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NFPA 306 Control of Gas Hazards on Vessels 1984

National Fire Protection Association Batterymarch Park, Quincy, MA 02269

NOTICE

All questions or other communications relating to this document should be sent only to NFPA Headquarters, addressed to the attention of the Committee responsible for the document.

For information on the procedures for requesting Technical Committees to issue Formal Interpretations, proposing Tentative Interim Amendments, proposing amendments for Committee consideration, and appeals on matters relating to the content of the document, write to the Secretary, Standards Council, National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.

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Policy Adopted by NFPA Board of Directors on December 3, 1982

The Board of Directors reaffirms that the National Fire Protection Association recognizes that the toxicity of the products of combustion is an important factor in the loss of life from fire. NFPA has dealt with that subject in its technical committee documents for many years.

There is a concern that the growing use of synthetic materials may produce more or additional toxic products of combustion in a fire environment. The Board has, therefore, asked all NFPA technical committees to review the documents for which they are responsible to be sure that the documents respond to this current concern. To assist the committees in meeting this request, the Board has appointed an advisory committee to provide specific guidance to the technical committees on questions relating to assessing the hazards of the products of combustion.

Statement on NFPA Procedures

This material has been developed under the published procedures of the National Fire Protection Association, which are designed to assure the appointment of technically competent Committees having balanced representation. While these procedures assure the highest degree of care, neither the National Fire Protection Association, its members, nor those participating in its activities accepts any liability resulting from compliance or noncompliance with the provisions given herein, for any restrictions imposed on materials or processes, or for the completeness of the text.

NFPA has no power or authority to police or enforce compliance with the contents of this document and any certification of products stating compliance with requirements of this document is made at the peril of the certifier.

Standard for the

Control of Gas Hazards on Vessels

NFPA 306-1984

1984 Edition of NFPA 306

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 Annual Meeting held May 21-24, 1984 in New Orleans, Louisiana. It was issued by the Standards Council on June 14, 1984, with an effective date of July 5, 1984, and supersedes all previous editions.

The 1984 edition of this standard has been approved by the American National Standards Institute.

Changes other than editorial are indicated by a vertical rule in the margin of the pages on which they appear. These lines are included as an aid to the user in identifying changes from the previous edition.

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, and 1980. The 1984 revision represents a partial revision with those changes noted by a vertical line.

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This list represents the membership at the time the Committee was balloted on the text of this edition. Since that time, changes in the membership may have occurred.

NOTE: Membership on a Committee shall not in and of itself constitute an endorsement of the Association or any document developed by the Committee on which the member serves.

Contents

Standard for the Control of Gas Hazards on Vessels

NFPA 306-1984

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 which 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 which 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, as by being in a sinking condition or by having been 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.

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

Coiled Vessels. Tank vessels using a closed system of heating coils which 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 which has been compressed and/or liquefied for the purpose of transportation and has a Reid vapor pressure exceeding 40 psia (2.76×10^5 Pa).

Hollow Structures. Rudders, rudder stocks, skegs, castings, masts and booms, rails, and other attachments to a vessel which 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 subsection, are limited to the inspection and certification procedures described in this standard and consulting services connected therewith.

Marine Chemist's Certificate. A written statement issued by a Marine Chemist in the form and manner prescribed by this standard. It states the conditions which 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 (9.6×10^4 Pa) or more.

2. Grade B. Any flammable liquid having a Reid vapor pressure under 14 lb (9.6×10^4 Pa) and over 8½ lb (5.9×10^4 Pa).

3. Grade C. Any flammable liquid having a Reid vapor pressure of 8½ lb (5.9×10^4 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. This is dependent on concentration, rate, method, and site of absorption, general state of health, and individual differences.

Repair Classifications.

(a) *Hot Work.* Any construction, alteration, repair, or shipbreaking involving riveting, welding, burning, or similar fire-producing operations. Grinding, drilling, sand or shot blasting, or similar spark-producing operations shall be considered hot work except when circumstances do not necessitate such classification.

(b) *Cold Work.* Any construction, alteration, repair, or shipbreaking which 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 such a manner as 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.

1-6 Standard Safety Designations. The following standard safety designations shall be used where applicable in preparing Marine Chemist's Certificates, cargo tank labels, and other references.

1-6.1 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 by volume; and that,

(b)* Toxic materials in the atmosphere are within permissible concentrations; and that,

(c)* The residues are not capable of producing toxic materials under existing atmospheric conditions while maintained as directed on the Marine Chemist's Certificate.

(d) If any of the conditions of 1-6.1(a), (b), or (c) do not exist then the designation "Not Safe for Workers" shall be used.

1-6.2 Not Safe for Workers. Means that in the compartment or space so designated, the requirements of "Safe for Workers" have not been met.

1-6.3 Safe for Hot Work. Means that in the compartment so designated:

(a) The oxygen content of the atmosphere is at least 19.5 percent by volume, with the exception of inerted spaces or where external hot work is to be performed; and that,

(b)* The concentration of flammable materials in the atmosphere is below 10 percent of the lower flammable limit; and that,

(c) The residues are not capable of producing a higher concentration than permitted by 1-6.3(b) under existing atmospheric conditions in the presence of fire, and while maintained as directed on the Marine Chemist's Certificate; and, further, that,

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

(e) If any of the conditions of 1-6.3(a), (b), (c) or (d) do not exist then the designation "Not Safe for Hot Work" must be used.

1-6.4 Not Safe for Hot Work. Means that in the compartment so designated, the requirements of "Safe for Hot Work" have not been met.

1-6.5 Safe for Shipbreaking. Means that the compartment so designated:

(a) Shall meet the requirements of 1-6.3(a) through (d).

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

1-6.6 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 least.

(b) The space has been flooded with water, provided that any hot work is performed at least 3 ft (.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 flammable limit and such procedure is approved by a Marine Chemist.

(c) The kind of gas and the safe disposal or securing gas inerting media shall be noted on the Marine Chemist's 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.

1-6.7 Inerting for Flammable Compressed Gas. Means that individual pressure tanks with a working pressure of 50 psi (3.45×10^5 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 Marine Chemist's Certificate.

Chapter 2 Minimum Requirements Precedent to the Issuance of Marine Chemist's Certificate — Applicable in All Cases

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 providing for SAFE FOR WORKERS or SAFE FOR HOT WORK.

2-1.1 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 on all calibration checks.

2-1.2 The Marine Chemist's determinations shall include an internal inspection and tests of the spaces to be certified and adjacent spaces thereto.

2-1.3 The Marine Chemist's determination shall include such tests as are appropriate to designations of Section 1-6, and determinations shall 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) Assurance that cargo valves in prescribed areas of work are tagged and secured in such a manner as to avoid accidental opening or operation

(f) Tests of cargo heating coils at the main deck level.

2-1.4 Tanks that have carried Grade E liquids whose flash point is 200°F (93.3°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 1-6.3(d). The remainder of the space and adjacent spaces shall meet the requirements of 1-6.3(a), 1-6.3(b), and 1-6.3(c).

2-2 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 Marine Chemist's Certificate shall be prepared in form and manner prescribed by this standard.

2-2.1 The Certificate shall include the frequency and type of such additional tests, inspections, qualifications, and other instructions as the Marine Chemist specifies.

2-2.2 The Certificate shall state conditions under which the Marine Chemist should be consulted or recalled.

2-2.3 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.

2-3 Issuance of Certificates.

2-3.1 The Marine Chemist's 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.

2-3.1.1 If the Certificate is issued in connection with commencement of repair work, it shall be delivered to, and signed for by, ship repairer or his authorized representative.

2-3.1.2 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.

2-3.2 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.

2-3.3 All Certificates shall be issued within 24 hours prior to the time the prescribed work is commenced, unless otherwise noted on the Marine Chemist's Certificate.

2-4 Responsibility for Obtaining Certificate and Maintaining Conditions.

2-4.1 It is the responsibility of the vessel repairer or shipbreaker 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.

2-4.2 Throughout the course of repairs or alterations it is the responsibility of the vessel repairer or shipbreaker to maintain conditions observed by the Marine Chemist at the time of his inspection and in accordance with 2-2.1, 2-2.2 and 2-2.3.

2-4.3 It is the responsibility of the vessel repairer or shipbreaker 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.

Chapter 3 Mandatory Requirements for Vessels

3-1 Vessels to Be Repaired.

3-1.1 Tank Vessels.

3-1.1.1 Tank vessels may be repaired when cleaned or cleaned and inerted in accordance with the provisions in 3-3.1 or 3-3.2, respectively. A Marine Chemist's Certificate to this effect shall be required. Repairs or alterations involving hot work shall not be undertaken unless specifically authorized by the Marine Chemist's Certificate.

Exception No. l: 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 Marine Chemist's 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 l0 percent of the lower flammable limit shall be kept closed and secured. The securing of the compartments, cofferdams, and other areas shall be noted on the Marine Chemist's Certificate.

Exception No. 5: Tank vessels which proceed to a dry dock or special 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 3-3.3 and 3-3.4.

3-1.2 Requirements for Use of a Special Berthing Area for Cleaning, Gas Freeing, or Inerting.

3-1.2.1 Vessels which have not been cleaned, gas freed, or inerted shall proceed to a special berth, selected and set apart with due regard to the hazards of the location and to hazards to adjacent property.

3-1.2.2 The degassing, cleaning, or inerting of vessels at such special berths shall be carried out in accordance with the requirements of 3-3.1 or 3-3.2 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 special berth until it has been degassed and cleaned or inerted in accordance with the requirements of 3-3.1 or 3-3.2 nor shall such repairs be then undertaken if another vessel, which has not complied with these requirements, is in the special berth at the same time.

3-1.3 Vessels Carrying Flammable Compressed Gas. On any vessels which have carried flammable compressed gas in bulk, no repairs or alterations involving hot work shall be made unless the provisions of 3-1.1.1 have been complied with, provided, however, individual pressure tanks, inerted in accordance with 1-6.7, are considered in a safe condition for such work not directly involving these tanks or their pipelines.

3-1.4 Vessels Other than Tank Vessels.

3-1.4.1 On any vessels which have carried flammable or combustible liquid in bulk as fuel or cargo, or cargoes which 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 1-6 and 1-6.6. Repairs and alterations shall not be undertaken until a Marine Chemist's Certificate is obtained.

3-2 Electric Welding Operations. For all electrical welding operations, grounded 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.

3-3 Minimum Requirements for Issuance of a Marine Chemist's Certificate.

3-3.1 Where a Safe Condition Is to Be Obtained Entirely by Cleaning. (*See Appendix B.*)

3-3.1.1 All steam supplied cargo heater coils shall be made safe by steaming, flushing with water, blowing with air, or inerting.

Exception: 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 4-3.2.

3-3.1.2 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.

3-3.1.3 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.

3-3.1.4 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 1-6.1 and/or 1-6.3, as applicable.

Exception: Spaces covered by 2-1.4.

3-3.1.5 The residue in all compartments concerned (with the exception of tanks containing Grade E liquids whose flash point is 200°F [93.3°C] or above) shall be such that the conditions of 1-6.1 and/or 1-6.3, as applicable, shall be met.

3-3.2 Where a Safe Condition Is to Be Obtained by Both Cleaning and Inerting or Entirely by Inerting. (*See Appendix B.*)

3-3.2.1 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 least. 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 least. A Marine Chemist shall supervise the safe disposal or securing of the inerting medium following completion of the repair work on the inerted space and adjacent spaces.

3-3.2.2 All steam supplied cargo heater coils shall be made safe by steaming, flushing with water, blowing with air, or inerting. 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.

Exception No. 1: Coils in cargo tanks that have been used for chemicals which may react with water or steam shall be cleaned in accordance with the requirements of 4-3.2.

Exception No. 2: 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.

3-3.2.3 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.

3-3.2.4 All access openings to an inerted space shall be appropriately labeled with a warning sign "Not Safe for Workers," which shall remain in place throughout the course of repairs.

3-3.2.5 Compartments or spaces in which internal repairs or alterations are to be undertaken shall be cleaned to comply with the requirements of 3-3.1 and all other spaces (with the exception of tanks containing Grade E liquids with a flash point of 200°F [93.3°C] or above) shall be inerted in accordance with the requirements of 1-6.6 or 1-6.7.

3-3.2.6 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 3-3.2, and all other spaces (with the exception of tanks containing Grade E liquids with a flash point of 200°F [93.3°C] or above) shall be inerted in accordance with the requirements of 1-6.6 or 1-6.7.

3-3.3 Where a Safe Condition Is to Be Obtained Entirely by Cleaning Certain Compartments and by Securing the Other Compartments. (*See Appendix B.*)

3-3.3.1 Nonadjacent spaces containing atmospheres exceeding 10 percent of lower flammable limit shall be closed and secured, and those spaces noted on the Marine Chemist's Certificate.

3-3.3.2 All steam supplied cargo heater coils to the spaces involved shall have been made safe by steaming, flushing with water, blowing with air, or inerting; 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 such a manner as to avoid accidental opening or operation.

Exception No. 1: Coils in cargo tanks that have been used for chemicals which may react with water or steam shall be cleaned in accordance with the requirements of 4-3.2.

Exception No. 2: 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.

3-3.3.3 Compartments or spaces in which internal repairs or alterations are to be undertaken and all adja-

cent compartments, including those diagonally adjacent thereto, shall be cleaned to comply with the applicable requirements of 3-3.1. All other applicable spaces shall be closed and secured in such a manner as to avoid accidental opening or operation.

3-3.4 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.*)

3-3.4.1 All steam supplied cargo heater coils to the spaces involved, except those to the inerted spaces, shall have been made safe by steaming, flushing with water, blowing with air, or inerting; 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 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, and the valves closed and secured in such a manner as to avoid accidental opening or operation.

Exception No. 1: Coils in cargo tanks that have been used for chemicals which may react with water or steam shall be cleaned in accordance with the requirements of 4-3.2.

Exception No. 2: 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.

3-3.4.2 Nonadjacent spaces containing atmospheres exceeding 10 percent of lower flammable limit shall be closed and secured in such a manner as to avoid accidental opening or operation, and those spaces noted on the Marine Chemist's Certificate.

3-3.4.3 Compartments or spaces in which internal repairs or alterations are to be undertaken shall be cleaned to comply with the requirements of 3-3.1 and all adjacent compartments, including those diagonally adjacent thereto, shall be inerted to comply with the applicable requirements of 1-6.6 and all other compartments shall be closed and secured in compliance with 3-3.3.1.

3-3.4.4 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 3-3.1. All adjacent compartments, including those diagonally adjacent thereto, shall be inerted or cleaned to comply with applicable requirements of 3-3.2. All other applicable spaces shall be closed and secured in compliance with 3-3.3.1.

Chapter 4 Additional Requirements for Bulk Chemical Cargo Tanks

4-1 Scope.

4-1.1 This section describes the conditions required before making repairs 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 Section 3-1.

4-1.2 The definitions set forth in Section 1-5 shall also apply to this chapter.

4-2 Minimum Requirements.

4-2.1 All minimum requirements for issuance of the Marine Chemist's Certificate set forth in Chapter 2 of this standard are applicable to spaces that have carried or have been exposed to chemicals in bulk.

4-2.2 The designation "Not Safe for Workers" shall be used for spaces that have carried material of unknown chemical hazards. See 2-2.3.

4-2.3 Results of any chemical hazard tests may be noted on the Marine Chemist's Certificate.

4-3 Minimum Conditions.

4-3.1 Minimum conditions which shall prevail prior to the issuance of a Marine Chemist's Certificate for spaces that have contained chemicals in bulk shall be as set forth in Section 3-3, insofar as they are applicable, and as set forth in this section.

4-3.2 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.

4-3.3 Compartments having carried chemicals in bulk and which are to be cleaned shall be so cleaned that the atmosphere in those compartments is in accordance with 1-6.1 and 1-6.3 as applicable.

4-3.4 The residues in the compartments concerned shall be such that the conditions of 1-6.1 and 1-6.3, as applicable, will be met.

Chapter 5 Additional Requirements for Flammable Cryogenic Liquid Carriers

5-1 Scope.

5-1.1 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

making repairs in spaces that have carried or have been exposed to flammable cryogenic liquid cargoes in their liquid or vapor form.

5-1.2 This chapter supplements the factors to be considered prior to issuance of the Marine Chemist's Certificate in accordance with Section 2-1.

5-1.3 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.

5-2 Definitions.

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

5-2.2 The following additional definitions are applicable:

Cargo Area. That part of the ship which 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 colder than -130°F (-90°C).

Gas-Dangerous Space:

(a) A space in the cargo area which 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 which 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 gas-tight 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 entrances and ventilation openings 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 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.

5-3 Minimum Requirements.

5-3.1 All minimum requirements for issuance of the Marine Chemist's 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.

5-3.2 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 flammable limit or are inerted in accordance with 1-6.6.

5-3.3 Vessels whose cargo containment systems have not met the criteria of 5-3.2 may undergo specific limited repairs in locations outside the "gas-dangerous spaces." However, such repairs or alterations shall not be undertaken until a Marine Chemist's Certificate is obtained.

5-3.3.1 When undergoing repairs in accordance with 5-3.3 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.

5-3.4 Interbarrier spaces or insulation may contain pockets of cargo vapors which 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.

5-3.5 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 outturn and any pertinent unusual incidents encountered.

5-4 Minimum Conditions.

5-4.1 Minimum conditions which shall prevail prior to the issuance of a Marine Chemist's Certificate for spaces that have contained or been exposed to flammable cryogenic liquids or their vapors shall be as set forth in Section 3-3, insofar as they are applicable, and as set forth in this section.

5-4.2 When vessels are undergoing repairs, no venting of cargo tanks, systems, or other spaces which may contain inert gas or flammable vapors shall take place without approval of the Marine Chemist. Any other activity which may similarly alter the atmosphere in the vicinity of the repair work may only be undertaken with such approval.

5-4.3 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.

5-4.4 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 practical to provide safe conditions satisfactory to the Marine Chemist.

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

A-1-6.1(b) Refer to *Threshold Limit Values for Chemical Substances and Physical Agents* (latest edition), American Conference of Governmental Industrial Hygienists, P.O. Box 1937, Cincinnati, OH 45201.

A-1-6.1(c) See A-1-6.1(b) above.

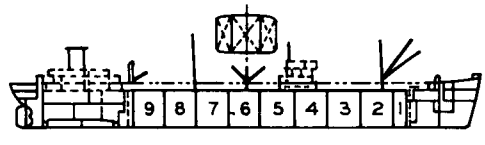
A-1-6.3(b) The terms "lower flammable limit" and "lower explosive limit" are used synonymously. Refer to NFPA 325M-1984, *Fire Hazard Properties of Flammable Liquids, Gases and Volatile Solids*, National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.

A-1-6.6(a) The improper introduction of an inerting gas can generate sufficient static electricity for ignition. Refer to NFPA 69-1978, *Standard on Explosion Prevention Systems*, National Fire Protection Association, Batterymarch Park, Quincy, MA 02269 for level of oxygen to support combustion.

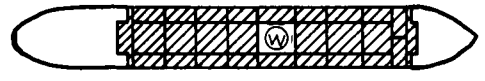
Appendix B

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.



3-3.1 -- SAFE CONDITION OBTAINED ENTIRELY BY CLEANING.



3-3.2 -- SAFE CONDITIONS OBTAINED BY CLEANING AND INERTING.

3-3.3 -- SAFE CONDITION OBTAINED ENTIRELY BY CLEANING AND SECURING.

3-3.4 -- SAFE CONDITIONS OBTAINED BY CLEANING, INERTING AND SECURING.

KEY: ////-INERT; XXXX-SECURED; □-CLEAN; Ⓦ-WORK

Appendix C

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

MARINE CHEMIST CERTIFICATE

SERIAL NO. A 00000

Survey Requested by	Vessel Owner or Agent	Date
Vessel	Type of Vessel	Specific Location of Vessel
Last Three (3) Cargoes	Test Method	Time Survey Completed

In the event of any physical or atmospheric changes adversely affecting the STANDARD SAFETY DESIGNATIONS assigned to any of the above spaces, or if in any doubt, immediately stop all work and contact the undersigned Marine Chemist.

QUALIFICATIONS: Transfer of ballast or manipulation of valves or closure equipment tending to alter conditions in pipe lines, tanks or compartments subject to gas accumulation, unless specifically approved in this Certificate, requires inspection and endorsement or reissue of Certificate for the spaces so affected. All lines, vents, heating coils, valves, and similarly enclosed appurtenances shall be considered "not safe" unless otherwise specifically designated.

STANDARD SAFETY DESIGNATIONS (partial list, paraphrased from NFPA 306 Subsections 1-6.1 through 1-6.4, and Subsection 5-3.2).

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 by volume; and that, (b) toxic materials in the atmosphere are within permissible concentrations; and that, (c) the residues are not capable of producing toxic materials under existing atmospheric conditions while maintained as directed on the Marine Chemist's Certificate.

NOT SAFE FOR WORKERS: Means that in the compartment or space so designated, the requirements of Safe for Workers have not been met.

SAFE FOR HOT WORK: Means that in the compartment so designated: (a) oxygen content of the atmosphere is at least 19.5 percent by volume, with the exception of inerted spaces or where external hot work is to be performed; and that, (b) the concentration of flammable materials in the atmosphere is below 10 percent of the lower flammable limit; and that, (c) the residues are not capable of producing a higher concentration than permitted by (b) above under existing atmospheric conditions in the presence of fire, and while maintained as directed on the Marine Chemist's Certificate; and further, that, (d) all adjacent spaces containing or having contained flammable or combustible materials have been cleaned sufficiently to prevent the spread of fire, or are satisfactorily inerted, or, in the case of fuel tanks or lube oil tanks, or engine room or fire room bilges, have been treated in accordance with the Marine Chemist's requirements.

NOT SAFE FOR HOT WORK: Means that in the compartment so designated, the requirements of Safe for Hot Work have not been met.

SAFE FOR REPAIR YARD ENTRY: Means that the compartments and spaces of the flammable cryogenic liquid carrier so designated: (a) 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 flammable limit, or (b) are inerted.

CHEMIST'S ENDORSEMENT. This is to certify that I have personally determined that all spaces in the foregoing list are in accordance with NFPA 306 Control of Gas Hazards on Vessels and have found the condition of each to be in accordance with its assigned designation.

"The undersigned acknowledges receipt of this Certificate under Section 2-3 of NFPA 306 and understands conditions and limitations under which it was issued."

This Certificate is based on conditions existing at the time the inspection herein set forth was completed and is issued subject to compliance with all qualifications and instructions

Signed _____ Signed _____

Name Company Date Marine Chemist Certificate No

NOTE THIS CERTIFICATE IS VALID ONLY ON MARINE VESSELS

20M-5-84-UDP

VESSEL POSTING

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