

NFPA 306  
Control of  
Gas Hazards  
on Vessels  
1988 Edition



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## **NFPA 306**

### **Standard for the Control of Gas Hazards on Vessels**

#### **1988 Edition**

This edition of NFPA 306, *Standard for the Control of Gas Hazards on Vessels*, was prepared by the Technical Committee on Gas Hazards, released by the Correlating Committee on Marine Fire Protection, and acted on by the National Fire Protection Association, Inc. at its Fall Meeting held November 9-11, 1987 in Portland, Oregon. It was issued by the Standards Council on December 2, 1987, with an effective date of December 22, 1987, and supersedes all previous editions.

The 1988 edition of this standard has been approved by the American National Standards Institute.

#### **Origin and Development of NFPA 306**

The original standard on this subject was developed by the NFPA Committee on Marine Fire Hazards in 1922 in cooperation with the NFPA Committee on Flammable Liquids. It was adopted by the Association and published as Appendix A of the "Regulations Governing Marine Fire Hazards." Further editions with minor changes were published in 1923, 1926, and 1930. In 1947, a completely revised standard was prepared by a joint committee of the American Bureau of Shipping and the National Fire Protection Association. A revised edition was developed by the NFPA Sectional Committee on Gas Hazards, approved by the Committee on Marine Fire Protection, and adopted in 1962, amended in 1963, 1969, 1971, 1972, 1975, 1980, and 1984.

The 1988 edition represents a complete revision which adds a new safety designation, a safe condition for vessels in lay-up, and a section on military unique vessels. Chapters 2, 3 and 4 were restructured to present the sequence for obtaining a Marine Chemist Certificate.

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**NFPA 306**  
**Standard for the**  
**Control of Gas Hazards on Vessels**  
**1988 Edition**

NOTICE: An asterisk (\*) following the number or letter designating a paragraph indicates explanatory material on that paragraph in Appendix A.  
 Information on referenced publications can be found in Appendix D.

**Chapter 1 General**

**1-1 Scope.**

**1-1.1** This standard applies to vessels carrying or burning as fuel flammable or combustible liquids. It also applies to vessels carrying or having carried flammable compressed gases, chemicals in bulk, or other products capable of creating a hazardous condition.

**1-1.2** This standard describes the conditions required before a space may be entered or work may be started on any vessel under construction, alteration, repair, or for shipbreaking.

**1-1.3** This standard applies to cold work, application or removal of protective coatings, and work involving riveting, welding, burning, or like fire-producing operations.

**1-1.4** This standard applies to vessels while in the United States, its territories, and possessions, both within and outside of yards for ship construction, alteration, ship repair, or shipbreaking.

**1-1.5** The standard applies specifically to those spaces on vessels that are subject to concentrations of combustible, flammable, and toxic liquids, vapors, gases, and chemicals as hereinafter described. This standard is also applicable to those spaces on vessels that may not contain sufficient oxygen to permit safe entry.

**1-2 Purpose.** The purpose of this standard is to provide minimum requirements and conditions for use in determining that a space or area on a vessel is safe for entry or work.

**1-3\* Emergency Exception.** Nothing in this standard shall be construed as prohibiting the immediate drydocking of a vessel whose safety is imperiled (the vessel is sinking or is seriously damaged), making it impracticable to clean and gas free in advance.

**1-4\* Governmental Regulations.** Nothing in this standard shall be construed as superseding existing requirements of any governmental or local authority. Attention of owners, repairers, and chemists is directed to the "Rules and Regulations for Tank Vessels" and other rules and regulations for vessel inspection of the United States Coast Guard and the "Occupational Safety and Health Standards" of the United States Department of

Labor which prescribe an inspection prior to making repairs involving riveting, welding, burning, or similar fire-producing operations, and prior to entering spaces where oxygen deficiency may exist. Those standards provide, under the conditions stated therein, for inspection by a Marine Chemist certificated by the National Fire Protection Association or, alternatively, inspection by certain other persons.

**1-5 Definitions.** Unless expressly stated elsewhere, the following terms shall, for the purpose of this standard, have the meanings indicated below.

**Adjacent Spaces.** Those spaces in all directions from subject space, including all points of contact, corners, diagonals, decks, tank tops, and bulkheads.

**Certificate.** See "Marine Chemist's Certificate."

**Chemical.** Any compound, mixture, or solution in the form of a solid, liquid, or gas, that may be hazardous by virtue of its properties other than or in addition to flammability, or by virtue of the properties of compounds that might be evolved from hot work or cold work.

**Coiled Vessels.** Tank vessels using a closed system of heating coils that use thermal oil as the heating media.

**Flammable.** The words "flammable" and "inflammable" are interchangeable or synonymous terms for the purpose of this standard.

**Flammable Compressed Gas.** Any flammable gas that has been compressed and/or liquefied for the purpose of transportation and has a Reid vapor pressure exceeding 40 psia ( $2.76 \times 10^5$  Pa).

**Hollow Structures.** Rudders, rudder stocks, skegs, castings, masts and booms, rails, and other attachments to a vessel that enclose a void space.

**Marine Chemist.** The holder of a valid Certificate issued by the National Fire Protection Association in accordance with the "Rules for Certification of Marine Chemists," establishing him as a person qualified to determine whether construction, alteration, repair, or shipbreaking of vessels, which may involve hazards covered by this standard, can be undertaken with safety.

Activities of a Marine Chemist, as defined in this section, are limited to the inspection and certification procedures described in this standard and consulting services connected therewith.

**Marine Chemist's Certificate (Certificate).** A written statement issued by a Marine Chemist in the form and manner prescribed by this standard. It states the conditions that the Marine Chemist found at the time of his inspection.

**Materials.**

(a) **Flammable Liquid.** Any liquid having a flash point (closed cup) below 80°F (26.6°C) and having a vapor pressure not exceeding 40 psi absolute (2068.6 mm Hg) at 80°F (26.6°C).

1. **Grade A.** Any flammable liquid having a Reid vapor pressure of 14 lb ( $9.6 \times 10^4$  Pa) or more.

2. **Grade B.** Any flammable liquid having a Reid vapor pressure under 14 lb ( $9.6 \times 10^4$  Pa) and over  $8\frac{1}{2}$  lb ( $5.9 \times 10^4$  Pa).

3. **Grade C.** Any flammable liquid having a Reid vapor pressure of  $8\frac{1}{2}$  lb ( $5.9 \times 10^4$  Pa) or less and a flash point of 80°F (26.6°C) or below.

(b) **Combustible Liquid.** Any liquid having a flash point (open cup) at or above 80°F (26.6°C).

1. **Grade D.** Any combustible liquid having a flash point below 150°F (65.5°C) and above 80°F (26.6°C).

2. **Grade E.** Any combustible liquid having a flash point of 150°F (65.5°C) or above.

(c) **Toxic Materials.** Any material whose properties contain the inherent capacity to produce injury to a biological system. This is dependent on concentration, rate, method, and site of absorption.

#### Repair Classifications.

(a) **Hot Work.** Any construction, alteration, repair, or shipbreaking operation involving riveting, welding, burning, or similar fire-producing operations. Grinding, drilling, abrasive blasting, or similar spark-producing operations shall be considered hot work unless deemed otherwise by a Marine Chemist.

(b) **Cold Work.** Any construction, alteration, repair, or shipbreaking that does not involve heat, fire, or spark-producing operations.

(c) **Work Below Deck.** Work in or on enclosed spaces surrounded by shell, bulkheads, and overheads.

(d) **Work in the Open.** Work performed from open decks or in spaces from which the overhead has been completely removed.

**Secured.** Closed in a manner to avoid accidental opening or operation.

**Shipbreaking.** The breaking down of a vessel's structure for the purpose of scrapping the vessel; includes the removal of gear, equipment, or any component part of a vessel.

#### Tanker Designations.

(a) **Tank Vessels.** Any vessel especially constructed or converted to carry liquid bulk cargo in tanks.

(b) **Tank Ship.** Any tank vessel propelled by power or sail.

(c) **Tank Barge.** Any tank vessel not equipped with a means of self-propulsion.

**Vessel.** Includes every description of watercraft used, or capable of being used, as a means of transportation on water.

## Chapter 2 Minimum Requirements for Issuance of Marine Chemist's Certificate and Maintenance Conditions

**2-1 The Marine Chemist Shall Personally Determine Conditions.** A Marine Chemist may issue a Certificate setting forth, in writing, that the prescribed work to a vessel can be undertaken with safety. The Marine Chemist shall physically inspect the conditions and carry out tests within each compartment or space ensuring compliance with the minimum applicable requirements to his satisfaction prior to issuing a Certificate.

### 2-2 Procedures Prior to Issuance of a Certificate.

**2-2.1** The calibration of all instruments used by the Marine Chemist shall be checked before and after each day's use. A record shall be maintained of all calibration checks.

**2-2.2** The Marine Chemist's determinations shall include an internal inspection and tests of the spaces to be certified and spaces adjacent thereto. The determinations shall also include:

- (a) the three previous cargoes carried,
- (b) the nature and extent of the work,
- (c) starting time and duration of the work,
- (d) tests of cargo and vent lines at manifolds and accessible openings,
- (e) verification that cargo valves in prescribed areas of work are tagged and secured in a manner to avoid accidental opening or operation, and
- (f) tests of cargo heating coils.

**2-3 Standard Safety Designations and Conditions Required.** The following standard safety designations shall be used where applicable in preparing Certificates, cargo tank labels, and other references.

**2-3.1 SAFE FOR WORKERS.** Means that in the compartment or space so designated:

- (a) \*The oxygen content of the atmosphere is at least 19.5 percent and not greater than 22 percent by volume, and
- (b) \*The concentration of flammable materials is below 10 percent of the lower explosive limit, and
- (c)\* Any toxic materials in the atmosphere associated with cargo, fuel, tank coatings, inerting mediums, or fumigants are within permissible concentrations at the time of the inspection, and
- (d)\* The residues or materials associated with the work authorized by the Certificate will not produce uncontrolled toxic materials under existing atmospheric conditions while maintained as directed on the Certificate.
- (e) If any of the conditions of 2-3.1(a), (b), (c), or (d) do not exist, then the designation "Not Safe for Workers" or "Enter with Restrictions" shall be used.

**2-3.2 NOT SAFE FOR WORKERS.** Means that in the compartment or space so designated, personnel shall not be allowed to enter.

**2-3.3 ENTER WITH RESTRICTIONS.** Means that in any compartment or space so designated, entry for work may be made only if conditions of proper protective equipment, clothing, and time are as specified.

**2-3.4 SAFE FOR HOT WORK.** Means that in any compartment or space so designated:

(a)\* The oxygen content of the atmosphere is not to exceed 22 percent by volume and that,

(b)\* The concentration of flammable materials in the atmosphere is less than 10 percent of the lower explosive limit, and that

(c) The residues are not capable of producing a higher concentration than permitted by 2-3.4(a) or (b) under existing atmospheric conditions in the presence of hot work and while maintained as directed on the Certificate, and further,

(d) All adjacent spaces, including diagonal spaces, containing or having contained flammable or combustible materials, are sufficiently clean to prevent the spread of fire; or are satisfactorily inerted; or in the case of ship's fuel oil tanks or lube tanks, or engine room or fire room bilges or other machinery spaces, have been treated in accordance with the Marine Chemist's requirements.

(e) If any of the conditions of 2-3.4(a), (b), (c), or (d) do not exist, the designation "Not Safe for Hot Work" must be used.

**2-3.5 NOT SAFE FOR HOT WORK.** Means that in the compartment so designated, hot work shall not be permitted.

**2-3.6 SAFE FOR SHIPBREAKING.** Means that the compartment so designated:

(a) Shall meet the requirements of 2-3.4(a) through (d).

(b) The residual combustible materials designated are not capable of producing fire beyond the extinguishing capabilities of the equipment on hand.

**2-3.7 Inerted.** Means that one of the following procedures has been completed in the compartment or space so designated:

(a)\* Carbon dioxide or other nonflammable gas acceptable to the Marine Chemist has been introduced into the space in sufficient volume to maintain the oxygen content of the atmosphere of the enclosed space at or below 8.0 percent or 50 percent of the amount required to support combustion, whichever is less.

(b) The space has been flooded with water, provided that any hot work is performed at least 3 ft (0.9 m) below the water level and, further, provided that the gas content of the atmosphere above the water does not exceed 10 percent of the lower explosive limit and such procedure is approved by a Marine Chemist.

(c) The kind of gas and the safe disposal and securing of gas inerting media shall be noted on the Certificate by

the Marine Chemist upon completion of repairs. Closing and securing of hatches and other openings, except vents, may be considered as "safe disposal" by the Marine Chemist.

**2-3.8 Inerted for Flammable Compressed Gas.** Means that individual pressure tanks with a working pressure of 50 psi ( $3.45 \times 10^5$  Pa) or more are considered in a safe condition for such work not directly involving these tanks or their pipelines when a positive pressure is maintained on the tanks by the flammable vapors and special precautions are observed under carefully controlled conditions as specified on the Certificate.

**2-3.9 Safe for Lay-up.** Means that for any tank ship so designated any of the following conditions has been met:

(a) The vessel has been cleaned in accordance with the provisions in Section 3-1 and the vessel is inspected weekly by the responsible owner's representative to ensure that no change in conditions occurs.

(b) All the cargo tanks have been discharged of cargo as far as practicable, the residues are not capable of producing more than 10 percent of the LEL, and the vessel is inspected weekly by the responsible owner's representative to ensure that no change in conditions occurs.

(c) All the cargo tanks have been inerted to less than 8 percent oxygen or 50 percent of the amount to support combustion, whichever is less; a responsible owner's representative is in constant attendance and the vessel is reinspected daily until stabilized; thereafter, the responsible owner's representative is to maintain daily inspections and records of oxygen content.

**2-4 Preparation of Certificates.** When the Marine Chemist is satisfied that the requirements of this standard and any other requirements necessary in order that the prescribed work can be undertaken with safety have been carried out or have not been met, a Certificate shall be prepared in form and manner prescribed by this standard.

**2-4.1** The Certificate shall include the frequency and type of such additional tests, inspections, qualifications, and other instructions as the Marine Chemist specifies.

**2-4.2** The Certificate shall state conditions under which the Marine Chemist should be consulted or recalled.

**2-4.3** Such qualifications and requirements shall include precautions, including protective equipment and devices, necessary to eliminate or minimize hazards that may be present from protective coatings or residues from cargoes.

**2-5 Issuance of Certificates.** The Certificate shall be completed and a signature for receipt of the Certificate shall be obtained, signifying the understanding of the conditions and limitations under which it is issued.

**2-5.1** If the Certificate is issued in connection with commencement of repair work, it shall be delivered to, and signed for by, the ship repairer or his authorized representative.

**2-5.2** If the Certificate is issued for purposes other than the commencement of repair work, it shall be delivered to, and signed for by, the person who authorized the inspection or his authorized representative.

## **2-6 Responsibility for Obtaining Certificate and Maintaining Conditions.**

**2-6.1** Work authorized by the Certificate must commence within 24 hours unless otherwise noted on the Certificate.

**2-6.2** It is the responsibility of the vessel repairer, ship-breaker, or vessel builder to retain the services of the Marine Chemist, to secure copies of his Certificate, and to provide the master of the vessel and the representatives of the vessel owner with copies of such Certificate. Receipt and understanding of the Certificate shall be acknowledged by signature of the person or his representative requesting the service.

**2-6.3** Throughout the course of repairs or alterations, conditions on the Certificate shall be maintained on the vessel by full observations of all qualifications and requirements.

**2-6.4** It is the responsibility of the vessel repairer, ship-breaker, or vessel builder to ensure that the prescribed work is carried out at the same location where the Certificate was issued unless movement is authorized by the Marine Chemist on the Certificate.

**2-6.5** It is the responsibility of the person signing for receipt of the Certificate to securely post the Certificate in a conspicuous place aboard the vessel.

**2-6.6** All access openings to spaces designated "Not Safe for Workers," including inerted spaces, shall be appropriately labeled with a warning sign "Not Safe for Workers," which shall remain in place unless recertificated.

## **Chapter 3 Preparing Vessels for Issuance of a Marine Chemist's Certificate**

### **3-1 Where a Safe Condition Is to Be Obtained Entirely by Cleaning. (See Appendix B.)**

**3-1.1** All cargo pumps, cargo lines, inert gas lines, crude oil wash lines, piped cargo fire extinguishing systems, and vent lines shall have been flushed with water, blown with steam or air, or inerted.

**3-1.2** Compartments concerned shall be so cleaned that the atmosphere in all cargo compartments and adjacent spaces, including those diagonally adjacent to, is in accordance with 2-3.1 and/or 2-3.4, as applicable.

**3-1.3** Tanks or compartments with residues whose flash point is 180°F (82.2°C) or above may be partially cleaned for minor hot work. Such spaces and adjacent spaces directly affected shall be cleaned back a sufficient distance from the work to meet the requirements of 2-3.4(d). The

remainder of the space and adjacent spaces shall meet the requirements of 2-3.4(a), (b), and (c).

**3-1.4** The residue in all compartments concerned (with the exception of tanks described in 3-1.3) shall be such that the conditions of 2-3.1 and/or 2-3.4, as applicable, shall be met.

### **3-2 Where a Safe Condition Is to Be Obtained by Both Cleaning and Inerting or Entirely by Inerting. (See Appendix B.)**

**3-2.1** The Marine Chemist shall approve the use of the inerting medium and shall personally supervise introduction of the inerting medium into the space to be inerted, except in situations where an inerting medium has been introduced prior to the vessel's arrival at the repair facility. A Marine Chemist, in all cases, shall personally conduct tests to determine that the oxygen content of the inerted space is at or below 8 percent or 50 percent of the amount required to support combustion, whichever is less. The Marine Chemist shall be readily available during the entire period of work, and he shall determine that the oxygen level in the inerted space is maintained at or below 8 percent or 50 percent of the amount required to support combustion, whichever is lower. On vessels not utilizing cargo space inerting systems, a Marine Chemist shall specify the safe disposal and securing of the inerting medium following completion of the repair work on the inerted space and adjacent spaces.

**3-2.2** All piped cargo fire extinguishing systems within the cargo tanks and vent lines, except those in the inerted spaces, shall have been flushed with water, blown with steam or air, or inerted. (All valves to the inerted spaces shall be tagged and secured in such a manner as to avoid accidental opening or operation.) All cargo pumps and cargo lines, inert gas lines, and crude oil wash lines shall have been flushed with water, blown with steam or air, or inerted.

**3-2.3** All spaces to be inerted shall be sufficiently intact to retain the inerting medium. All valves, hatches, and other openings to the inerted spaces, except those controlling the inerting medium, shall be closed and secured.

**3-2.4** Compartments or spaces in which internal repairs or alterations are to be undertaken shall be cleaned to comply with the requirements of 3-3 and all other spaces (with the exception of tanks described in 3-1.3) shall be inerted in accordance with the requirements of 2-3.7 or 2-3.8.

**3-2.5** Compartments or spaces on which external repairs or alterations are to be undertaken on the external boundaries (deck or shell) may be inerted by gas instead of being cleaned as described in 3-2, and all other spaces (with the exception of tanks described in 3-1.3) shall be inerted in accordance with the requirements of 2-3.7 or 2-3.8.

### **3-3 Where a Safe Condition Is to Be Obtained Entirely by Cleaning Certain Compartments and by Securing the Other Compartments. (See Appendix B.)**

**3-3.1** Nonadjacent spaces containing atmospheres exceeding 10 percent of the lower explosive limit shall be closed and secured, and those spaces noted on the Certificate.

**3-3.2** All piped cargo fire extinguishing systems and vent lines to the spaces involved shall have been flushed with water, blown with steam or air, or inerted, and the valves to all other compartments closed and secured. All cargo pumps and cargo lines, inert gas lines, and crude oil wash lines, shall have been flushed with water, blown with steam or air, or inerted, and the valves closed and secured in a manner to avoid accidental opening or operation.

**3-3.3** Compartments or spaces in which internal repairs or alterations are to be undertaken and all adjacent compartments, including those diagonally adjacent thereto, shall be cleaned to comply with the applicable requirements of 3-1. All other applicable spaces shall be closed and secured in a manner to avoid accidental opening or operation.

**3-4 Where a Safe Condition Is to Be Obtained by Both Cleaning and Inerting or Entirely by Inerting Certain Compartments and by Securing the Other Compartments. (See Appendix B.)**

**3-4.1** All piped cargo fire extinguishing systems and vent lines to the spaces involved, except those to the inerted spaces, shall have been flushed with water, blown with steam or air, or inerted, and the valves to all other compartments closed and secured in a manner to avoid accidental opening or operation. All cargo pumps and cargo lines, inert gas lines, and crude oil wash lines shall have been flushed with water, blown with steam or air, or inerted, and the valves closed and secured in such a manner as to avoid accidental opening or operation.

**3-4.2** Nonadjacent spaces containing atmospheres exceeding 10 percent of the lower explosive limit shall be closed and secured in a manner to avoid accidental opening or operation, and those spaces noted on the Certificate.

**3-4.3** Compartments or spaces in which internal repairs or alterations are to be undertaken shall be cleaned to comply with the requirements of 3-1 and all adjacent compartments, including those diagonally adjacent thereto, shall be inerted to comply with the applicable requirements of 2-3.7 and all other compartments shall be closed and secured in compliance with 3-3.1. With respect to inerted spaces, the requirements of 3-2.1 apply.

**3-4.4** Compartments or spaces on which external repairs or alterations are to be undertaken on the external boundaries (deck or shell) may be inerted by gas instead of being cleaned as described in 3-1. All adjacent compartments, including those diagonally adjacent thereto, shall be inerted or cleaned to comply with applicable requirements of 3-2. All other applicable spaces shall be closed and secured in compliance with 3-3.1.

**3-5 Cargo Heater Coils.**

**3-5.1** All steam supplied cargo heater coils to the spaces involved, except those to the inerted spaces, shall have been made safe by one of the following means: steaming, flushing with water, blowing with air, or inerting.

**3-5.2** Coils in cargo tanks that have been used for chemicals that may react with water or steam shall be cleaned in accordance with the requirements of 5-3.2.

**3-5.3** On coiled vessels using thermal heating oils [FP 500°F+ (260°C+)] or above, the Marine Chemist shall satisfy himself as to the integrity of the heater coils in the prescribed work areas.

**3-6 Electric Welding Operations.** When determined to be necessary by the Marine Chemist, electrical welding ground cables shall be connected to the ship's structure, as close as possible to the point of welding, with a safe current-carrying capacity equal to or exceeding the specified maximum output capacity of the unit which it services.

**3-7 Requirements for Use of a Designated Berthing Area for Cleaning, Gas Freeing, or Inerting.**

**3-7.1** Vessels that have not been cleaned, gas freed, or inerted shall proceed to a designated berth, selected and set apart with due regard to the hazards of the location and to hazards to adjacent property.

**3-7.2** The degassing, cleaning, or inerting of vessels at such designated berths shall be carried out in accordance with the requirements of 3-1 or 3-2 before they are shifted to other berths. No repairs involving hot work, other than in boiler or machinery spaces when specifically certified by a Marine Chemist, shall be undertaken on any vessel in such designated berth until it has been degassed and cleaned or inerted in accordance with the requirements of 3-1 or 3-2 nor shall such repairs be then undertaken if another vessel that has not complied with these requirements is in the designated berth at the same time.

**3-8 Adjacent Ship's Fuel Oil Tanks.** No hot work shall be permitted within 3 ft (0.9 m) of any ship's fuel oil tanks unless these tanks have been cleaned, inerted, or the work is authorized by the Marine Chemist.

**Chapter 4 Vessels Required to Have Marine Chemist's Certificate**

**4-1 Tank Vessels.** Tank vessels may be repaired when cleaned, or cleaned and inerted, in accordance with the provisions in 3-1 or 3-2, respectively. A Certificate to this effect shall be required. Repairs or alterations involving hot work shall not be undertaken unless specifically authorized by the Certificate.

*Exception No. 1: Tank vessels may enter a repair yard for examination, afloat or in dry dock, provided that all bulk cargo compartments and cofferdams are kept closed.*

*Exception No. 2: Tank vessels may enter a repair yard for scraping, washing down, and painting, afloat or in dry dock, provided that all bulk cargo compartments and cofferdams are kept closed.*

*Exception No. 3: Tank vessels may enter a repair yard for work (hot or cold) to be performed outside of the vessel, afloat or in dry dock, on the propeller, tailshaft, or rudder, or for work to be performed off the vessel, such as on the anchors or chains, provided that all bulk cargo compartments and cofferdams are kept closed.*

*Exception No. 4: Tank vessels may enter a repair yard, afloat or in dry dock, for work within boiler and machinery spaces and/or other locations provided that, where hot work is to be undertaken, a Certificate shall be required. This Certificate shall set forth each specific location for which hot work is approved. All bulk cargo compartments, cofferdams, and/or other areas where the flammable content of the atmosphere is above 10 percent of the lower explosive limit shall be kept closed and secured. The securing of the compartments, cofferdams, and other areas shall be noted on the Certificate.*

*Exception No. 5: Tank vessels that proceed to a dry dock or designated berth selected with due regard to the hazards of the location and to hazards to adjacent property may undergo specific limited repairs of a local nature when the compartments or spaces involved and the adjacent compartments or spaces are prepared in accordance with the provisions of 3-3 and 3-4.*

**4-2 Vessels Other Than Tank Vessels.** On any vessels that have carried flammable or combustible liquid in bulk as fuel or cargo, or cargoes that may produce hazardous atmospheres (including, but not limited to, those of decomposition or reaction with oxygen from the atmosphere), no repairs involving hot work shall be made in or on the external boundaries (shell, tank top, or deck) of cargo tanks, fuel tanks, oil pipelines, heating coils or hollow structures, and machinery spaces, unless such compartment and pipelines, as deemed necessary by the Marine Chemist, have been cleaned or inerted to meet the appropriate designation requirements of Section 2-3 and 2-3.7. Repairs and alterations shall not be undertaken until a Certificate is obtained.

**4-3 Military Unique Vessels (i.e., U.S. Navy, Coast Guard, Army).**

**4-3.1** Oilers and tank barges shall be treated as "Tank Vessels" in accordance with Section 4-1.

**4-3.2** All ammunition shall be removed from any space requiring hot work. Adjacent spaces containing ammunition shall be treated in accordance with Marine Chemist requirements. Adjacent spaces containing flammable or combustible liquids shall be treated in accordance with 2-3.4.

**4-3.3** Adjacent tanks used for radiation shielding on nuclear-powered vessels shall be treated in accordance with the Marine Chemist's requirements.

**4-3.4** All other types of military vessels shall be treated in accordance with Section 4-2.

**4-3.5** All tanks, confined spaces, and machinery compartments in which "internal" repairs or alterations are to be undertaken shall be cleaned to comply with the requirements of 2-3.1 or 2-3.3, and 2-3.4; and all adjacent compartments shall be cleaned to meet the requirements of 2-3.4, or any of the adjacent tanks may be inerted to meet the requirements of 2-3.7.

*Exception: Spaces covered by 3-1.3, Section 3-8, and 4-3.3.*

**4-3.6** All tanks, confined spaces, and machinery compartments on which "external" repairs or alterations are to be undertaken shall be cleaned to comply with the requirements of 2-3.4, or any tanks may be inerted to comply with the requirements of 2-3.7; and all adjacent compartments shall be cleaned to meet the requirements of 2-3.4, or any adjacent tanks may be inerted to meet the requirements of 2-3.7.

*Exception: Spaces covered by 3-1.3, Section 3-8, and 4-3.3.*

**4-4 Vessels in Lay-up.** A tank ship in lay-up shall be treated in accordance with Section 4-1. No repairs or alterations involving hot work shall be made unless authorized by the Marine Chemist in accordance with the provisions of 2-3.9.

**4-5 Vessels Carrying Flammable Compressed Gas.** On any vessels that have carried flammable compressed gas in bulk, no repairs or alterations involving hot work shall be made unless the provisions of 4-1 have been complied with, provided individual pressure tanks, inerted in accordance with 2-3.8, are considered in a safe condition for such work not directly involving these tanks or their pipelines.

## Chapter 5 Additional Requirements for Bulk Chemical Cargo Tanks

### 5-1 Scope.

**5-1.1** This section describes the conditions required before repairs can be made in spaces that have carried or have been exposed to chemicals in bulk. The remaining spaces in the vessel shall comply with the applicable provisions in Chapter 4.

**5-1.2** The definitions set forth in Section 1-5 shall apply to this chapter.

### 5-2 Minimum Requirements.

**5-2.1** All minimum requirements for issuance of the Certificate set forth in Chapter 2 of this standard are applicable to spaces that have carried or have been exposed to chemicals in bulk.

**5-2.2** The designation "Not Safe for Workers" shall be used for spaces that have carried material of unknown chemical hazards. (See 2-4.3.)

5-2.3 Results of any chemical hazard tests may be noted on the Certificate.

### 5-3 Minimum Conditions.

5-3.1 Minimum conditions that shall prevail prior to the issuance of a Certificate for spaces that have contained chemicals in bulk shall be as set forth in Chapter 3, insofar as they are applicable, and as set forth in this section.

5-3.2 All pipelines, including heating coils, fire extinguishing systems, and vents, together with the cargo pumps and cargo lines serving the chemical-carrying spaces, shall be initially dealt with to the satisfaction of the Marine Chemist. Care shall be exercised in the selection of methods and materials used for cleaning or inerting to avoid noncompatibility with previous cargoes.

5-3.3 Compartments having carried chemicals in bulk and that are to be cleaned shall be so cleaned that the atmosphere in those compartments is in accordance with 2-3.1 and 2-3.4, as applicable.

5-3.4 The residues in the compartments concerned shall be such that the conditions of 2-3.1 and 2-3.4, as applicable, will be met.

## Chapter 6 Additional Requirements for Flammable Cryogenic Liquid Carriers

### 6-1 Scope.

6-1.1 The design and operational characteristics of tank, cargo-handling, and related systems on vessels carrying flammable cryogenic liquid cargoes must be fully appreciated by the Marine Chemist in making the determinations required by Section 2-1 of this standard. This chapter describes the conditions required before repairs can be made in spaces that have carried or have been exposed to flammable cryogenic liquid cargoes in their liquid or vapor form.

6-1.2 This chapter supplements the factors to be considered prior to issuance of the Certificate in accordance with Section 2-1.

6-1.3 **Special Endorsement Attesting to Marine Chemist's Qualifications.** Only those Marine Chemists who have evidenced the required additional experience, training, and knowledge shall be authorized to issue certificates under the requirements of this chapter. Such Chemists shall receive a special endorsement on the Marine Chemist's Certificate issued them by the National Fire Protection Association.

### 6-2 Definitions.

6-2.1 The definitions set forth in Section 1-5 shall apply to this chapter.

6-2.2 The following additional definitions are applicable:

**Cargo Area.** That part of the ship that contains the cargo containment system and cargo pump and compressor rooms and includes deck areas over the full beam and length of the ship above the foregoing. Where fitted, the cofferdams, ballast, or void spaces at the after end of the aftermost hold space, or the forward end of the forwardmost hold space, are excluded from the cargo area.

**Cargo Containment System.** The arrangement for containment of cargo including, where fitted, a primary and secondary barrier, associated insulation, and any intervening spaces and adjacent structure if necessary for the support of these elements. If the secondary barrier is part of the hull structure, it may be a boundary of the hold space.

**Cryogenic Liquid.** A refrigerated liquefied gas having a boiling point lower than  $-130^{\circ}\text{F}$  ( $-90^{\circ}\text{C}$ ).

### Gas-Dangerous Space.

(a) A space in the cargo area that is not arranged or equipped in an approved manner to ensure that its atmosphere is at all times maintained in a gas-safe condition.

(b) An enclosed space outside the cargo area through which any piping that may contain liquid or gaseous products passes, or within which such piping terminates, unless approved arrangements are installed to prevent any escape of product vapor into the atmosphere of that space.

(c) A cargo containment system and cargo piping.

1. A hold space where cargo is carried in a cargo containment system requiring a secondary barrier.

2. A hold space where cargo is carried in a cargo containment system not requiring a secondary barrier.

(d) A space separated from a hold space described in (c) 1, above, by a single gastight steel boundary.

(e) A cargo pump room and cargo compressor room.

(f) A zone on the open deck, or semienclosed space on the open deck within 9.84 ft (3 m) of any cargo tank outlet, gas or vapor outlet, cargo pipe flange, cargo valve, or entrance and ventilation opening to cargo pump rooms and cargo compressor rooms.

(g) The open deck over the cargo area and 9.84 ft (3 m) forward and aft of the cargo area on the open deck up to a height of 7.88 ft (2.4 m) above the weather deck.

(h) A zone within 7.88 ft (2.4 m) of the outer surface of a cargo containment system where such surface is exposed to the weather.

(i) An enclosed or semienclosed space in which pipes containing products are located.

(j) A compartment for cargo hoses.

(k) An enclosed or semienclosed space having a direct opening into any gas-dangerous space or zone.

**Hold Space.** The space enclosed by the ship's structure in which a cargo containment system is situated.

**Interbarrier Space.** That space between a primary and secondary barrier, whether or not completely or partially occupied by insulation or other material.

**Primary Barrier.** The inner element designed to contain the cargo when the cargo containment system includes two boundaries.

**Secondary Barrier.** The liquid-resisting outer element of a cargo containment system designed to afford temporary containment of any envisaged leakage of liquid cargo through the primary barrier and to prevent the lowering of the temperature of the ship's structure to an unsafe level.

### 6-3 Minimum Requirements.

**6-3.1** All minimum requirements for issuance of the Certificate as set forth in Chapter 2 of this standard shall be met prior to commencement of hot work or entry in spaces that have carried or been exposed to flammable cryogenic liquids or their vapors.

**6-3.2 Special Safety Designation.** The special safety designation "Safe for Repair Yard Entry" applies only to flammable cryogenic liquid carriers and describes vessels whose compartments and spaces have been tested by sampling at remote sampling stations, and results indicate the atmosphere tested to be above 19.5 percent oxygen and less than 10 percent of the lower explosive limit or are inerted in accordance with 2-3.7.

**6-3.3** Vessels whose cargo containment systems have not met the criteria of 6-3.2 may undergo specific limited repairs in locations outside the "gas-dangerous spaces." However, such repairs or alterations shall not be undertaken until a Certificate is obtained. When undergoing such repairs, the vessel shall be berthed in a special location selected with due regard to the hazards of the location and to hazards to adjacent property. Should the Marine Chemist have reason to question the safety of any aspect of the site selection, he shall consult the proper governmental authorities.

**6-3.4** Interbarrier spaces or insulation may contain pockets of cargo vapors that can be released over varying time periods. The Marine Chemist shall inspect for gas concentration and combustible materials before work in or on the boundaries of such places is begun.

**6-3.5** The following information shall be used by the Marine Chemist as a guide for making his inspection:

- (a) Description and schematic arrangement of provisions for inerting cargo tanks, hold spaces, or interbarrier spaces, as applicable
- (b) Description and instruction manual for calibration of the cargo leak detector equipment
- (c) Schematic plan showing locations of leak detector(s) and sampling points
- (d) Schematic plan(s) of liquid and vapor cargo piping
- (e) U.S. Coast Guard Letter of Compliance and Certificate of Fitness for foreign flag vessels or the Certificate of Inspection and Certificate of Fitness for U.S. flag vessels
- (f) The recent history of cargoes handled with special reference to overturn and any pertinent unusual incidents encountered.

### 6-4 Minimum Conditions.

**6-4.1** Minimum conditions that shall prevail prior to the issuance of a Certificate for spaces that have contained or been exposed to flammable cryogenic liquids or their vapors shall be as set forth in Chapter 3, insofar as they are applicable, and as set forth in this section.

**6-4.2** When vessels are undergoing repairs, no venting of cargo tanks, systems, or other spaces that may contain inert gas or flammable vapors shall take place without approval of the Marine Chemist. Any other activity that may similarly alter the atmosphere in the vicinity of the repair work may only be undertaken with such approval.

**6-4.3** Vessels that are capable of burning cargo boil-off as a fuel for their main propulsion system or for other purposes shall be inspected to assure that gas supply lines to the fire room or other spaces have been properly secured, inerted, or otherwise properly treated, prior to repairs to this system.

**6-4.4** Prior to the opening of cargo machinery or systems for repairs, such equipment shall have been adequately purged and ventilated to remove cargo vapor or inert gas.

## Appendix A

*This Appendix is not a part of the requirements of this NFPA document, but is included for information purposes only.*

**A-1-3** In all emergency situations, all necessary precautionary measures should be undertaken as soon as is practical to provide safe conditions satisfactory to the Marine Chemist.

**A-1-4** All applicable regulations, requirements, and standards should be consulted.

**A-2-3.1(a)** It is important that any change from ambient air, either above or below, should be investigated. Even though any change from ambient air is undesirable, the range of 19.5 percent to 22 percent has been selected for reasons of the accuracy of the meter and the precision with which it can be read. The setting of the instrument for 20.8 percent should be made in ambient air under the conditions of temperature and humidity within the compartment or space to be tested.

**A-2-3.1(b)** The level of 10 percent LEL should not be used to determine the toxic level. It is to be used in those instances where a fire hazard would be present, but not a toxic hazard, i.e., propane, methane, etc.

**A-2-3.1(c)** Permissible concentrations can be found in the latest version of *Threshold Limit Values for Chemical Substances*, published by the American Conference of Governmental Industrial Hygienists, the Permissible Exposure Limit Value in Subpart Z of 29 CFR 1910.1000, or the value listed in the Manufacturers Safety Data Sheet (MSDS).

**A-2-3.1(d)** See A-2-3.1(c) above.

A-2-3.4(a) See A-2-3.1(a) above.

Appendix B

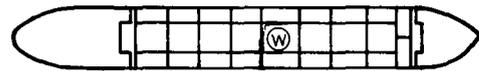
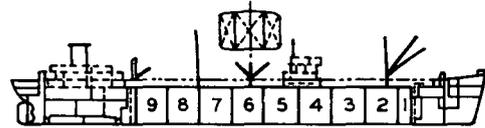
A-2-3.4(b) The terms "lower flammable limit" and "lower explosive limit" are used synonymously. Refer to NFPA 325M, *Fire Hazard Properties of Flammable Liquids, Gases, and Volatile Solids*.

It is important that any change from the levels found by the marine chemist be investigated. A positive change in the LEL would indicate the presence of flammable contaminants in the atmosphere.

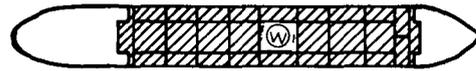
A-2-3.7(a) The improper introduction of an inerting gas can generate sufficient static electricity for ignition. Refer to NFPA 69, *Standard on Explosion Prevention Systems*, for level of oxygen to support combustion.

*This Appendix is not a part of the requirements of this NFPA document, but is included for information purposes only.*

These illustrations are examples of safe conditions discussed in this standard. Although the single plane drawings show horizontal separations only, vertical compartmentation should be similarly treated.



3-1-- SAFE CONDITION OBTAINED ENTIRELY BY CLEANING.



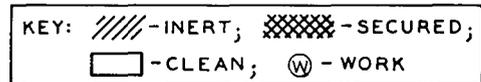
3-2-- SAFE CONDITIONS OBTAINED BY CLEANING AND INERTING.



3-3-- SAFE CONDITION OBTAINED ENTIRELY BY CLEANING AND SECURING.



3-4-- SAFE CONDITIONS OBTAINED BY CLEANING, INERTING AND SECURING.





**Appendix D Referenced Publications**

**D-1** The following documents or portions thereof are referenced within this standard for informational purposes only and thus are not considered part of the requirements of this document. The edition indicated for each reference is the current edition as of the date of the NFPA issuance of this document.

**D-1.1 NFPA Publications.** National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.

NFPA 69-1986, *Standard on Explosion Prevention Systems*

NFPA 325M-1984, *Fire Hazard Properties of Flammable Liquids, Gases, and Volatile Solids.*

**D-1.2 Other Publications.**

*Threshold Limit Values for Chemical Substances and Physical Agents* (latest edition), American Conference of Governmental Industrial Hygienists, P.O. Box 1937, Cincinnati, OH 45201.

US DOL-OSHA, *Permissible Exposure Limit Value.* Subpart Z, 29 CFR 1910.1000, U.S. Government Printing Office, Superintendent of Documents, Washington, DC 20402.

**Index**

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## **SUBMITTING PROPOSALS ON NFPA TECHNICAL COMMITTEE DOCUMENTS**

**Contact NFPA Standards Administration for final date for receipt of proposals  
on a specific document.**

### **INSTRUCTIONS**

**Please use the forms which follow for submitting proposed amendments.  
Use a separate form for each proposal.**

1. For each document on which you are proposing amendment indicate:
  - (a) The number and title of the document
  - (b) The specific section or paragraph.
2. Check the box indicating whether or not this proposal recommends new text, revised text, or to delete text.
3. In the space identified as "Proposal" include the wording you propose as new or revised text, or indicate if you wish to delete text.
4. In the space titled "Statement of Problem and Substantiation for Proposal" state the problem which will be resolved by your recommendation and give the specific reason for your proposal including copies of tests, research papers, fire experience, etc. If a statement is more than 200 words in length, the technical committee is authorized to abstract it for the Technical Committee Report.
5. Check the box indicating whether or not this proposal is original material, and if it is not, indicate source.
6. If supplementary material (photographs, diagrams, reports, etc.) is included, you may be required to submit sufficient copies for all members and alternates of the technical committee.

**NOTE:** The NFPA Regulations Governing Committee Projects in Paragraph 10-10 state: Each proposal shall be submitted to the Council Secretary and shall include:

- (a) identification of the submitter and his affiliation (Committee, organization, company) where appropriate, and
- (b) identification of the document, paragraph of the document to which the proposal is directed, and
- (c) a statement of the problem and substantiation for the proposal, and
- (d) proposed text of proposal, including the wording to be added, revised (and how revised), or deleted.

FORM FOR PROPOSALS ON NFPA TECHNICAL COMMITTEE DOCUMENTS

Mail to: Secretary, Standards Council

National Fire Protection Association, Batterymarch Park, Quincy, Massachusetts 02269

Date 5/18/85 Name John B. Smith Tel. No. 617-555-1212

Address 9 Seattle St., Seattle, WA 02255

Representing (Please indicate organization, company or self) Fire Marshals Assn. of North America

1. a) Document Title: Protective Signaling Systems NFPA No. & Year NFPA 72D

b) Section/Paragraph: 2-7.1 (Exception)

2. Proposal recommends: (Check one)  new text  
 revised text  
 deleted text.

3. Proposal (include proposed new or revised wording, or identification of wording to be deleted):

Delete exception.

4. Statement of Problem and Substantiation for Proposal:

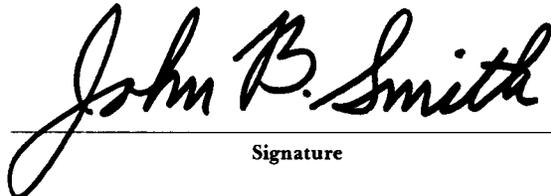
A properly installed and maintained system should be free of ground faults. The occurrence of one or more ground faults should be required to cause a "trouble" signal because it indicates a condition that could contribute to future malfunction of the system. Ground fault protection has been widely available on these systems for years and its cost is negligible. Requiring it on all systems will promote better installations, maintenance and reliability.

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