, the access is not considered to be blocked.

f. Single access: When the space, due to its structure, arrangement or configuration, can have only a single access and the ventilation ducting blocks or partially blocks the access, only breakaway ducting will be used. In addition, personnel working inside the space shall be equipped with NIOSH approved respiratory protection (approved for the hazard) and safety belt and lifeline. An attendant shall be stationed outside the space to render aid in an emergency.

2003. VENTILATION. Confined or enclosed spaces frequently contain atmospheres which are flammable, toxic, and/or oxygen depleted or enriched. Natural ventilation is generally insufficient to achieve an adequate interchange between the contaminated air inside the space and fresh air outside the space. This lack of air interchange is particularly true in confined spaces which have limited openings.

1. Ventilation provided by air-moving devices provides an effective means of removing contaminated air from a confined or enclosed space, introducing clean respirable air into a space, and of controlling the level of hazards created by contaminants in the space or evolved from operations conducted within the space. No single rule or set of rules can be established which will cover all ventilation requirements applicable to confined or enclosed spaces. It must be recognized that the objective of ventilation in confined or enclosed spaces is to:

a. Remove contaminated air (flammable or toxic) from the space and maintain safe levels of concentration in terms of Permissible Exposure Limits (PELs) or Lower Explosive Limits (LELs) as appropriate.

b. Provide fresh, respirable air in the space for breathing.

c. Capture and remove contaminants generated within the space or dilute such contaminants to safe levels of concentration in terms of applicable PELs or LELs.

2. These objectives can be achieved only by a comprehensive evaluation of the requirements based on the space in question, the contents of the space and the operations to be conducted within the space. Ventilation requirements may be calculated based on all aspects of the space and operations. Evaluation of ventilation must be based on measurements taken of the ventilation system, and/or the atmosphere of the space, to ensure that safe conditions are achieved and maintained. This chapter sets forth minimum requirements and provides additional guidance in the application of ventilation in confined or enclosed spaces.

3. Confined or enclosed spaces shall be ventilated prior to entry or work to the degree necessary to reduce flammables and toxics to acceptable levels, and to provide proper oxygen content within the space.

4. Ventilation for entry and work. Ventilation requirements for entry into, and work in, confined or enclosed spaces are dependent upon the nature of the space, the contents, and the operations to be conducted within the space. For purposes of gas free engineering, requirements will be considered for general ventilation, dilution ventilation and local exhaust ventilation. Operations conducted

within a confined or enclosed space may 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 exhaust system.

5. General Ventilation. General ventilation may be utilized in a confined or enclosed space to provide uncontaminated respirable air for breathing, and to maintain general comfort of personnel. It may also suffice to maintain concentrations of toxic and flammable atmospheres to acceptable levels where the source of such contaminants are small and/or evolution of airborne contaminants is low. The accepted industry practice and the required level established by the Gas Free Engineer Manual, NAVSEA 56470-AA-SAF-010 for general ventilation is one complete air change every three (3) minutes. Therefore, a 30,000 cubic foot space requires a general ventilation rate of 10,000 cubic feet per minute.

6. Local exhaust ventilation. A local exhaust system consists of an arrangement where the air intake (duct opening or hood) is positioned close to the point of work where contaminants are generated. A local exhaust system captures the contaminants as they are generated, draws them into the duct work of the system and removes them from the work environment. Local exhaust systems are most effective in removing contaminants generated at one point, such as welding or localized solvent cleaning.

7. Dilution ventilation. Dilution ventilation consists of introducing uncontaminated air into a space in order to dilute the contaminated air within the space to an acceptable level.

Dilution ventilation is not as effective in contaminate control as local exhaust ventilation but may be required for certain types of operations which cannot be effectively controlled with a local exhaust system, such as spray finishing. Dilution ventilation requirements may be calculated based on the generation rate of the contaminant, the specified level or percentage of LEL or PEL required to be achieved by dilution, and the applicable PEL or LEL of the contaminant involved. The pvosisions of :Industrial Ventilation," American Conference of Governmental Industrial Hygienists, shall be utilized in determining dilution ventilation requirements for operations conducted within confined or enclosed spaces.

8. Ventilating flammable atmospheres. Fans, blowers, motors and other such equipment utilized to ventilate atmospheres which contain flammable or explosive vapors, fumes, mists, dusts, etc., shall be approved explosion-proof equipment or equipment which is intrinsically safe by design such as jet air movers, steam eductors, etc. Equipments shall be bonded and grounded as appropriate to control static electricity accumulation and discharges.

9. Ventilation system arrangement. Ventilation systems should be arranged to provide the best possible distribution of air throughout the space and to provide clean, respirable make-up air to replace contaminated air removed from the space.

10. Air Circulation. The location of exhaust duct inlets and make-up air inlets is extremely important to achieving proper air distribution throughout a confined or enclosed space. Locating an exhaust fan in the top of a deep, single-opening confined space

(where make-up air enters the space through the same opening in which the fan is located) will accomplish very little. Short circuiting will occur with the fan exhausting most of the make-up air which enters the space before its circulates through the space. The distribution of air in this case, can be greatly improved by extending a duct from the fan exhaust inlet to the bottom of the space. Air distribution and circulation can be vastly improved when make-up air and exhaust air move through separate openings in the space.

11. Make-up air. Make-up air drawn into a space to replace contaminated air must be clean and contain sufficient oxygen levels for respiration. Make-up air inlets should not be located near exhaust outlets since this may result in contaminated exhaust air being recirculated into the space. Where make-up air and exhaust air move through the same opening, ducting should be provided to carry exhaust air a sufficient distance away from the opening to prevent recirculation of contaminated air.

12. Exhaust outlets. Ventilation exhaust outlets which contain flammables or toxics, shall be vented to the outside atmosphere in a location which will accommodate dilution and dispersal of the contaminants. Exhaust outlets shall not be placed in locations which will allow exhaust air to contaminant adjacent spaces, accumulate or pocket in low areas or expose personnel to harmful or dangerous atmospheres.

Certain systems may require filtration of exhaust air prior to exhausting to the outside atmosphere. Such systems shall be fitted with the filtration or separation devices appropriate for the contaminant. Systems shall comply

with appropriate state and/or federal environmental protection regulations.

13. Contaminants lighter or heavier than air. Contaminants which are lighter or heavier than air will tend to accumulate in the greatest concentration in the higher or lower areas, respectively, of a confined or enclosed space. A certain amount of diffusion may occur which will disperse the contamination in varying degrees of concentration throughout the space. However, the greatest and most dangerous concentrations will occur in the higher or lower portions of the space. Increased temperatures from heated processes or natural causes will increase evaporation and convection rates and cause vapors or gases to diffuse and rise to the upper portions of the space. Ventilation arrangements and the placement of exhaust and make-up air inlets should consider these characteristics. When contaminants which are heavier than air are present, exhaust outlets should be located near the bottom of the space with the make-up air inlet at the top of the space. When contaminants are lighter than air, or elevated temperatures are present, the system should be reversed with the exhaust outlet at the top of the space and make-up air inlet at the bottom of the space. These arrangements will allow the ventilation system to capture and remove the contaminants at the point of greatest concentration and with the least amount of dispersal of the contaminants throughout the space.

14. Blowing versus drawing air. Air should not be blown into a space which contains flammable or toxic materials or atmospheres. Blowing air into a space will serve to agitate and evaporate the contaminants, and disperse them throughout the space. Blowing air

into a space also results in an uncontrolled expulsion of the hazardous atmospheres from the space through any and all openings which may be available. This may result in contamination of adjacent spaces and areas. Drawing air from the space may be less efficient from an air movement standpoint, but produces a controlled capture and removal process. Air may be blown into a space only when no flammable or toxic materials are present or are being generated by the work process, and ventilation is required only to provide clean, respirable air for breathing and general comfort.

2004. Ventilation requirements for specific operations.

1. Determination as to the effectiveness of ventilation in reducing and maintaining safe levels of flammables, toxics and provision of proper breathing air can only be achieved through proper sampling of the atmosphere within the space. Compliance with specified minimum ventilation requirements does not, in it self, ensure that no flammable or toxic hazards will exist, due to the many variables which affect any given work situation. In many cases, it may be necessary to use ventilation in combination with approved respiratory protective devices. For example, dilution ventilation may be used to maintain flammable vaoprs at a concentration of 10% or less of the LEL. The ventilation provided may not be sufficient to dilute the contaminant to acceptable personnel exposure levels due to the fact that much higher volumes of air are normally required to dilute to PEL values. In such cases, ventilation may be used to control flammable vapor concentrations and approved respiratory protective devices used to protect personnel from toxic exposures. Each work situation must be evaluated by competent, qualified personnel to ensure the ventilation provided is achieving the desired effect.

Tests,measurements, samples and evaluations shall be performed by the Industrial Hygienist or Engineering personnel as appropriate to the nature of the operation and contaminants. Ventilation provided for any given operation is acceptable, even though it is less than the levels prescribed in this chapter, when it is demonstrated by test and evaluation that the ventilation provided is sufficient to maintain prescribed levels of clean respirable air and appropriate levels of LELs and PELs as applicable.

2. Welding, cutting, burning, and brazing. Ventilation requirements are as follows:

a. Local exhaust ventilation

(1) Where welding, cutting, burning or similar operations are conducted within confined or enclosed spaces, local exhaust ventilation shall be provided, whenever possible, to capture and remove contaminants from the work space. The local exhaust system shall have an air flow sufficient to maintain a velocity in the direction of the exhaust inlet of 100 linear feet per minute in the zone of operation when the exhaust inlet is at its most remote distance from the point of operation. It must be noted that capture velocities decrease drastically as the distance between the exhaust inlet and the point of operation increases. Flanged exhaust inlets are approximately 25% more efficient than unflanged inlets and should be used for local exhaust systems.

(2) Exposure levels of toxic materials shall not exceed PEL levels. Personnel shall be equipped with National Institute of Occupational Safety and Health (NIOSH) approved respiratory protective devices appropriate for the exposure, except where industrial hygiene sampling tests and evaluations clearly establish that concentrations

of contaminants within the workers breathing zones are within PEL levels. Process characterization data base information may be utilized to predict expected contaminant levels. Ventilation is required, even though respiratory protective devices are utilized to provide a controlled means of capturing and removing toxic contaminants from the work space. This will avoid uncontrolled dispersal of toxic materials and possible contamination of adjacent spaces and areas, and exposure of personnel not directly associated with the operation.

(3) Where highly toxic metals or other materials are involved in the operation, greater airflows may be required to ensure proper capture of contaminants and provide more dilution. Personnel shall always be equipped with NIOSH approved respiratory protective devices when working with highly toxic materials since even slight interference with or failure of the ventilation system may result in significant personnel exposures. Such toxic metals and materials include but are not limited to:

(a) Flourine compounds

(b) Zinc

(c) Lead

(d) Mercury

(e) Beryllium

(f) Cadmium

(g) Cleaning and degreasing compounds

(h) Stainless steels involving chemical flux, iron powder, or gas shielded arc

(i) Halogenated hydrocarbons

b. Dilution ventilation.

(1) Where local exhaust ventilation cannot be provided effectively, due to the location, configuration, or nature of the space or similar restrictive factors, dilution ventilation shall be provided. It must be recognized that dilution ventilation is seldom successfully applied to fume and dust control operations, due to uneven rates of contaminant evolution, lack of accurate data of amount of contaminant generated, high volumes of dilution air required, etc. Work in confined spaces with poor air circulation and distribution, with workers immediately adjacent to the point of operation where contaminants are at their highest level of concentration, further compounds the problems. Therefore, personnel shall be equipped with NIOSH approved respiratory protective devices appropriate for the exposure, except where industrial hygiene sampling tests and evaluations clearly establish that concentrations of contaminants are within acceptable exposure levels. Dilution ventilation provides a means of diluting, collecting, and removing contaminated air from the space in a controlled manner. Care shall be taken to ensure that adjacent areas and spaces are not contaminated, and exhaust discharges are filtered to remove the contaminant, or are located in an area which will permit rapid dispersal in the outside atmosphere as appropriate.

(2) Dilution ventilation flow rates shall be based on the requirements of 29 CFR (Code of Federal Regulations) 1910, 29 CFR 1915 and the American Conference of Governmental Industrial Hugienists (ACGIH) Industrial Ventilation Manual as follows:

(a) One air change every three minutes, but not less than 2,000 cfm per welder where 5/32" or 3/16" rod is used; 3,500 cfm per welder where 1/4" ros is used; or 4,500 cfm per welder where 3/8" rod is used. Dilution airflows must be shown by test and evaluation to be adequate to consistently and reliably maintain concentrations of contaminants in the workers breathing zones at or below acceptable exposure levels (PELs), or personnel shall be equipped with NIOSH approved respiratory protective devices.

2. Painting, coating, use of solvents. Paint and preservative coating removers, cleaning solvents, liquid vehicles for paints and preservatives coatings, and similar materials are frequently toxic and flammable. Where operations involving such materials are conducted in confined or enclosed spaces, ventilation shall be utilized to control the hazards. Generally, contaminants generated from these types of operations are dispersed over a wide area rather than at a single point of generation, therefore, local exhaust ventilation is not effective in controlling contaminants. Dilution ventilation shall be utilized.

a. Dilution to personnel exposure limits. Where dilution ventilation is utilized to control toxic exposures, ventilation shall be designed to dilute contaminants to 25% or less of established PEL exposure levels. Due to the nature of ventilation problems in confined spaces, personnel shall be equipped with NIOSH approved respiratory protective devices except where industrial hygiene sampling tests and evaluations clearly establish that concentrations of contaminants are consistently and reliably maintained within acceptable PELs.

b. Dilution to Lower Explosive Limit. Where sufficient airflows cannot be reliably and consistently provided to dilute contaminants to established PELs, ventilation shall be provided to dilute contaminants to 10% or less of the lower explosive limit of the material involved. Personnel shall be equipped with appropriate NIOSH approved respiratory protective equipment. Ventilation shall be continuous during operations and shall continue after operations cease until flammable materials have evaporated and the space is gas free. Final testing of the space shall be conducted after the ventilation system has been secured for at least 10 minutes. Frequent testing of the space shall be conducted during operations to ensure flammable atmospheres do not develop. When concentrations of flammable vapors exceed 10% of the LEL, operations shall be stopped and personnel removed from the space. Operations shall not be resumed until ventilation deficiencies have been corrected. In this regard, it must be recognized that in operations such as spray painting, flammable concentrations will exist at some point within the cone shaped space from the spray nozzle. The existence of these flammable concentrations within the spray cone is not caused to discontinue operations. The effect of dilution ventilation of the total atmosphere within the space must be determined. Where flammable concentrations are found to exist at significant distances outside the spray cone, the dilution ventilation system must be considered suspect and the actions described above shall be taken.

c. Dilution ventilation flow rates. Flow rates for dilution ventilation for maintaining specified PEL exposure levels or 10% of the lower explosive limits shall be determined and calculated in accordance with ACGIH "Industrial Ventilation" Manual.

3. Abrasive Blasting. Contaminants produced by abrasive blasting in confined or enclosed spaces cannot reasonably be controlled by ventilation. Personnel performing such operations shall be equipped with NIOSH approved respiratory protective devices and other personal protective equipment as prescribed by NAVOSH standards. Ventilation shall be provided with sufficient airflow to remove suspended dust particles from the atmosphere and thereby increase the visibility within the space. Airflow rates may be estimated based on 15,000 cfm per blast nozzel, or 80 cfm per square foot of floor area of the space. Air velocity in exhaust ducts should be at least 4,500 fpm to provide adequate transport of dust particles. Exhaust air shall be filtered or otherwise processed to remove contaminants as may be required by state and/or federal environmental protection requirements.

2005. Space Cleaning.

1. The Gas Free Engineer is responsible for the following with respect to space cleaning operations:

a. Testing and evaluation of the space

b. Prescribing conditions which must be attained before entry for cleaning is authorized.

c. Issuance of a provisional certificate for entry for cleaning where entry is necessary to conduct or complete the cleaning process.

d. Specifying conditions which must be observed during entry for cleaning such as ventilation, non-sparking tools, etc.

e. Collaboration, where necessary, with personnel responsible for cleaning operations to determine the safest and most effective cleaning method.

2. Cleaning methods: There are many different methods and techniques which may be utilized to effectively clean a confined or enclosed space. No single method can be prescribed which will meet the requirements of the various conditions which may be encountered. The method of cleaning selected is dependent upon the nature of the space to be cleaned and the material contained within the space.

a. Process Equipment (degreasers, dip tanks, etc.) - Clean in accordance with manufacturers' requirements.

b. Sewer lines, storm sewers - where contamination must be removed from these areas, flushing with large volumes of clean water is recommended.

c. Utility tunnels - dry tunnels may be effectively vapor freed by proper use of ventilation. Where water/liquid seepage has occurred and water flushing is not feasible, liquids which constitute a hazard within the space should be pumped out, and the space ventilated.

d. Boilers, condensers, evaporators, steam drums - Clean in accordance with manufacturers' instructions and applicable technical manuals and instructions.

3. Developing cleaning procedures. Where cleaning methods and procedures are not established by manufacturer instructions, technical manuals or other directives, a cleaning procedure shall be jointly

developed and approved by the cognizant shop, safety and health, fire officials, and the Gas Free Engineer.

a. Steam Cleaning - steam cleaning is the most effective method of cleaning tanks which have contained low flash point hydrocarbon fuels and solvents such as gasoline. Steam cleaning is effective in removing such materials which have permeated seams, scale, blisters, concrete, etc. However, steam cleaning presents certain problems which must be given proper consideration.

(1) Temperatures of tank walls being steam cleaned should not be allowed to exceed 110 degrees Centigrade (230 degrees Fahrenheit). Excessive temperatures may cause buckling of walls, warping or cracking of structures, etc., and may also adversely affect flammable or combustible materials within boundary spaces.

(2) Tanks which contain liners or coatings may be adversely affected by steam. In such cases, cleaning methods other than steam shall be utilized. However, it should be recognized that it will be more difficult to thoroughly remove materials such as gasoline when a cleaning method other than steaming is utilized, and residual contamination of the space is more likely.

(3) Care must be taken to ensure that excessive pressure does not build up in the space being steamed cleaned. Hatches, vent covers, etc., shall be opened to allow adequate venting during the steaming process. The steam pressure shall not exceed the tank operating pressure.

(4) Steam jets can produce static buildup and discharge and should not be used in spaces which contain concentrations of flammable vapors above 10% of the LEL.

2006. Emergency and Rescue Procedures.

1. Emergency and rescue procedure, in order to be most effective, must be planned consistent with the nature of the operations and the conditions within the confined or enclosed space. Adequate consideration to emergency and rescue procedures must be given in the evaluation of confined or enclosed space hazards. When personnel are entering and working in confined or enclosed space, emergency and rescue plans and procedures shall incorporate the following requirements:

a. An emergency/rescue control point shall be established at a location suitable to supply emergency rescue assistance within a reasonable period of time. The location must be carefully evaluated dependent upon the nature and conditions of the operation and the space. In some cases, it may be necessary to locate the rescue control point immediately adjacent to the space such as emergency entries into the spaces which are IDLH. In other cases, a centrally located control point may serve a wide area involving multiple confined or enclosed spaces. Fire Department and/or Medical Department response teams may also serve as rescue control points.

b. Emergency/rescue control points shall be manned with an adequate number of trained and qualified personnel to enable rescue of personnel from confined or enclosed spaces.

c. Rescue personnel entering a space to attempt rescue shall be equipped with a NIOSH approved pressure-demand self contained breathing apparatus, harness and life line and any other personal protective equipment applicable to the conditions.

d. In all cases where conditions of entry and/or work in a confined or enclosed space require the use of respiratory protective devices and life lines with attendants as set forth in paragraphs 3-4, 3-5, and 3-6 of reference (a), the attendants shall be equipped with a NIOSH approved pressure-demand self contained breathing apparatus.

e. Attendant personnel shall be thoroughly instructed that no rescue attempt involving entry shall be made until the rescue control point has been notified and assistance has arrived. Rescue efforts by means of the life line shall be made until assistance arrives.

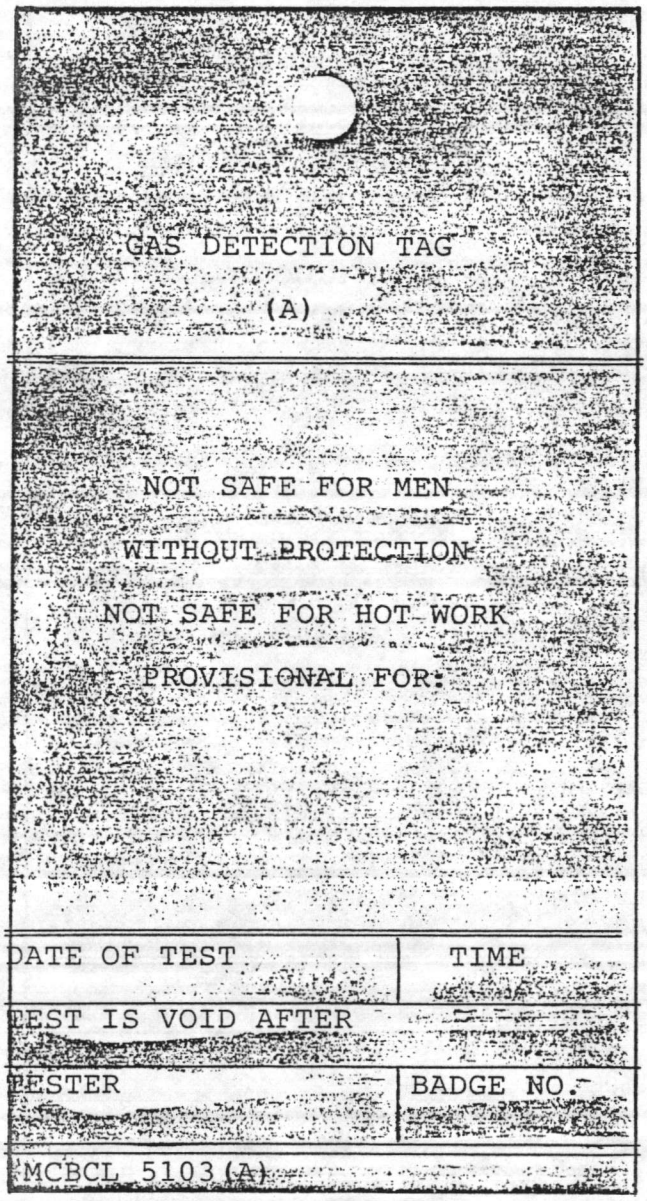
f. All personnel involved in confined or enclosed space entry and/or work shall be instructed in the proper procedures to be followed in rescue efforts including the location of the rescue control point and the means of notifying the control point in the event of an emergency.

g. Medical services and treatment shall be readily available for personnel overcome or injured in confined or enclosed space incidents. Location of medical facilities and means of communication should be incorporated into confined/enclosed space emergency and rescue plans.

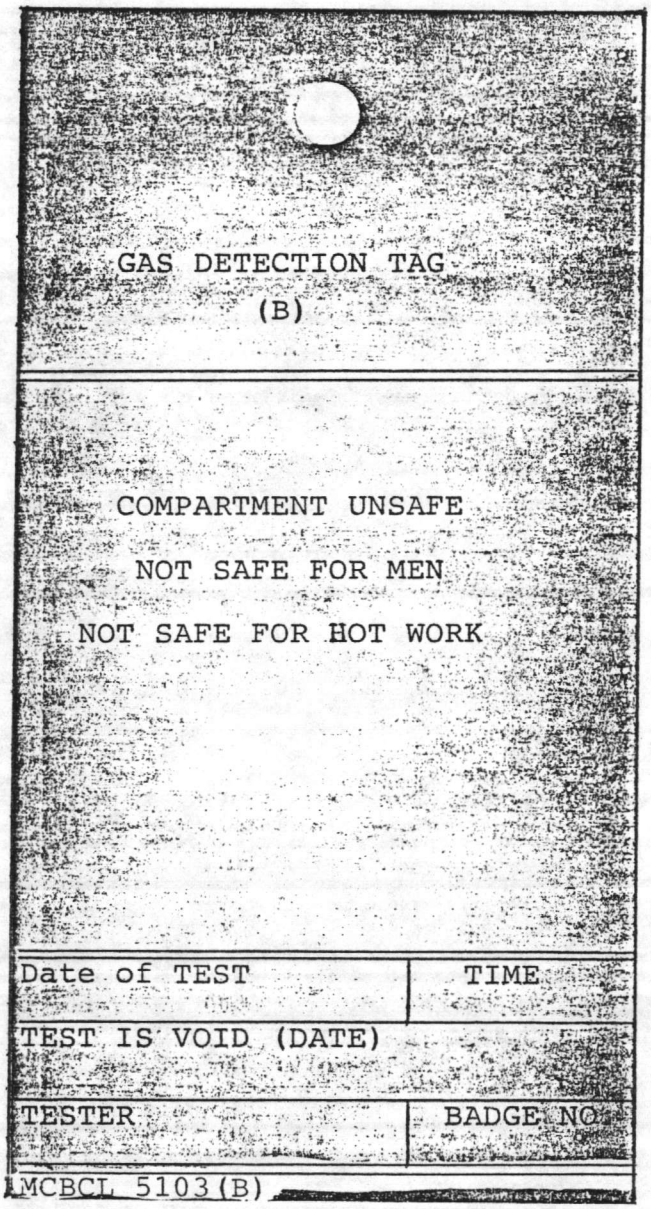
2007. Request for Gas Free Engineer Services.

1. Request for service of the Base Gas Free Engineer will be submitted to the GFE via telephone extension 3891/5725 at least 1 workday in advance of operation. In the event of an emergency GFE services will be made available as soon as possible.

SAMPLE GAS FREE ENGINEER TAGS



(Orange/Black)



(Red/Black)

ENCLOSURE (1)

SAMPLE GAS FREE ENGINEER TAGS

GAS DETECTION TAG
(C)

SAFE FOR MEN
NOT SAFE FOR
HOT WORK

DATE OF TEST	TIME

TEST IS VOID (DATE)

TESTER	BADGE NO.

MCBCL 5103(C)

(Yellow/Black)

GAS DETECTION TAG
(D)

COMPARTMENT GAS FREE
SAFE FOR MEN
SAFE FOR HOT WORK
EXCEPT ON
1
2

DATE OF TEST	TIME

TEST IS VOID AFTER

TESTER	BADGE NO.

MCBCL 5103(D)

(Green/Black)

ENCLOSURE (1)

SAMPLE GAS FREE ENGINEER TAGS

GAS DETECTION TAG

(E)

CROSS OUT SECTION THAT DOES NOT APPLY

INERTED

NOT SAFE FOR MEN INSIDE

SAFE FOR MEN AND HOT

WORK OUTSIDE

PRESSED UP

WITH _____

SAFE FOR MEN AND HOT

WORK OUTSIDE

DATE	TIME

CONDITION VOID AFTER

TESTER	BADGE NO.

MCBCL 5103(E)

(White/Red)

ENCLOSURE (1)

NAVY GAS FREE CERTIFICATE
MCBCL 5103/4

INITIAL DATE OF TEST: HR. _____ DAY _____ MO. _____ YR. _____

INITIAL EXPIRATION THIS CERTIFICATE EXPIRES: HR. _____ DAY _____

MO. _____ YR. _____

GFE PERSONNEL SIGNATURE: _____

RE-TEST/UPDATE: TIME _____ DATE _____ EXPIRES _____

GFE PERSONNEL SIGNATURE: _____

RE-TEST/UPDATE: TIME _____ DATE _____ EXPIRES _____

GFE PERSONNEL SIGNATURE _____

UNIT/ACTIVITY: _____

ITEM COMPT./SPACE: _____

TYPE OF OPERATION TO BE CONDUCTED: _____

THIS CERTIFICATE INDICATES THE CONDITIONS THAT EXIST AT THE TIME TESTS WERE CONDUCTED

☐ **NOT** SAFE FOR PERSONNEL — **NOT** SAFE FOR HOT WORK

☐ **NOT** SAFE FOR PERSONNEL WITHOUT PROTECTION — **NOT** SAFE FOR HOT WORK

☐ **SAFE** FOR PERSONNEL — **NOT** SAFE FOR HOT WORK

☐ **SAFE** FOR PERSONNEL — **SAFE** FOR HOT WORK

☐ INERTED — **NOT SAFE** FOR PERSONNEL **INSIDE** — SAFE FOR PERSONNEL AND HOT WORK **OUTSIDE** _____

REMARKS

ENCLOSURE (1)