NFPA® 306

Standard for the Control of Gas Hazards on Vessels

2024 Edition

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An International Codes and Standards Organization

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NFPA® 306

Standard for the

Control of Gas Hazards on Vessels

2024 Edition

This edition of NFPA 306, *Standard for the Control of Gas Hazards on Vessels*, was prepared by the Technical Committee on Gas Hazards. It was issued by the Standards Council on April 23, 2023, with an effective date of May 13, 2023, and supersedes all previous editions.

This edition of NFPA 306 was approved as an American National Standard on May 13, 2023.

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, adopted in 1962, and amended in 1963, 1969, 1971, 1972, 1975, 1980, and 1984.

In 1988, a complete revision was prepared by the committee. It added 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.

The 1993 edition contained amendments to the 1988 edition.

The 1997 edition, which marked the 75th year for these requirements, incorporated a new standard safety designation that reflected a common approach to an industry practice. That new designation was also supported by other changes to the document, including expanded inspection of vessel piping systems.

The 2001 edition incorporated a revised standard safety designation, and several changes that reflect safe, commonly used industry practices. Several new definitions were also included. For the first time in this document, the well-established relationship between the Marine Chemist and the competent person [as defined by US Department of Labor, Occupational Safety and Health Administration (OSHA) regulations], and the frequency of retesting confined spaces, was provided.

The 2003 edition was completed on an expedited schedule to further revise requirements in the standard that must complement those shipyard safety requirements defined by OSHA. The committee clarified the standard and the Marine Chemist's role by further defining the atmospheric hazards associated with safe entry and hot work as the standard's primary focus. The standard also clarified the intent for defining *permissible concentrations* by stating that the most conservative value for the various exposure limits should be used.

The 2009 edition included changes to several definitions within the standard. The term *vessel* was expanded to apply to special purpose floating structures such as offshore drilling, production, and/or storage vessels. Definitions for *contract employer*, *host employer*, and *multiemployer workplace* were added to the standard. The committee amended the definition of *adjacent spaces* to include areas affected by hot work and also clarified requirements for testing and inspecting spaces adjacent to hot work operations. The committee also made several revisions to the requirements for obtaining a Marine Chemist Certificate and maintaining the conditions on the Certificate.

For the 2014 edition, the Technical Committee on Gas Hazards reorganized the requirements to reflect the actual work process that is involved when a marine vessel goes from normal operating status to the point where a Marine Chemist's Certificate is obtained and repair work can begin. Over

the years, Marine Chemists have become recognized experts in fire prevention during vessel repairs, which has led to repair contractors calling on them to provide services or consultation for areas and spaces on a vessel where the chemist is not necessarily required by either OSHA or US Coast Guard regulations. Those consultations can include tests and inspections in accommodation areas, storage spaces, and auxiliary equipment rooms. New provisions were added that address this evolution of the NFPA Certificated Marine Chemist's role in ship repair. In addition, the Technical Committee established a maximum acceptable concentration of combustible or flammable gas of less than 10 percent of the lower explosive limit (LEL) in all spaces adjacent to hot work, and incorporated information from an OSHA compliance directive for cargo, passenger, and miscellaneous vessels explaining that a Marine Chemist's Certificate is necessary any time hot work is closer than 7.6 m (25 ft) to an adjacent tank that contains a liquid with a flashpoint at or below 65.6°C (150°F). The 2014 edition also provided new explanatory material in Annex A about how frequently a space must be checked by the shipyard's competent person after a certificate has been posted. This guidance stresses the importance of maintaining safe conditions within confined spaces and provides minimum reinspection and testing criteria to achieve this objective.

In the 2019 edition, the technical committee revised the scope and purpose of NFPA 306 to align more accurately with US Coast Guard and OSHA regulations that affect waterfront facilities, shipyards, and facilities engaged in shipyard employment. Accordingly, a new definition for the term *waterfront facility* from US Coast Guard regulation 33 CFR 6.01-4 was added to the standard. The hazards associated with hot work in, on, and adjacent to ammunition spaces were addressed with references provided for applicable publications issued by the US Navy, Naval Sea Systems Command (NAVSEA). The committee clarified that the determination of conditions for the purpose of issuing a Marine Chemist's Certificate must exist at the time of the Marine Chemist's tests and inspection. The standard mandated that if a space is designated "Inerted" it must also be designated "Not Safe for Workers." Depending on the scope of work, it must designate "Safe for Hot Work" or "Safe for Limited Hot Work" as applicable. To emphasize that a change of the conditions that affect the safety of work authorized by a Marine Chemist's Certificate needs to be communicated to the Marine Chemist, the Marine Chemist's name and a contact number were required to be noted on the certificate. With the growth of marine vessels fueled by liquefied natural gas (LNG), Chapter 9 was revised to apply to both flammable cryogenic liquids that were carried as cargo and/or as fuel.

The most significant change to the 2024 edition of the standard concerns the Standard Safety Designation, Safe for Shipbreaking. The structural integrity and complexity of ships, barges, offshore oil platforms, and other marine vessels make shipbreaking a challenging process. It involves many safety, health, and environmental issues. The committee determined there was a need to improve the processes used in shipbreaking (ship recycling, dismantling, or disposal) to ensure the safety and health of the workers involved in these operations. In addition to cleaning and inspection requirements for vessels that are so designated, the duration of a Marine Chemist's Certificate for shipbreaking is restricted to a maximum of 3 days.

Other revisions include the addition of a chapter that provides minimum requirements for a Marine Chemist to use to verify that a land-side confined space within a shipyard, repair facility, marine terminal, or other waterfront facility is safe for workers to enter and perform work (e.g., hot work). The cleaning requirements for hollow structures and spaces that contain soft and greasy preservative coatings are specified in this edition, as are the criteria to be used when the Marine Chemist assesses the integrity and safety of heating coils. The requirements for inerting land-side tanks have been revised to be consistent with the inerting operations of the tanks that are on ships and barges. Revisions to this edition also address how information shall be documented on a Marine Chemist's Certificate.

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Committee Scope: This Committee shall have primary responsibility for documents on the prevention of fire and explosion of flammable vapors in compartments or in spaces on board vessels and within shipyards and on the conditions that must exist in those compartments or spaces in order that workers can safely enter them and perform work.

Contents

NFPA 306

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NOTICE: An asterisk (*) following the number or letter designating a paragraph indicates that explanatory material on the paragraph can be found in Annex A.

A reference in brackets [ ] following a section or paragraph indicates material that has been extracted from another NFPA document. Extracted text may be edited for consistency and style and may include the revision of internal paragraph references and other references as appropriate. Requests for interpretations or revisions of extracted text shall be sent to the technical committee responsible for the source document.

Information on referenced publications and extracted publications can be found in Chapter 2 and Annex F.

Chapter 1 Administration

1.1 Scope.

1.1.1 This standard applies to vessels that carry or burn as fuel, flammable or combustible liquids, flammable compressed gases, flammable cryogenic liquids, chemicals in bulk, or other products capable of creating a hazardous condition.

1.1.2 This standard applies to vessels while in the United States, including its territories and possessions, both within and outside of yards and waterfront facilities for ship construction, ship alteration, ship repair, or shipbreaking.

1.1.3 This standard describes the conditions and procedures for determining such conditions required before a space can be entered or before work can be started, continued, or started and continued on any vessel under construction, alteration, or repair, or on any vessel awaiting shipbreaking.

1.1.4 This standard applies specifically to those spaces and the associated pipelines on vessels that are subject to concentrations of combustible, flammable, and toxic liquids, vapors, gases, and chemicals as herein described.

1.1.4.1 This standard is also applicable to those spaces on vessels that might not contain sufficient oxygen to permit safe entry.

1.1.4.2 When requested, the Marine Chemist shall apply this standard to other spaces to ensure and promote safe working conditions.

1.1.5 This standard applies to cold work, application or removal of protective coatings, and hot work involving riveting, welding, burning, or similar fire-producing and/or spark-producing operations.

1.1.6 This standard applies to land-side confined spaces, located within the boundaries of a waterfront facility, shipyard, or ship repair facility, and related shipyard employment — regardless of geographic location, whether stationary or mobile — including, but not limited to, the following:

(1) Underground and aboveground storage tanks
(2) Other hollow structures such as tank trucks, railroad tank cars, power plant fuel tanks, storage tanks, dip and laundry tanks, vaults, and tunnels
(3) Other spaces that could contain dangerous atmospheres

1.1.7 This standard applies to Marine Chemists performing activities related to inspection and certification procedures described in this standard and consulting services connected therewith on board any vessel and within the boundaries of a waterfront facility, shipyard, or ship repair facility.

1.1.8* This standard does not apply to physical, biological, or radiological hazards on a vessel, in vessel sections, or in a waterfront facility, shipyard, or ship repair facility.

1.1.8.1 For the purposes of this standard, physical hazards do not include fire and explosion hazards.

1.2 Purpose. The purpose of this standard is to provide minimum requirements and conditions for use in determining that a space or area located within the boundaries of a waterfront facility, shipyard, or ship repair facility and related shipyard employment regardless, of geographic location, is safe for entry or work.

1.3* Emergency Exception. Nothing in this standard shall be construed as prohibiting the Marine Chemist from allowing the immediate drydocking or emergency repair of a vessel whose safety is imperiled or that presents the potential of a serious release, discharge, or disbursement into the environment of combustible, flammable, or toxic liquids, vapors, gases, or solid chemicals (the vessel is sinking or is seriously damaged), making it impracticable to clean and to gas free in advance. This emergency exception shall be subject to the approval of any authority having jurisdiction.

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 Marine Chemists is directed to the rules and regulations for tank vessels in 46 CFR 35, "Operations," and other rules and regulations for vessel inspection of the US Coast Guard and the Occupational Safety and Health Administration standards (OSHA) of the US Department of Labor in 29 CFR 1915, "Occupational Safety and Health Standards for Shipyard Employment," which prescribe an inspection prior to making repairs involving hot work and prior to entering spaces where oxygen deficiency can exist. Those standards provide, under the conditions stated therein, for inspection by a Marine

Chemist certified by the National Fire Protection Association or, alternatively, for inspection by certain other persons.

Chapter 2 Referenced Publications

2.1 General. The documents or portions thereof listed in this chapter are referenced within this standard and shall be considered part of the requirements of this document.

2.2 NFPA Publications. National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02169-7471.

NFPA 312, *Standard for Fire Protection of Vessels During Construction, Conversion, Repair, and Lay-Up,* 2021 edition.

"Rules for the Certification and Recertification of Marine Chemists," as amended 2021.

2.3 Other Publications.

2.3.1 US Government Publications. US Government Publishing Office, 732 North Capitol Street, NW, Washington, DC 20401-0001.

Title 29, Code of Federal Regulations, Part 1915, "Occupational Safety and Health Standards for Shipyard Employment."

Title 46, Code of Federal Regulations, Part 35, "Operations."

2.3.2 Other Publications.

Merriam-Webster's Collegiate Dictionary, 11th edition, Merriam-Webster, Inc., Springfield, MA, 2003.

2.4 References for Extracts in Mandatory Sections.

NFPA 55, *Compressed Gases and Cryogenic Fluids Code,* 2023 edition.

Chapter 3 Definitions

3.1 General. The definitions contained in this chapter shall apply to the terms used in this standard. Where terms are not defined in this chapter or within another chapter, they shall be defined using their ordinarily accepted meanings within the context in which they are used. *Merriam-Webster's Collegiate Dictionary*, 11th edition, shall be the source for the ordinarily accepted meaning.

3.2 NFPA Official Definitions.

3.2.1* Authority Having Jurisdiction (AHJ). An organization, office, or individual responsible for enforcing the requirements of a code or standard, or for approving equipment, materials, an installation, or a procedure.

3.2.2 Shall. Indicates a mandatory requirement.

3.2.3 Standard. An NFPA standard, the main text of which contains only mandatory provisions using the word "shall" to indicate requirements and that is in a form generally suitable for mandatory reference by another standard or code or for adoption into law. Nonmandatory provisions are not to be considered a part of the requirements of a standard and shall be located in an appendix, annex, footnote, informational note, or other means as permitted in the NFPA manuals of style. When used in a generic sense, such as in the phrases "standards development process" or "standards development activities," the term "standards" includes all NFPA standards, including codes, standards, recommended practices, and guides.

3.3 General Definitions.

N **3.3.1 Aboveground Storage Tank.** A tank located above ground used to contain flammable, combustible, or toxic liquids or vapors.

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

3.3.3 Barge. Any vessel not equipped with a means of self-propulsion.

N **3.3.4 Belowground Storage Tank.** A tank located below ground level used to contain flammable, combustible, or toxic liquids or vapors.

N **3.3.5 Blanking.** The absolute closure of a pipe by fastening a solid flat plate (designed to retain anticipated pressure) across the opening, using a gasket, and fully engaged bolts in all flange holes.

N **3.3.6 Blinding.** The absolute closure of the open end of a pipe by fastening a solid flat plate (designed to retain anticipated pressure) across the opening, using a gasket, and fully engaged bolts in all flange holes.

3.3.7 Certificate. See 3.3.33, Marine Chemist's Certificate.

3.3.8 Chemical. Any compound, mixture, or solution in the form of a solid, liquid, or gas that might 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.

3.3.9 Coiled Vessels. Tank vessels using a closed system or heating coils that use thermal oil as the heating medium.

3.3.10 Cold Work. Any work which does not involve riveting, welding, burning, or other fire- or spark-producing operations.

3.3.11* Combustible Liquid. Any liquid that has a closed-cup flash point at or above 37.8°C (100°F).

3.3.12* Combustible Material. Material made of or surfaced with wood, compressed paper, plant fiber, plastic, or other material that will ignite and burn, whether flame-proofed or not, or whether plastered or unplastered.

3.3.13* Competent Person. A person who is designated in writing by their employer in accordance with 29 CFR 1915.7.

3.3.14 Contract Employer. An employer of welders, burners, grinders, painters, cleaners, or other workers who perform work under the direction of a host employer at a multi-employer worksite.

Δ **3.3.15 Cryogenic Fluid.** A fluid with a boiling point lower than –90°C (–130°F) at an absolute pressure of 101.3 kPa (14.7 psi). [**55,** 2023]

N **3.3.16 Cryogenic Liquid.** See 3.3.15, Cryogenic Fluid.

N **3.3.17 Double Block and Bleed.** The positive closure of a pipe by closing and locking or tagging two in-line valves, and by opening and locking or tagging a drain or vent valve in the line or pipe between the two closed valves.

N **3.3.18* Energy Isolating Device.** A mechanical device that physically prevents the transmission or release of energy.

N **3.3.19 Energy Source.** A source of electrical, mechanical, hydraulic, pneumatic, chemical, thermal, or other form of energy.

3.3.20 Facility. A shoreside location, such as a shipyard, cleaning plant, naval base, dock, or pier complex, that is under the ownership or control of the same party and has the same continuous shoreline under their ownership or operation.

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

3.3.22* Flammable Cryogenic Liquid Area. That part of the vessel that contains the flammable cryogenic liquid containment system, pump room, and compressor room and that includes the deck areas over both the full beam and the length of the vessel located above the aforementioned.

3.3.23* Flammable Cryogenic Liquid Containment System. The arrangement for containment of cargo or fuel including, where applicable, a primary and secondary barrier, associated insulation, and any intervening spaces and adjacent structures if necessary for the support of these elements.

3.3.24 Flammable Cryogenic Liquid Hold Space. The space enclosed by the vessel's structure in which a cargo containment system is situated.

3.3.25* Flammable Liquid. A liquid that has a closed-cup flash point that is below 37.8°C (100°F) and a maximum vapor pressure of 2068 mm Hg (40 psia) at 37.8°C (100°F).

N **3.3.26 Floating Roof.** A structure used to cover a flammable or combustible or toxic product in a tank to prevent vapor from escaping to the atmosphere.

3.3.27 Hollow Structures. A structure that is enclosed and not open to the atmosphere, including, but not limited to, the following: rudders, rudder stocks, skegs, castings, masts and booms, rails, lapped plates, and other hollow attachments on a vessel or in a shipyard that enclose a void space.

3.3.28 Host Employer. An employer who is in charge of coordinating work or who hires other employers to perform work at a multi-employer worksite.

Δ **3.3.29* Hot Work.** Any activity involving any of the following: riveting, welding, burning, the use of powder-actuated tools or similar fire-producing operations; any operation that raises the temperature of the work piece equal to or greater than 204°C (400°F); or grinding, drilling, abrasive blasting, the use of nonintrinsically safe tools, spark-producing tools, or similar operations in the presence of or against the accumulations of readily combustible materials, flammable gases, or flammable or combustible liquids or vapors when the atmosphere is equal to or exceeds 10 percent of the LEL.

3.3.30 Interbarrier Space. That space associated with a flammable cryogenic liquid tank between a primary and secondary barrier, whether or not completely or partially occupied by insulation or other material.

N **3.3.31 Lead-Free Tank.** A tank that has: (1) previously contained a leaded product in its last three loadings, (2) been cleaned to meet the requirements of Section 5.1, and (3) been tested for lead in air and found to have an internal atmosphere below the applicable limit for exposure to organic lead.

3.3.32* Marine Chemist. The holder of a valid certificate issued by the National Fire Protection Association in accordance with the "Rules for the Certification and Recertification of Marine Chemists," establishing the person's qualifications to determine whether construction, alteration, repair, or shipbreaking of vessels can be undertaken with safety.

3.3.33 Marine Chemist's Certificate (Certificate). A document issued by a Marine Chemist, on a form authorized by the National Fire Protection Association, stating the conditions that the Marine Chemist found at the time of inspection. *(See Annex C for an example.)*

3.3.34 Multi-Employer Worksite. A workplace where there is a host employer and at least one contract employer.

N **3.3.35 Pontoon.** A void space used to provide flotation for a floating roof.

3.3.36 Primary Barrier. The inner element of a flammable cryogenic liquid tank designed to contain the flammable cryogenic liquid when the containment system includes two boundaries.

3.3.37* Requester. A host employer or contract-employer noted at the top of the Marine Chemist's Certificate in the space, "Survey Requested by," who is responsible for maintenance of safe conditions as noted on the Marine Chemist's Certificate.

N **3.3.38* Roof Seal.** A seal around the floating roof used to contain or reduce product vapors from escaping to the atmosphere.

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

3.3.40* Secured. Closed in a manner to prevent opening or operation.

3.3.41 Ship. Any vessel propelled by power or sail.

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

3.3.43 Special Endorsement for Vessels Having Flammable Cryogenic Liquid Fuel or Cargo (FCL Endorsement). An endorsement to a Marine Chemist's Certificate in accordance with the *Rules for the Certification and Recertification of Marine Chemists,* establishing that the holder is qualified to determine whether construction, alteration, repair, or shipbreaking of vessels that carry flammable cryogenic liquid as cargo and/or use flammable cryogenic liquid as fuel can be undertaken with safety.

N **3.3.44* Subject Space.** A space or compartment where work is intended or will occur either within or on the boundary of the space.

3.3.45 Tank Vessel. Any vessel especially constructed or converted to carry liquid bulk cargo in tanks.

3.3.46 Toxic. A property of any chemical that has the capacity to produce adverse health effects or injury to workers, which is dependent on concentration, duration of exposure, and route of entry.

3.3.47* Vessel. Every description of watercraft or other artificial contrivance used or capable of being used as a means of transportation on water, including special purpose floating structures not primarily designed for or used as a means of transportation on water.

3.3.48 Visual Inspection. The physical survey of the space or compartment and surroundings in order to identify potential atmospheric and fire hazards.

3.3.49 Waterfront Facility. All piers, wharves, docks, or similar structures to which vessels might be secured and all naval yards, stations, and installations, including ranges; areas of land, water, or land and water under and in immediate proximity to them; buildings on them or contiguous to them; and equipment and materials on or in them.

Chapter 4 Vessels Required to Have Marine Chemist's Certificate

4.1 Tank Vessels. Tank vessels shall be permitted to be repaired in accordance with the provisions of Chapter 5. 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 shall be permitted to enter a repair yard — while afloat or in dry dock — for examination, provided that all bulk cargo compartments and cofferdams are kept closed.

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

Exception No. 3: Tank vessels shall be permitted to enter a repair yard — while afloat or in dry dock — for cold work to be performed outside of the vessel on the propeller, tailshaft, or rudder, or for hot 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 shall be permitted to enter a repair yard — while afloat or in dry dock — for work within boiler and machinery spaces and 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 other areas where the flammable content of the atmosphere is above 10 percent of the LEL shall be kept closed and secured. The securing of the compartments, cofferdams, and other areas shall be noted on the Certificate.

4.2 Vessels Other Than Tank Vessels.

Δ **4.2.1** On vessels that have carried flammable or combustible liquid in bulk as fuel or cargo, or that have carried cargoes that can produce hazardous atmospheres (including, but not limited to, those caused by decomposition or reaction with oxygen from the atmosphere), no repairs involving hot work shall be made in or on the external boundaries (e.g., shell, tank top, or deck) of cargo tanks, fuel tanks, oil pipelines, heating coils or hollow structures, and machinery spaces until a Certificate is obtained.

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4.3 Military Unique Vessels (i.e., US 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 the compartment where hot work is conducted or isolated from hot work.

4.3.2.1 Adjacent spaces containing ammunition shall be treated in accordance with the Marine Chemist's requirements.

4.3.2.2 Adjacent spaces containing flammable or combustible liquids shall be treated in accordance with the Marine Chemist's requirements and acknowledged on the Certificate.

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 tanks, confined spaces, and machinery spaces in which internal repairs or alterations are to be undertaken shall be cleaned to comply with the requirements of either 7.1.1 or 7.1.3.

Δ **4.3.4.1** For repair or alteration involving hot work, the spaces or compartments described in 4.3.4 shall meet the requirements of 7.1.4, 7.1.6, or 5.1.3.

N **4.3.4.2** All adjacent spaces or compartments shall be either cleaned to meet the requirements of 7.1.4, 7.1.6, or 5.1.3; or permitted to meet the requirements of 7.1.8.

4.3.4.3 The adjacent spaces described in 4.3.4.2 shall be permitted to be secured in accordance with the Marine Chemist's requirements and acknowledged on the Certificate.

4.3.5 All tanks, confined spaces, and machinery spaces in which external repairs or alterations are to be undertaken either shall be cleaned to comply with the requirements of 7.1.4 or 7.1.6 or shall be inerted to comply with the requirements of 7.1.8.

4.3.5.1 All adjacent compartments shall be cleaned to meet the requirements of 7.1.4, 7.1.6, or 5.1.3 or shall be permitted to be inerted to meet the requirements of 7.1.8.

4.3.5.2 The adjacent spaces described in 4.3.5.1 shall be permitted to be secured in accordance with the Marine Chemist's requirements and acknowledged on the Certificate.

4.3.6 All other types of military vessels shall be treated in accordance with Section 4.2.

4.4 Vessels in Lay-Up. A tank vessel in lay-up shall be treated in accordance with Section 4.1 and NFPA 312. No repairs or alterations involving hot work shall be made unless authorized by the Marine Chemist in accordance with the provisions of 7.1.10.

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 Section 4.1 have been complied with, provided individual pressure tanks (inerted in accordance with 7.1.9) are considered in a safe condition for such work not directly involving these tanks or their pipelines.

Δ **4.6 Land-Side Storage Tanks.** In shipyards and waterfront facilities, all above- and belowground storage tanks, rail cars, tank trucks, fuel tanks, storage tanks, dip and laundry tanks,

vaults and tunnels, or other spaces that could contain dangerous atmospheres shall be considered vessels requiring Marine Chemist certification.

Chapter 5 Preparing Vessels by the Vessel Owner, Operator, or Repairer, for Issuance of a Marine Chemist's Certificate Involving Hot Work

5.1* Where a Safe Condition Is to Be Obtained Entirely by Cleaning. *[See Figure B.1, part (a).]*

5.1.1 All cargo pumps, transfer pumps, associated transfer lines, inert gas lines, crude oil wash lines, piped cargo fire-extinguishing lines, vapor control and recovery lines, and vent lines to the spaces involved in the scope of work shall have been flushed with water or blown with steam or air.

5.1.2 Compartments concerned shall be cleaned so that the atmosphere in all cargo compartments and adjacent spaces, including those diagonally adjacent to the cargo compartments, is in accordance with 7.1.1, 7.1.4, or 7.1.6, or with both 7.1.1 and 7.1.6, or with both 7.1.1 and 7.1.4, as applicable.

5.1.3 Partial Cleaning for Limited Hot Work.

5.1.3.1 Tanks or compartments containing combustible residues or soft and greasy preservative coatings shall be permitted to be partially cleaned for limited hot work as described by 5.1.3.2, 5.1.3.3, and 5.1.3.4.

5.1.3.1.1 Areas to be cleaned shall be both of the following:

(1) Cleaned a sufficient distance from the hot work to prevent the spread of fire
(2) Cleaned in such a manner as to prevent sparks or slag from the hot work operations from being thrown or dropped into combustible residues or soft and greasy preservative coatings

5.1.3.1.2 A fire watch shall not be used in lieu of cleaning to establish a safe condition.

5.1.3.1.3 The specific location and type of hot work shall be listed on the Marine Chemist's Certificate.

5.1.3.2 Tanks or compartments that have not been washed or steamed, have residues or soft and greasy preservative coatings whose flash point is 82.2°C (180°F) or above, and are free of flowing residues or coatings shall be permitted to be partially cleaned for limited hot work.

5.1.3.2.1 The area to be cleaned shall meet the requirements of 7.1.4.

5.1.3.2.2 The flash point of the residues or soft and greasy preservative coatings shall be verified by the Marine Chemist prior to issuing a Certificate.

5.1.3.3* Tanks or compartments that have been washed or steamed as thoroughly as practicable and are free of flowing residues or soft and greasy preservative coatings shall be permitted to be partially cleaned for limited hot work.

5.1.3.3.1 The area to be cleaned shall meet the requirements of 7.1.4.

5.1.3.3.2 An ignitibility test shall be performed on the residues or preservative coatings prior to issuing a Certificate.

5.1.3.4 When subject spaces are cleaned to meet 5.1.3.2 or 5.1.3.3, adjacent spaces shall be permitted to be cleaned to meet the requirements of 5.1.3.2 or 5.1.3.3, provided the residues or preservative coatings meet the requirements of 5.1.3.2.

5.1.4 The residues or preservative coatings in all compartments concerned (with the exception of tanks described in 5.1.3) shall be such that the conditions of either 7.1.1 or 7.1.4, or both 7.1.1 and 7.1.4, as applicable, shall be met.

5.2* Where a Safe Condition Is to Be Obtained by Both Cleaning and Inerting or Entirely by Inerting. *[See Figure B.1, parts (b) and (c).]*

5.2.1 The Marine Chemist shall do both of the following:

(1) Approve the use of the inerting medium.
(2) Personally supervise the introduction of the inerting medium into the space to be inerted, except in situations where an inerting medium has been introduced prior to the arrival of the Marine Chemist at the vessel, shipyard, ship repair facility, or waterfront facility.

5.2.1.1 A Marine Chemist, in all cases, shall personally conduct tests to determine that the oxygen content of the inerted space is at or below 6 percent or 50 percent of the amount required to support combustion, whichever is less.

5.2.1.2 The Marine Chemist shall be readily available during the entire period of work and shall determine and direct that the oxygen level in the inerted space is at or below 6 percent or 50 percent of the amount required to support combustion, whichever is lower.

5.2.1.3 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.

5.2.2 Cargo pumps, cargo lines, and crude oil wash lines involved in the scope of the work shall have been flushed with water, blown with steam or air, or inerted.

5.2.2.1 All valves to the inerted spaces shall be positioned in such a manner and tagged as to prevent or, by written notice, restrict operation.

5.2.2.2 All vent lines (unless they are inerted) shall be inspected to ensure they are free of gas, vapor, and product.

5.2.3 All spaces to be inerted shall be sufficiently intact, and remain 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.

5.2.4 Care shall be exercised in the selection of methods and materials used for cleaning or inerting to avoid incompatibility with previous cargoes.

5.2.5 Compartments or spaces in which internal repairs or alterations are to be undertaken shall be cleaned to comply with the requirements of Section 5.3, and all other spaces (with the exception of tanks described in 5.1.3) shall be inerted in accordance with the requirements of 7.1.8 or 7.1.9, as applicable.

5.2.6 Compartments or spaces on which external repairs or alterations are to be undertaken on the external boundaries (deck or shell) shall be permitted to be inerted instead of

being cleaned as described in Section 5.2, and all other spaces (with the exception of tanks described in 5.1.3) shall be inerted in accordance with the requirements of 7.1.8 or 7.1.9, as applicable.

5.3* Where a Safe Condition Is to Be Obtained by Cleaning Certain Compartments and by Securing the Other Compartments. *[See Figure B.1, part (d).]*

5.3.1 Nonadjacent spaces containing atmospheres exceeding 10 percent of the LEL shall be closed and secured in a manner to prevent or, by written notice, restrict opening or operation, and those spaces shall be noted on the Certificate.

5.3.2 Cargo pumps and cargo lines, and crude oil wash lines to the spaces involved in the scope of work, shall have been flushed with water or blown with steam or air.

5.3.2.1 Vent lines, unless they are inerted to the space involved in the scope of work, shall be inspected to ensure they are free of gas, vapor, and product.

5.3.3 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 Section 5.1. All other applicable spaces shall be closed and secured in a manner to prevent or, by written notice, restrict opening or operation.

5.4* Where a Safe Condition Is to Be Obtained by Cleaning Some Compartments, by Inerting Some Compartments, and by Securing Some Compartments. *[See Figure B.1, part (e).]*

5.4.1 Cargo pumps and cargo lines, inert gas lines, and crude oil wash lines to the spaces involved in the scope of work shall have been flushed with water, blown with steam or air, or inerted.

5.4.1.1* All valves to the inerted spaces shall be tagged and secured in such a manner as to prevent or, by written notice, restrict opening or operation.

5.4.1.2 Unless they are inerted, vent lines to the spaces involved in the scope of work shall be inspected to ensure they are free of gas, vapor, and product.

5.4.2 Nonadjacent spaces containing atmospheres exceeding 10 percent of the LEL shall be closed and secured in a manner to prevent or, by written notice, restrict opening or operation, and those spaces shall be noted on the Certificate.

5.4.3 Compartments or spaces in which internal repairs or alterations are to be undertaken shall be cleaned to comply with the requirements of Section 5.1; and all adjacent compartments, including those diagonally adjacent thereto, shall be inerted to comply with the applicable requirements of 7.1.8 and Section 5.2. All other compartments shall be closed and secured in compliance with 5.3.1. With respect to inerted spaces, the requirements of 5.2.1 shall apply.

5.4.4 Compartments or spaces on which external repairs or alterations are to be undertaken on the external boundaries (deck or shell) shall be permitted to be inerted by gas instead of being cleaned as described in Section 5.1. All adjacent compartments, including those diagonally adjacent thereto, shall be inerted or cleaned to comply with applicable requirements of 7.1.8 and Sections 5.1 and 5.2. All other applicable spaces shall be closed and secured in compliance with 5.3.1.

5.5* Cargo Heater Coils.

5.5.1 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:

(1) Steaming
(2) Flushing with water
(3) Blowing with air
(4) Inerting

5.5.1.1 Coils in cargo tanks that have been used for chemicals that could react with water or steam shall be cleaned in accordance with the requirements of 5.2.4.

5.5.2 On coiled vessels using thermal heating oils with a flashpoint of 149°C (300°F) or greater, and where such coils are filled with oil and are in service, the Marine Chemist shall be satisfied as to the integrity of the heater coils in the prescribed work areas.

N **5.5.2.1** Thermal heating coils shall be cleaned in accordance with 5.5.1 if hot work is to be performed on them or if their integrity is in question.

N **5.5.2.2** Thermal oil heating coils that have been emptied of thermal oil media shall be treated as steam coils in accordance with 5.5.1.

N **5.5.2.3** On coiled vessels using thermal heating oils that have been disconnected or taken out of service, the Marine Chemist shall treat those heating coils in accordance with 5.5.1.

5.6 Electric Welding Operations. When determined by the Marine Chemist to be necessary, 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 units that they service.

5.7 Requirements for Use of a Designated Berthing Area for Cleaning, Gas Freeing, or Inerting.

5.7.1 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 the hazards to adjacent property.

5.7.2 The degassing, cleaning, or inerting of vessels at such designated berths shall be carried out in accordance with the requirements of Section 5.1 or Section 5.2, as appropriate, 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 Section 5.1 or Section 5.2, as appropriate, 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.

5.8* Vessel Fuel Oil Tanks. No hot work shall be permitted immediately adjacent to any vessel's fuel oil tanks unless the work has been authorized by the Marine Chemist, except as provided in 29 CFR 1915.14(a)(iv).

N **5.9* Hollow Structures.** No hot work shall be done on or against hollow structures unless they have been tested for flammable or combustible gases or liquids in accordance with 7.1.4.2.

Chapter 6 Procedures for the Marine Chemist Prior to Issuance of a Certificate

6.1* Calibration and Function Verification. The accuracy and sampling integrity of instruments used by the Marine Chemist shall be verified before each day's use.

6.1.1 Calibration of sensors shall be verified using a known concentration of test gas.

6.1.2 A record of the verification of accuracy or calibration shall be maintained for at least 3 months.

Δ 6.2 Determination of Conditions.

***N* 6.2.1** The Marine Chemist shall personally determine conditions.

***N* 6.2.1.1** The Marine Chemist shall be permitted to issue a Certificate setting forth in writing that the prescribed work to a vessel can be undertaken with safety at the time of inspection.

***N* 6.2.1.2** This determination shall include atmospheric tests and, where possible, a visual inspection of each tank, compartment, space, pipeline, appurtenance, heating coil and/or structure to be certified.

***N* 6.2.2** The Marine Chemist shall, where possible, physically enter each compartment or space and conduct a visual inspection to determine the atmospheric or fire hazards, taking into account the scope of the intended work and the standard safety designation to be used.

***N* 6.2.3** The Marine Chemist shall carry out tests within each compartment or space, ensuring compliance with the minimum applicable requirements prior to issuing a Certificate.

N* 6.2.3.1 The flashpoint of residues or soft or greasy preservative coatings shall be verified by the Marine Chemist.

N* 6.2.3.2 If the flashpoint of the residues or soft or greasy preservative coatings cannot be verified, an ignitability test shall be performed on the residues or soft or greasy preservative coatings by the Marine Chemist.

***N* 6.2.4** For repairs or alterations involving hot work, all adjacent spaces and other spaces or areas that can be affected by the hot work shall be treated in accordance with 7.1.4.4 or 7.1.4.5.

***N* 6.2.4.1** The inspection shall include spaces or areas where products of hot work such as sparks, slag, embers, or the transfer of heat can act as ignition sources.

***N* 6.2.5** The Marine Chemist's activities related to the inspections and tests necessary for completing the Marine Chemist's Certificate shall include 6.2.5.1 through 6.2.5.7.

***N* 6.2.5.1** The Marine Chemist shall determine the previous three loadings of cargo tanks or fuel tanks.

***N* 6.2.5.2** The Marine Chemist shall obtain from the Certificate requester, competent person, or other responsible person the nature and extent of the intended work.

***N* 6.2.5.3* Requirements for Cargo Pipelines.**

***N* 6.2.5.3.1** The Marine Chemist shall conduct tests and an inspection of pipelines that last contained a flammable or combustible liquid, vapor, or gas that is associated with the scope of the hot work to ensure it meets the standard safety designation at the time of the inspection.

N* 6.2.5.3.2 Where hot work will be done directly to or on the pipeline, the Marine Chemist shall verify that a pipeline that previously contained flammable or combustible liquid or gas has been blown with air or steam, or flushed with water in accordance with 5.1.1; or verify that the pipeline is inerted in accordance with 5.2.1.1.

***N* 6.2.5.3.3** Where the scope of the hot work does not involve the pipeline, the Marine Chemist shall verify the integrity of the pipeline within the cargo tank or cargo pump room.

***N* 6.2.5.3.4** The Marine Chemist shall verify that pipelines that could release hazardous materials into a cargo tank or a cargo pump room that will be certified for entry are either disconnected, blanked off, or otherwise blocked by a positive method, or the valves are positioned and tagged in such a manner to prevent, or by written notice restrict, operation.

***N* 6.2.5.4 Requirements for Pipelines Not Associated with Cargo.**

***N* 6.2.5.4.1** The Marine Chemist shall conduct tests and an inspection of the pipelines associated with the scope of the work or in the compartments concerned.

***N* 6.2.5.4.2** Where hot work will be done directly to or on the pipeline, the Marine Chemist shall verify that pipelines that previously contained flammable or combustible liquid or gas are blown with air or steam, or flushed with water in accordance with 5.1.1; or verify the pipeline is inerted in accordance with 5.2.1.1. *(See A.6.2.5.3.2.)*

***N* 6.2.5.4.3** Where the scope of work does not involve the pipeline, the Marine Chemist shall verify the integrity of the pipeline within the compartment or space.

***N* 6.2.5.4.4** The Marine Chemist shall verify that pipelines that could release hazardous materials into spaces that will be certified for entry or hot work are either disconnected, blanked off, or otherwise blocked by a positive method, or the valves are positioned and tagged in such a manner to prevent, or by written notice restrict, operation.

***N* 6.2.5.4.5** For pipelines associated with flammable cryogenic liquid fuel, the requirements of 6.2.5.3 or 6.2.5.4 and Chapter 9 shall be used.

***N* 6.2.5.5 Steam-Supplied Heating Coils.**

***N* 6.2.5.5.1** The Marine Chemist shall witness that the steam-supplied heating coils involved in the scope of work are blown with air or steam, or flushed with water in accordance with 5.5.1. *(See A.6.2.5.3.2.)*

***N* 6.2.5.5.2** The Marine Chemist shall test steam-supplied heating coils.

***N* 6.2.5.6 Thermal Oil Heating Coils.**

***N* 6.2.5.6.1** Where hot work repairs do not involve the thermal oil heater coils, the integrity of the thermal oil heater coil system within the tank shall be verified.

***N* 6.2.5.6.1.1** The thermal oil heater coils shall be intact.

***N* 6.2.5.6.1.2** The thermal oil heating system shall be full of thermal oil.

***N* 6.2.5.6.2** Thermal oil heater coils found to be leaking, fractured, broken, or otherwise determined to be unsafe shall be treated in accordance with 5.5.1.

N 6.2.5.6.3 Where hot work repairs will be made to the thermal oil heater coil, the Marine Chemist shall witness that the coil is blown with air or steam, or flushed with water in accordance with 5.5.1; or verify the pipeline is inerted in accordance with 5.2.1.1. *(See A.6.2.5.3.2.)*

N 6.2.5.6.4 Thermal oil heater coil systems that have been disconnected or removed from service shall be treated in accordance with 5.5.1.

N 6.2.5.7 In spaces that are not cargo tanks or are not adjacent to cargo tanks, the Marine Chemist shall carry out tests to determine the atmospheric or fire hazards that exist within each affected compartment or space ensuring compliance with the minimum applicable requirements prior to issuing a Certificate.

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Chapter 7 Standard Safety Designations and Conditions Required

7.1 General. The standard safety designations in 7.1.1 through 7.1.10 shall be used where applicable in preparing Certificates.

Δ 7.1.1* The designation ATMOSPHERE SAFE FOR WORKERS requires that, in the compartment or space so designated, the criteria in 7.1.1.1 through 7.1.1.5 shall be met at the time the Certificate is issued:

N 7.1.1.1* The oxygen content of the atmosphere shall be greater than or equal to 19.5 percent and less than 22 percent by volume.

N 7.1.1.2* The concentration of flammable materials shall be below 10 percent of the lower explosive limit (LEL).

N 7.1.1.3* Any toxic chemicals in the atmosphere associated with cargo, fuel, tank coatings, inerting mediums, adjacent spaces, fumigants, or other contents shall be within permissible concentrations at the time of the inspection, except as provided in 7.1.1.4. *(See 7.1.1.6.)*

N 7.1.1.4 Further testing for toxic materials shall not be required if previous testing indicates that these materials have been eliminated or are not capable of regeneration to hazardous levels while maintained as directed on the Marine Chemist's Certificate.

N 7.1.1.5* The residues or chemicals remaining in a certified space are not capable of producing toxic materials that exceed permissible concentrations under existing atmospheric conditions while maintained as directed on the Certificate.

7.1.1.6 If any of the conditions of 7.1.1.1, 7.1.1.2, 7.1.1.3, or 7.1.1.5 do not exist, then the designation NOT SAFE FOR WORKERS or ENTER WITH RESTRICTIONS shall be used.

7.1.2 The designation NOT SAFE FOR WORKERS indicates that the compartment or space so designated shall not be entered by personnel.

Δ 7.1.3 The designation ENTER WITH RESTRICTIONS indicates that in all spaces so designated, entry for work shall be permitted only if conditions of proper personal protective equipment (PPE), clothing, time, or any or all of the aforementioned, as appropriate, are as specified.

N 7.1.3.1 The designation ENTER WITH RESTRICTIONS shall not be used to designate spaces with immediately dangerous to life or health (IDLH) atmospheres except to install ventilation equipment or for emergency rescue.

Δ 7.1.3.2 Under the heading, "Restrictions," there shall be a statement describing the specific conditions of personal protection equipment, clothing, time, or any or all of the aforementioned.

Δ 7.1.4 The designation SAFE FOR HOT WORK requires that in the compartment or space so designated, the criteria in 7.1.4.1 through 7.1.4.7 shall be met at the time the Certificate is issued.

N 7.1.4.1 The oxygen content of the atmosphere shall not be greater than 22 percent by volume. *(See A.7.1.1.1.)*

N 7.1.4.2* The concentration of flammable materials in the atmosphere shall be less than 10 percent of the LEL.

N 7.1.4.3* The residues, scale, or soft and greasy preservative coatings in the entire space shall be cleaned sufficiently to prevent the spread of fire and incapable of producing a higher concentration than permitted by 7.1.4.1 or 7.1.4.2 under existing atmospheric conditions in the presence of hot work and while maintained as directed on the Certificate.

N 7.1.4.4* All spaces adjacent to cargo tanks certified SAFE FOR HOT WORK, as well as all cargo tanks adjacent to a hot work site, shall comply with 7.1.4.4(1) and either 7.1.4.4(2) or 7.1.4.4(3) as follows:

(1) Have combustible gas readings less than 10 percent of the LEL
(2) Have been cleaned of residues, scale, or preservative coatings to prevent the spread of fire
(3) Have been inerted

N 7.1.4.5 Noncargo tank spaces, such as fuel tanks, lube tanks, engine room, or fire room bilges, or machinery spaces adjacent to noncargo spaces certified SAFE FOR HOT WORK, shall be treated in accordance with Marine Chemist requirements and acknowledged on the Certificate.

N 7.1.4.6 Passageways, Living Spaces, and Storerooms.

N 7.1.4.6.1 Spaces such as passageways, living spaces, or storerooms that are not adjacent to cargo tanks and are undergoing hot work meet the requirements of 7.1.4.1 and 7.1.4.2.

N 7.1.4.6.2 Passageways, living spaces, or storerooms along with any adjacent spaces, shall be treated in accordance with the Marine Chemist's instructions

N 7.1.4.6.3 Passageways, living spaces, or storerooms shall be either free of material that could ignite under conditions of work or be protected with barriers to prevent the spread of fire.

7.1.4.7 If any of the conditions of 7.1.4.1, 7.1.4.2, 7.1.4.3, or 7.1.4.4 do not exist, the designation NOT SAFE FOR HOT WORK shall be used.

7.1.5 The designation NOT SAFE FOR HOT WORK indicates that in, or on, the compartment or space so designated, hot work shall not be permitted.

Δ 7.1.6 The designation SAFE FOR LIMITED HOT WORK indicates that the criteria in 7.1.6.1 through 7.1.6.4 shall be met at the time the Certificate is issued.

N **7.1.6.1** Any compartment or space so designated shall meet the requirements of 7.1.4.1 and 7.1.4.2, unless inerted in accordance with 7.1.8.

N **7.1.6.2** Under the heading, Limitations, the Certificate shall include either a statement that describes the specific location and the type of hot work that is permitted; or a list of the areas that are to be excluded from hot work.

N **7.1.6.3** The compartment or space so designated shall meet the conditions of 7.1.6.3.1 or 7.1.6.3.2.

N **7.1.6.3.1** Portions of the compartment or space shall meet the requirements of 7.1.4.3 and 7.1.4.4, or 7.1.4.5, as well as the applicable portions of 5.1.3.

N **7.1.6.3.2** Hot work is limited to the location or locations described in the "Limitations" in 7.1.6.2.

N **7.1.6.4** In compartments or spaces on vessels that are not considered cargo or fuel tanks and have not contained and are not subject to concentrations of combustible, flammable, or toxic liquids, vapors, or gases, the Marine Chemist shall survey the subject spaces and the adjacent spaces in accordance with 6.2.1.

N **7.1.6.5** The Certificate shall include instructions for the competent person to maintain safe work conditions.

7.1.7* The designation SAFE FOR SHIPBREAKING requires that the compartment so designated shall meet the criteria of 7.1.4.1, 7.1.4.2, 7.1.4.4, 7.1.4.5, and 7.1.7.1 through 7.1.7.5.

N **7.1.7.1** Residual combustible materials shall not be capable of producing fire beyond the extinguishing capabilities of equipment on hand as determined by the facility.

N **7.1.7.2*** Free-standing combustible and flammable liquids that might generate flammable vapors shall be removed from tanks, compartments, pumps, and pipelines to meet the criteria for the designation SAFE FOR HOT WORK.

N **7.1.7.3*** Cargo pumps, fuel transfer pumps, and pipelines shall have been flushed with water or blown with steam or air.

N **7.1.7.4*** Valves and drains on pipelines shall remain open.

N **7.1.7.5** Blanks shall be removed from pipelines.

N **7.1.7.6** Unless otherwise stated on the Certificate, the duration of a Certificate written for shipbreaking shall be restricted to three days from the date and time the Marine Chemist's inspections and tests were completed.

Δ **7.1.8** The designation INERTED requires that one of the following procedures in 7.1.8.1, 7.1.8.2, or 7.1.8.3 shall be met in the compartment or space so designated.

N **7.1.8.1* Use of Inert Gas.**

N **7.1.8.1.1** Carbon dioxide or other nonflammable gas acceptable to the Marine Chemist shall be introduced into the space to maintain the oxygen content of the atmosphere of the space at or below 6 percent by volume or 50 percent of the amount required to support combustion, whichever is less. *(See Annex E.)*

N **7.1.8.1.2** The Marine Chemist shall note on the Certificate the kind of inert gas, the methods for maintaining safe conditions, and the measures for safe disposal of the inert gas upon completion of repairs in accordance with 5.2.1.

N **7.1.8.1.3** Closing and securing of hatches and other openings, except vents, shall be permitted to be used as "safe disposal" methods by the Marine Chemist.

N **7.1.8.2 Use of Water to Inert Cargo Tanks and Fuel.**

N **7.1.8.2.1** Cargo tanks and fuel tanks shall be filled with water so that the water level is a minimum of 0.9 m (3 ft) above the intended exterior hot work and the atmosphere of the headspace meets the requirements of 7.1.4.2.

N **7.1.8.2.2** The water level shall be maintained throughout the intended work by tagging valves in a position to maintain the water level.

N **7.1.8.2.3** Any procedure to inert a cargo tank or fuel tank with water shall be approved by the Marine Chemist.

N **7.1.8.3 Use of Water to Inert Other Tanks.**

N **7.1.8.3.1** Tanks other than cargo tanks and fuel tanks shall be filled to overflow with water.

N **7.1.8.3.2** The water level shall be maintained throughout the intended work.

N **7.1.8.3.3** Valves shall be tagged or, by written notice, positioned to restrict operation to maintain the water level.

N **7.1.8.3.4** If any headspace remains in the tank, it shall meet the requirements of 7.1.4.2.

N **7.1.8.4*** All valves, vent lines, and other openings to the inerted spaces shall be positioned in such a manner and tagged as to prevent operation or, by written notice, restrict operation.

N **7.1.8.5** Spaces inerted to permit hot work shall also have either the SAFE FOR HOT WORK or SAFE FOR LIMITED HOT WORK designations included on the Certificate.

N **7.1.8.6** Spaces designated inerted shall be also designated NOT SAFE FOR WORKERS.

7.1.9 The designation INERTED FOR FLAMMABLE COMPRESSED GAS requires that individual pressure tanks with a working pressure of 3.45×10^5 Pa (50 psi) or more shall constitute 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 when special precautions are observed under carefully controlled conditions as specified on the Certificate.

Δ **7.1.10** The designation SAFE FOR LAY-UP requires that the tank ship so designated shall meet any of the conditions of 7.1.10.1, 7.1.10.2, or 7.1.10.3 at the time the Certificate is issued:

N **7.1.10.1** The vessel shall be both of the following:

(1) Cleaned in accordance with the provisions in Section 5.1
(2) Inspected weekly by the responsible owner's representative to ensure that no change in conditions occurs

N **7.1.10.2** All the cargo tanks shall be as follows:

(1) Discharged of cargo
(2) Checked to ensure cargo residues are not capable of producing more than 10 percent of the LEL
(3) Inspected weekly by the responsible owner's representative to ensure that no change in conditions occurs

N **7.1.10.3** All cargo tanks shall be inerted to less than 8 percent oxygen or 50 percent of the amount of oxygen required to support combustion, whichever is less.

N **7.1.10.3.1** The responsible owner's representative shall be in constant attendance.

N **7.1.10.3.2** The vessel shall be reinspected daily until stabilized.

N **7.1.10.3.3** After the vessel is stabilized, the responsible owner's representative shall maintain daily inspections and records of oxygen content.

7.1.10.4 Preparation of vessels for lay-up shall be in accordance with NFPA 312.

7.1.10.5 Failure to comply with the requirements of 7.1.10.1, 7.1.10.2, and 7.1.10.3 shall void the Certificate.

Chapter 8 The Marine Chemist's Certificate

8.1 Preparation of Certificates. When the Marine Chemist is satisfied that the related requirements necessary for the safe conduct of the work have been met, or has determined they have not been met, a Certificate shall be prepared in accordance with this standard.

8.1.1 The Certificate shall be written legibly.

8.1.1.1 The Marine Chemist shall write his or her name and contact information on the Certificate.

8.1.1.2 If ink stamps are used, all copies of the Certificate shall be stamped and legible.

N **8.1.2** The Certificate, when written to start work, shall include the standard safety designations in accordance with Chapter 7 and with 9.3.2 for vessels having flammable cryogenic liquid fuel or cargo.

8.1.3 The Certificate shall include instrument test results of the Marine Chemist's inspections and tests, for all spaces tested including adjacent spaces as required by this standard.

N **8.1.4** The Certificate shall include instrument test results of the Marine Chemist's inspections and tests, for all pipelines and heating coils tested as required by this standard.

8.1.5* Limits of detection (LOD) for toxic test results shall be indicated on the Certificate.

Δ **8.1.6** Any additional qualifications or requirements issued by the Marine Chemist, such as those in 8.1.6.1 through 8.1.6.3, shall be specified on the Certificate.

N **8.1.6.1** The frequency and type of such additional tests, inspections, qualifications, and other instructions as the Marine Chemist specifies shall be noted on the Certificate.

N **8.1.6.2** The conditions under which the Marine Chemist shall be consulted or recalled shall be noted on the Certificate.

N **8.1.6.3** Requirements necessary to maintain safe conditions during the work shall be noted on the Certificate, including, but not limited to, the following:

(1)* Fire watch
(2)* Fire barriers
(3)* Ventilation
(4) Methods to maintain safe conditions of pipelines and heating coils, such as ventilation or isolation (i.e., lock-out/tag-out)

Δ **8.1.7*** Any additional qualifications and requirements shall include both precautions, including protective equipment and devices, necessary to eliminate or minimize hazards that are present from combustibles, protective coatings, or residues from cargoes and limitations or restrictions, if any, on the areas where work is to be done that are listed on the Certificate.

N **8.1.8** If movement of the vessel is authorized within the facility, the Marine Chemist shall include on the Certificate the nature of any tests to be performed by a competent person after the vessel is moved and prior to beginning work.

8.2 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 and the requirements for maintaining conditions under which it is issued. Any additions to or deletions from such a Certificate after obtaining a signature for receipt shall void the Certificate and require reissuance.

8.2.1 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 or her authorized representative.

8.2.2 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 an authorized representative.

8.3 Responsibility for Obtaining the Marine Chemist's Certificate. It shall be the responsibility of the Certificate requester to retain the services of the Marine Chemist and to obtain copies of the Marine Chemist's Certificate in accordance with the provisions of this section.

8.3.1 It shall be the responsibility of the Certificate requester 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 designated in 8.2.1 or 8.2.2, as applicable.

8.3.2 It shall be the responsibility of the person signing for receipt of the Certificate to securely post it in a conspicuous place aboard the vessel before a space is entered or work is started.

8.3.3 It shall be the responsibility of the Certificate requester, vessel owner, or their representative to ensure that all access openings to spaces designated NOT SAFE FOR WORKERS, including inerted spaces, shall be appropriately labeled with a warning sign, which shall read NOT SAFE FOR WORKERS and which shall remain in place unless recertified.

8.3.4 Only one requester shall be listed on the Certificate.

8.3.4.1 The requester shall be responsible for providing a statement of the scope of the work at the time of the Marine Chemist's inspection.

8.3.4.2 The requester listed on the Certificate shall be responsible for maintaining the Certificate in accordance with Section 8.4 and with 29 CFR 1915.15.

8.3.4.3 If the requester is a host employer in a multi-employer workplace, then the host employer shall be responsible for

maintaining the Certificate for all contract employers unless the host employer requires each contract employer to obtain and maintain their own Certificate.

Δ **8.4 Responsibility for Maintaining the Conditions.** For the Certificate to be maintained, the requirements in 8.4.1 through 8.4.6 shall be met by the Certificate requester.

N **8.4.1*** Each compartment, space, or area that is assigned a standard safety designation on the Certificate shall be inspected by the shipyard competent person within one day unless otherwise noted on the Certificate.

N **8.4.2** Throughout the course of repairs or alterations, conditions on the Certificate shall be maintained on the vessel by testing and visually inspecting all certified spaces, including all adjacent spaces, accessory piping, valves, coils, and so on, that were part of the original inspection.

N **8.4.3*** Unless otherwise stated on the Certificate, certified spaces, including spaces adjacent to hot work, where work is being done shall be reinspected daily, or more often as necessary, by the shipyard competent person prior to entry or hot work.

N **8.4.4** It shall be the responsibility of the Certificate requester to ensure that the prescribed work is carried out at the original location within the facility for which the Certificate was issued, unless movement is authorized within that facility by the Marine Chemist on the Certificate.

N **8.4.4.1** If movement is authorized within the facility, a test and visual inspection of the spaces listed on the Certificate shall be performed by a competent person.

N **8.4.4.2** The competent person's tests and inspection shall be completed after the movement of the vessel and prior to the beginning of work.

N **8.4.5** The accuracy and sampling integrity of all instruments used by a competent person to maintain a Marine Chemist's Certificate shall be verified by either the competent person, another qualified individual, or metrology laboratory, before each day's use.

N **8.4.5.1** The calibration of the sensors of the instruments shall be verified by using a known concentration of test gas in a manner consistent with the manufacturer's recommendations.

N **8.4.5.2** A record of the verification of accuracy or calibration shall be maintained for at least 3 months.

N **8.4.6** Certificates not maintained according to the requirements in 8.4.1 through 8.4.5 shall be void.

Chapter 9 Additional Requirements for Vessels Having Flammable Cryogenic Liquid Fuel or Cargo

9.1 Scope.

9.1.1* The design and operational characteristics of tanks and systems on vessels that carry or burn as fuel flammable cryogenic liquids shall be evaluated by the Marine Chemist while making the determinations required by Section 6.2 of this standard.

9.1.2 This chapter describes the conditions required before repairs can be made in spaces that have been exposed to flammable cryogenic liquids in their liquid or vapor form.

9.1.3 This chapter supplements the factors to be considered prior to issuance of the Certificate in accordance with Section 6.2.

9.1.4 Only those Marine Chemists who have evidenced the required additional experience, training, and knowledge shall be authorized to issue Certificates under the requirements of Chapter 9. Such Marine Chemists shall receive a special endorsement on the Marine Chemist's Certificate issued them by the National Fire Protection Association.

9.2 Definitions. The following terms related to flammable cryogenic liquid carriers and defined in Chapter 3 shall apply to this chapter:

(1) Cryogenic Liquid. *See 3.3.16.*
(2) Flammable Cryogenic Liquid Area. *See 3.3.22.*
(4) Flammable Cryogenic Liquid Containment System. *See 3.3.23.*
(5) Flammable Cryogenic Liquid Hold Space. *See 3.3.24.*
(6) Interbarrier Space. *See 3.3.30.*
(7) Primary Barrier. *See 3.3.36.*
(8) Secondary Barrier. *See 3.3.39.*

9.3 Minimum Requirements.

9.3.1 All minimum requirements for issuance of the Certificate as set forth in Chapters 6, 7, and 8 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.

9.3.2 The special safety designation SAFE FOR REPAIR YARD ENTRY shall apply only to vessels that carry flammable cryogenic liquid as cargo or burn it as fuel, and describes vessels whose compartments and spaces either have been tested by sampling at remote sampling stations, with results indicating that the atmosphere tested is above 19.5 percent oxygen and less than 10 percent of the lower explosive limit (LEL), or have been treated in accordance with the Marine Chemist's instructions.

9.3.3 Vessels whose containment systems have not met the criteria of 9.3.2 shall be permitted to undergo specific limited repairs in locations outside those spaces, in accordance with the following conditions:

(1) Such repairs or alterations shall not be undertaken until a Certificate is obtained.
(2) 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.
(3) Should the Marine Chemist have reason to question the safety of any aspect of the site selection, he or she shall consult the proper governmental authorities.

9.3.4 Because interbarrier spaces or insulation could contain flammable 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.

9.3.5 The following information shall be used by the Marine Chemist as a guide for making his or her inspection:

(1) Description and schematic arrangement of provisions for inerting flammable cryogenic liquid tanks, hold spaces, or interbarrier spaces, as applicable

(2) Description and instruction manual for calibration of the flammable cryogenic liquid leak detector equipment
(3) Schematic plan showing locations of leak detector(s) and sampling points
(4) Schematic plan(s) of flammable cryogenic liquid and vapor piping
(5) US Coast Guard Letter of Compliance and Certificate of Fitness for foreign flag vessels, or the Certificate of Inspection and Certificate of Fitness for US flag vessels
(6) The recent history of cargoes handled with special reference to outturn and any pertinent unusual incidents encountered

9.4 Minimum Conditions.

9.4.1 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 5, insofar as they are applicable, and as set forth in Section 9.4.

9.4.2 When vessels are undergoing repairs, no venting of cargo or fuel tanks, systems, or other spaces that could contain inert gas or flammable vapors shall take place without approval of the Marine Chemist, and any other activity that could similarly alter the atmosphere in the vicinity of the repair work shall be permitted to be undertaken only with such approval.

9.4.3 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 ensure that gas supply lines to the engine room or other spaces have been properly secured, inerted, or otherwise properly treated prior to repairs to this system.

9.4.4 Prior to the opening of cargo machinery or fuel systems for repairs, such equipment shall have been purged and ventilated to remove vapors or inert gas.

N Chapter 10 Requirements for Performing Entry or Hot Work in or on Land-Side Storage Tanks Located Within a Shipyard or Waterfront Facility

***N* 10.1 Scope.**

N* 10.1.1 This chapter describes the conditions required before repairs can be made in spaces that have been exposed to flammable, combustible, or toxic liquids, vapors, or gasses.

***N* 10.1.2** This chapter supplements the factors to be considered prior to the issuance of the Certificate in accordance with Section 6.2.

***N* 10.2 Definitions.** The following terms related to land-side storage tanks and defined in Chapter 3 shall apply to this chapter:

(1) Aboveground Storage Tank. *(See 3.3.1.)*
(2) Belowground Storage Tank. *(See 3.3.4.)*
(3) Blanking. *(See 3.3.5.)*
(4) Blinding. *(See 3.3.6.)*
(5) Double Block and Bleed. *(See 3.3.17.)*
(6) Energy Isolating Device. *(See 3.3.18.)*
(7) Energy Source. *(See 3.3.19.)*
(8) Floating Roof. *(See 3.3.26.)*
(9) Lead-Free Tank. *(See 3.3.31.)*
(10) Pontoon. *(See 3.3.35.)*
(11) Roof Seal. *(See 3.3.38.)*

***N* 10.3 Minimum Requirements.**

***N* 10.3.1** All minimum requirements for issuance of the Certificate as set forth in Chapters 6, 7, and 8 of this standard shall be met prior to the commencement of hot work or entry in spaces that have contained flammable or combustible products or vapors.

N* 10.3.2 A tank shall be declared lead free based on the results of atmospheric testing and the application of the permissible concentration limit for exposure to lead.

***N* 10.3.3** The following information, along with other applicable sections of this standard, shall be considered by the Marine Chemist while making an inspection:

(1) A description, schematic, or visual inspection of the space, including all pipelines entering and exiting the space
(2) A review of the last three product loadings
(3) Verification that pipelines leading into and exiting the tank have been isolated by blanking, blinding, double block and bleed, an energy isolating device, or other positive means
(4) Atmospheric testing of pontoons
(5) Assessment of the roof seal, floating roofs, support columns, legs, or other hollow structures that might contain product
(6) Assessment of fire suppression piping
(7) Review and confirmation of lock-out/tag-out of energy sources
(8) Atmospheric testing of sumps, the adjacent area below the tank floor, and double walls, as applicable
(9) Atmospheric testing of pipelines and heating coils within the space, from the point of isolation

***N* 10.4* Minimum Conditions.** Applicable minimum conditions as set forth in Chapter 5 shall prevail prior to the issuance of a Certificate for tanks that have contained flammable, combustible, or toxic product or vapor.

Annex A Explanatory Material

Annex A is not a part of the requirements of this NFPA document but is included for informational purposes only. This annex contains explanatory material, numbered to correspond with the applicable text paragraphs.

A.1.1.8 The Marine Chemist, as a shipyard safety professional, should take note of any observed physical hazards in a tank or confined or enclosed space, and convey that information to those individuals who are empowered and qualified to correct such hazards. Some examples of physical hazards are, among others, broken or rusted ladder rungs, engulfment, entrapment, obvious electrical hazards, and noise hazards.

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. Some of the requirements in this standard might exceed minimum governmental regulations to better protect personnel and property.

A.3.2.1 Authority Having Jurisdiction (AHJ). The phrase "authority having jurisdiction," or its acronym AHJ, is used in NFPA standards in a broad manner because jurisdictions and

approval agencies vary, as do their responsibilities. Where public safety is primary, the authority having jurisdiction may be a federal, state, local, or other regional department or individual such as a fire chief; fire marshal; chief of a fire prevention bureau, labor department, or health department; building official; electrical inspector; or others having statutory authority. For insurance purposes, an insurance inspection department, rating bureau, or other insurance company representative may be the authority having jurisdiction. In many circumstances, the property owner or his or her designated agent assumes the role of the authority having jurisdiction; at government installations, the commanding officer or departmental official may be the authority having jurisdiction.

A.3.3.2 Adjacent Spaces. Pipelines and hollow structures are not adjacent spaces and are not considered safe for hot work unless noted on the Marine Chemist's Certificate.

A.3.3.11 Combustible Liquid. Definition applies as determined by the test procedures and apparatus set forth in Chapter 4 of NFPA 30. Combustible liquids are classified as Class II or Class III as follows:

(1) Class II Liquid — Any liquid that has a flash point at or above 37.8°C (100°F) and below 60°C (140°F)
(2) Class IIIA — Any liquid that has a flash point at or above 60°C (140°F), but below 93°C (200°F)
(3) Class IIIB — Any liquid that has a flash point at or above 93°C (200°F)

A.3.3.12 Combustible Material. See 29 CFR 1915 Subpart P for guidance when doing hot work near these materials and NFPA 312 for additional information on doing hot work around combustible material.

A.3.3.13 Competent Person. In accordance with OSHA's shipyard industry standard (29 CFR 1915.7), competent persons are required to be designated by their employer. The employer also has to ensure that the designated competent person has specific skills, knowledge, and abilities based on the criteria set forth in 29 CFR 1915.7. Maritime confined space safety training is available from NFPA, many Marine Chemists, and other safety or training professionals.

In addition to the criteria outlined in 29 CFR 1915.7, the following content is suggested as a minimum for competent person training:

(1) *Hazard Description and Recognition*
    (a) Relevant terms, fire and explosion theory, and relevant chemistry (including concepts of flash point, explosive range, the role of oxygen, classification of fuels, and solvent vapor pressure)
    (b) Relevant shipboard structures, locations, and systems
    (c) Toxicity of materials and concepts of exposure guidance
    (d) Toxicity resources, guidance, and standards [e.g., the ACGIH's *Threshold Limit Values for Chemical Substances and Physical Agents*, OSHA's "Shipyard Employment Standard" (29 CFR 1915)]
    (e) Safety data sheet (SDS) information and skills
(2) *Hazard Evaluation and Measurement*
    (a) Instrumentation theory, operation, maintenance, calibration, and hands-on training (including the workings and limitations of the combustible gas meter, the oxygen meter, colorimetric detector tube systems, and specific gas electrochemical sensors)
    (b) Preparation for and execution of shipboard confined space testing
(3) *Hazard Prevention, Control, and Elimination*
    (a) Regulations (scope and application of 29 CFR 1915 and NFPA 306)
    (b) The responsibilities and interactions of the competent person and NFPA-certified Marine Chemist
    (c) NFPA 306 and 29 CFR 1915 standard safety designations
    (d) Control of ignition sources
    (e) Ventilation theory and application
    (f) Key aspects of respiratory protection
    (g) Fire watch requirements
    (h) Written competent person records
    (i) Marine Chemist's Certificate
(4) *Practical Application Simulation*
    (a) Hands-on actual or simulated exercises, using instruments involving the students, as guided by the instructors
    (b) Practice and reviewed exercises in recordkeeping and certifications
(5) *Examination*

N **A.3.3.18 Energy Isolating Device.** Examples of energy isolating devices include manual circuit breakers, disconnect switches, blanks, blinds, and caps.

A.3.3.22 Flammable Cryogenic Liquid Area. Where applicable, the cofferdams, ballast tanks, or void spaces located at the after end of the aftermost hold space, or at the forward end of the forwardmost hold space, are excluded from the cargo area.

A.3.3.23 Flammable Cryogenic Liquid Containment System. If the secondary barrier is part of the hull structure, it can be a boundary of the hold space.

A.3.3.25 Flammable Liquid. Definition applies as determined by the test procedures and apparatus set forth in Chapter 4 of NFPA 30. Flammable liquids are classified as Class I as follows:

(1) Class I Liquid — Any liquid that has a closed-cup flash point below 37.8°C (100°F) and a Reid vapor pressure not exceeding 2068.6 mm Hg (40 psia) at 37.8°C (100°F), as determined by ASTM D323, *Standard Method of Test for Vapor Pressure of Petroleum Products (Reid Method)*

Class I liquids are further classified as follows:

(1) Class IA — Those liquids that have flash points below 22.8°C (73°F) and boiling points below 37.8°C (100°F)
(2) Class IB — Those liquids that have flash points below 22.8°C (73°F) and boiling points at or above 37.8°C (100°F)
(3) Class IC — Those liquids that have flash points at or above 22.8°C (73°F), but below 37.8°C (100°F)

A.3.3.29 Hot Work. Grinding, drilling, abrasive blasting, or similar spark-producing operations should always be considered hot work when conducted in the presence of accumulations of flammable gases, flammable or combustible liquids, their vapors, or accumulations of other common combustible materials. These operations or similar operations are considered hot work unless deemed otherwise by the Marine Chemist and stated in writing on the Marine Chemist Certificate.

A.3.3.32 Marine Chemist. Activities of a Marine Chemist, as defined in this standard, are limited to the inspection and certification procedures described in this standard and consulting services connected therewith.

A.3.3.37 Requester. The requester of the Marine Chemist Certificate is generally considered to be one of the following: vessel owner, vessel repairer, shipbreaker, or vessel builder.

N **A.3.3.38 Roof Seal.** There are many styles of roof seals. Some have a primary and secondary seal, while for others the entire unit is considered a wiper seal. A roof seal can also be known as a wiper seal or rim seal.

A.3.3.40 Secured. Examples of a secured condition include dogged down, bolted down, removing or locking the valve handwheel, and labeled.

N **A.3.3.42 Shipbreaking.** This term is synonymous with vessel scrapping, vessel disposal, and vessel recycling.

N **A.3.3.44 Subject Space.** Examples of a subject space include, but are not limited to, the following:

(1) A space that is affected by, or subject to, the effects of hot work, including hot work in those spaces, hot work directly on those spaces, and hot work indirectly to those spaces.
(2) A space that can be entered for cold work.
(3) A space that is inerted.
(4) A space that is not safe for workers.

A.3.3.47 Vessel. Offshore drilling, production and/or storage vessels can be included in this definition.

A.4.3.2 When working with ammunition spaces, the Marine Chemist should consult with local authorities such as the Explosive Safety Officer (ESO). The US Navy's Naval Sea Systems Command (NAVSEA) publications, *Ammunition and Explosives Safety Afloat* (OP 4) and *Ammunition and Explosives Safety Ashore* (OP 5), should be consulted when a Marine Chemist is requested for hot work involving spaces aboard vessels last containing ammunition. There might be circumstances in which hot work can be safely authorized within nonpermissible areas (no hot work is allowed inside or against spaces containing ammunition). In such cases, requests for waivers or exemptions should be in accordance with the requirements of OP 4 or OP 5 as appropriate.

A.5.1 The requirements of this section can be used in preparing other spaces such as fuel tanks, landside spaces, or hollow structures covered by the standard as appropriate.

A.5.1.3.3 This test can be performed by exposing a sample of the residue or preservative coating to a strong open flame and observing the ease with which it ignites or burns. This test should be performed off the vessel or in an area approved for hot work.

A.5.2 See A.5.1.

A.5.3 See A.5.1.

A.5.4 See A.5.1.

A.5.4.1.1 The valves to the inerted compartments referenced in this requirement do not include those valves that are part of a fixed inert gas system used in controlling the introduction of the inerting medium into the subject space. During the inerting process, the valves on the inert gas line to a subject space are used by qualified individuals to regulate inert gas flow and/or pressure in the inerted space.

A.5.5 See A.5.1.

A.5.8 On dry cargo vessels, miscellaneous vessels, passenger vessels, and shipyard employment land-side operations, no hot work is permitted adjacent to any vessels or other fuel oil tanks unless the work has been authorized by the Marine Chemist. When the adjacent space contains flammable or combustible liquids with a flash point at or below 65.6°C (150°F), or flammable gases and the distance between such spaces and the hot work is greater than 7.6 m (25 ft), then a competent person can visually inspect and test the space. [If the hot work is 7.6 m (25 ft) or closer to the adjacent space containing such flammables, then a Marine Chemist must certify the hot work.]

N **A.5.9** Such testing can be done by a Marine Chemist or, in some cases, by a Shipyard Competent Person. See 29 CFR 1915.54(c) and 29 CFR 1915(d).

A.6.1 It is recognized that in limited circumstances, the Marine Chemist might not be able to transport compressed calibration gas by air. In these limited cases, the Marine Chemist should make every attempt to verify the accuracy of their instruments prior to use.

N **A.6.2.3.1** Flashpoint verification can include a flashpoint test, consulting reference materials, or specifications for the product such as a safety data sheet, National Institute for Occupational Safety and Health (NIOSH) Pocket Guide, Wireless Information System for Emergency Responders (WISER), and other similar publications and information sources.

N **A.6.2.3.2** The ignitability test can be performed by exposing a sample of the residue or soft or greasy preservative coating to a strong open flame and observing the ease with which it ignites or burns. This test should be performed off the vessel or in an area approved for hot work.

N **A.6.2.5.3** Cargo pipelines include, but are not limited to, cargo manifold pipelines, cargo transfer pipelines, inert gas pipelines, crude oil wash (COW) pipelines, vapor control and recovery pipelines, cargo tank vent pipelines, and cargo pump room pipelines.

N **A.6.2.5.3.2** Blown with air means the pipeline has been blown with forced mechanical ventilation of sufficient pressure, volume, and flow rate to remove hazardous products and vapors from the pipeline.

A.7.1.1 Spaces adjacent to spaces that are certified by the Marine Chemist might or might not be open at the time of inspection. It is generally recognized that adjacent spaces pose a reduced risk to workers performing cleaning or other cold work in certified spaces. The Marine Chemist should consider those risks presented by adjacent spaces at the time of the inspection and prepare the Certificate based upon the knowledge of work described to the Marine Chemist by the vessel repairer, shipbreaker, or vessel builder. See statement on Certificate that highlights ". . . spaces not listed on the Certificate are not to be entered unless authorized on another Certificate and/or maintained in accordance with Subpart B, 29 CFR 1915."

A.7.1.1.1 It is important that any change from ambient oxygen levels, either up or down, be investigated. 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.

A.7.1.1.2 The level of 10 percent of the 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, such as with hydrogen, methane, and so forth, but not be a toxic hazard.

A.7.1.1.3 Permissible concentrations can be found in the latest version of *Threshold Limit Values for Chemical Substances and Physical Agents,* published by the American Conference of Governmental Industrial Hygienists, in Subpart Z of 29 CFR 1915.1000, "Permissible Exposure Limit Value," or the value listed in the manufacturer's safety data sheet (SDS).

When determining "permissible concentrations" according to 7.1.1.3, the Marine Chemist should use the lower value of the published ACGIH's Threshold Limit Values (TLVs) or OSHA's Permissible Exposure Limit (PEL) as the primary source for compliance with this requirement. Only in the absence of a published TLV and PEL for a substance should the Marine Chemist refer to the manufacturer's SDSs to determine if any alternate value exists.

A.7.1.1.5 See A.7.1.1.3.

•

A.7.1.4.2 The terms *lower flammable limit (LFL)* and *lower explosive limit (LEL)* are used synonymously. Refer to *Fire Protection Guide to Hazardous Materials.*

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.7.1.4.3 For spaces that have not contained flammable or combustible cargo, fuels, or oils, the Marine Chemist can use guidance documents such as NFPA 312 or 29 CFR 1915 Subpart P.

A.7.1.4.4 For adjacent spaces that have not contained flammable or combustible cargo, fuels, or oils, the Marine Chemist can use guidance documents such as NFPA 312 or 29 CFR 1915, Subpart P.

N **A.7.1.7** The structural complexity of vessels makes shipbreaking a challenging process. It involves many safety, health, and environmental issues. The draining and removal of fuels, oils, and other liquids from the vessel generally occurs throughout the shipbreaking process. A competent person needs to continually monitor these areas to ensure that they are still in compliance with the Marine Chemist's Certificate.

N **A.7.1.7.2** Hazardous liquids and gases that can be found in a vessel can include hydraulic oil, coolant fluid, high-pressure air, steam condensate, preservatives in rudders and skegs, and fire suppression materials such as aqueous film forming foam (AFFF), halon, and carbon dioxide. It is important to consider the hazards that the removal of these materials can create.

N **A.7.1.7.3** Examples of pipelines include, but are not limited to, pipelines that are used for the transfer of liquid or gas cargo, liquid or gas fuel, inert gas, crude oil wash systems, cargo or fuel vapor vents to atmosphere or vapor recovery systems, lubricating oil, hydraulic oil, refrigerant, fire extinguishing media (e.g., water, foam, gases), steam, water, sewage, and heating media (e.g., steam or thermal oil).

N **A.7.1.7.4** Holes should be drilled at the lowest possible points to ensure that the tanks, compartments, pumps, and pipelines are completely drained of liquids or gases.

A.7.1.8.1 The improper introduction of an inerting gas can generate sufficient static electricity for ignition. Refer to NFPA 69 for level of oxygen to support combustion and NFPA 77 and industry standards such as *International Safety Guide for Oil Tankers and Terminals* (ISGOTT) and *Tanker Safety Guide* (Chemicals).

A.7.1.8.4 Valves can be opened, closed, or blanked as necessary to maintain the inert condition of the space.

A.8.1.5 Due to the different methods of conducting tests for toxic materials, the results should be listed as "None detected" along with the limit of detection (LOD) or less than (<) the LOD as follows:

(1) *Example 1:* Benzene — None Detected, LOD = 0.5 ppm
(2) *Example 2:* Benzene <0.5 ppm

A result listed as zero (0) does not provide enough information to the end user of the Certificate. Some LODs can exceed established exposure limits.

N **A.8.1.6.3(1)** A fire watch is a trained person or persons responsible for continuously observing the hot work area, maintaining fire-safe conditions, and responding to emergencies during hot work operations and in the established period following the hot work operation. Requirements for the posting of a fire watch can be found in NFPA 312 and 29 CFR 1915 Subpart P.

A Marine Chemist should require the use of a fire watch if, during hot work, any of the following conditions are present:

(1) Slag, weld splatter, or sparks might pass through an opening and cause a fire.
(2) Fire-resistant guards or curtains are not used to prevent ignition of combustible materials on or near decks, bulkheads, partitions, or overheads.
(3) Combustible material closer than 35 ft (10.7 m) to the hot work in either the horizontal or vertical direction cannot be removed, protected with flame-proof covers, or otherwise shielded with metal or fire-resistant guards or curtains.
(4) The hot work is carried out on or near insulation, combustible coatings, or sandwich-type construction that cannot be shielded, cut back, or removed, or in a space within a sandwich-type construction that cannot be inerted.
(5) Combustible materials adjacent to the opposite sides of bulkheads, decks, overheads, metal partitions, or sandwich-type construction might be ignited by conduction or radiation.
(6) The hot work is close enough to cause ignition through heat radiation or conduction on insulated pipes, bulkheads, decks, partitions, or overheads; or combustible materials or coatings.
(7) The hot work is close enough to unprotected combustible pipe or cable runs to cause ignition.

N **A.8.1.6.3(2)** Fire barriers, such as welding blankets, welding curtains, and welding pads, should be listed by an organization that is acceptable to the AHJ. One such listing includes ANSI/FM 4950, *American National Standard for Evaluating Welding Pads, Welding Blankets and Welding Curtains for Hot Work Operations.*

A welding blanket is a heat-resistant fabric designed to be placed in the vicinity of a hot work operation; intended for use in horizontal applications with light-to-moderate exposures such as that resulting from chipping, grinding, heat treating, sand blasting, and light horizontal welding; designed to protect machinery; and intended to prevent ignition of combustible materials, such as wood, located adjacent to the underside of the blanket.

A welding curtain is a heat-resistant fabric designed to be placed in the vicinity of a hot work operation, intended for use in vertical applications with light-to-moderate exposures such as that resulting from chipping, grinding, heat treating, sand blasting, and light horizontal welding; and designed to prevent sparks from escaping an area.

A welding pad is a heat-resistant fabric designed to be placed directly under a hot work operation such as welding or cutting; intended for use in horizontal applications with severe exposures such as that resulting from molten substances or heavy horizontal welding; and designed to prevent the ignition of combustible materials located adjacent to the underside of the pad.

N **A.8.1.6.3(3)** Wherever natural ventilation might not ensure safe and healthy conditions with regard to the composition of the atmosphere, forced mechanical fresh air ventilation should be provided. In confined and enclosed spaces where dust, gas, vapor, steam, mist, or fumes can be formed, local exhaust ventilation should be used. Oxygen should never be used for ventilation. If it is not practicable or possible to ventilate an enclosed or confined space sufficiently to ensure a safe and healthy atmosphere is maintained throughout the duration of the work, then the Marine Chemist will need to designate the space as ENTER WITH RESTRICTIONS in accordance with 7.1.3 and 7.1.3.1.

Δ **A.8.1.7** For spaces that are designated NOT SAFE FOR WORKERS or NOT SAFE FOR HOT WORK, the Certificate can include instructions on how to achieve a safe condition for the intended scope of work. These instructions are a consulting service only and are not a statement of safe conditions at the time of inspection. It might be necessary for the Marine Chemist to be recalled to verify a safe condition has been achieved and issue a Certificate for the work.

N **A.8.4.1** *Within one day* refers to a calendar day that begins and ends at midnight.

A.8.4.3 The Marine Chemist can recognize a facility's procedures and infrastructure used to minimize risk and hazards to people and equipment through engineering controls supplemented by administrative controls. As an example, mechanical exhaust ventilation for the space has been installed and will operate continuously. OSHA, in 29 CFR 1915.13, notes that the frequency of retesting the atmospheric conditions of a space should be a function of several factors, including temperature, work in the tank, period of time elapsed, unattended tanks, work breaks, or ballasting.

Subsection 8.4.3 allows the rotation of work away from spaces that have been certified and worked in or on, but not where work has been suspended due to schedule requirements. It requires the shipyard competent person (if not the Marine Chemist) to reinspect and establish that safe conditions remain in certified spaces and applicable adjacent spaces before work resumes in or on such spaces. Vessel or shipyard management must always be aware, however, that any suspension of work in or on a confined or enclosed space constitutes a time for significant potential accumulation of hazards, and careful and documented reinspection before reentry and resumption of work is a strict necessity and requirement.

The intent of this wording is to clarify that spaces listed on the Marine Chemist Certificate do not need to be tested by the competent person unless work is being done on or in a space. For example, spaces on a Certificate do not need to be tested and inspected on a weekend if no work or entry is taking place. However, nothing is to prevent a competent person from testing more frequently than the minimum.

Where work is continuous, the affected spaces should be visually inspected, tested, and recorded on a daily basis to maintain the Marine Chemist's Certificate.

The word *daily* refers to a calendar day that begins and ends at midnight.

A.9.1.1 Vessels that carry flammable cryogenic liquids as either cargo or fuel present hazards due to the presence of gas-dangerous spaces. The following are examples of gas-dangerous spaces:

(1) 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-free condition
(2) An enclosed space outside the cargo or flammable cryogenic liquid storage area through which any piping that could 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
(3) A containment system and associated piping as follows:
    (a) A hold space where flammable cryogenic liquid is carried in a containment system requiring a secondary barrier
    (b) A hold space where flammable cryogenic liquid is carried in a containment system not requiring a secondary barrier
(4) A space separated from a hold space described in A.9.1.1(3)(a) above, by a single gastight steel boundary
(5) A pump room and compressor room
(6) A zone on the open deck or semi-enclosed space on the open deck within 3 m (9.84 ft) of any flammable cryogenic liquid tank outlet, gas or vapor outlet, flammable cryogenic liquid pipe flange, valve, or entrance and ventilation opening to related pump rooms and compressor rooms
(7) The open deck over the cargo area and 3 m (9.84 ft) forward and aft of the cargo area on the open deck up to a height of 2.4 m (7.88 ft) above the weather deck
(8) A zone within 2.4 m (7.88 ft) of the outer surface of a flammable cryogenic liquid containment system where such surface is exposed to the weather
(9) An enclosed or semi-enclosed space in which pipes containing product are located
(10) A compartment for transfer hose
(11) An enclosed or semi-enclosed space having a direct opening into any gas-dangerous space or zone

N A.10.1.1 Additional information concerning land-side storage tanks can be found in the following publications:

(1) NFPA 326 applies to the safeguarding of tanks or containers operating at nominal atmospheric pressure that contain or have contained flammable or combustible liquids or other hazardous substances and related vapors or residues.

(2) API RP 2207, *Preparing Tank Bottoms for Hot Work*, is a recommended practice that addresses hot work on the bottoms of storage tanks that have been in service to store flammable products.

N A.10.3.2 Organic lead compounds including, but not limited to, tetraethyl lead, tetramethyl lead, or mixtures of lead alkyls are added to gasoline to raise the octane rating. Lead alkyls are completely miscible with gasoline, will not separate out of a mixture, and are generally stable, as there is essentially no decomposition of lead alkyls in gasoline. Lead alkyls have a vapor pressure lower than that of gasoline and can produce lethal concentrations of lead vapor in the atmosphere. The use and storage of leaded gasoline in the US is extremely limited although it can still be produced in other countries.

N A.10.4 The Marine Chemist should be familiar with 29 CFR 1910.146 and 29 CFR 1926.1203 as many employers use these standards to safely enter above- and belowground tanks located within a shipyard or waterfront facility and do not follow 29 CFR 1915.

The Marine Chemist should also be familiar with the requirements of NFPA 326 and the recommendations presented in NFPA 329.

Annex B Examples of Safe Conditions

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

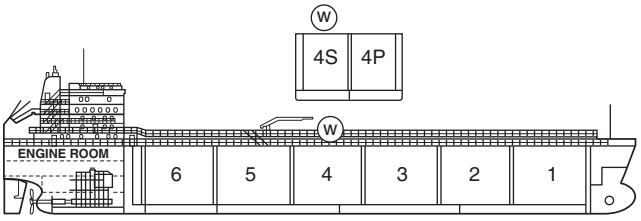
B.1 General. The illustrations of a double-hulled tank ship in Figure B.1, parts (a) through (e), are examples of safe conditions discussed in Chapter 5 of this standard. In this example, hot work is planned for the deck area above the four-starboard cargo tank. The vessel is not in a dry dock. The conditions shown in the drawings correspond to Sections 5.1 through 5.4 of this standard. Although the single plane drawings show horizontal separations only, vertical compartmentation should be similarly treated.

Annex C Samples of Marine Chemist's Certificates

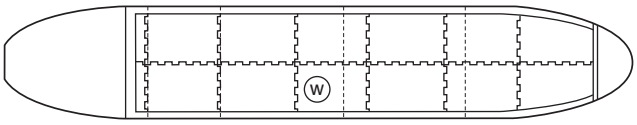
This annex is not a part of the requirements of this NFPA document but is included for informational purposes only.

C.1 Paper Marine Chemist's Certificate Form. The Certificate shown in Figure C.1 is a sample of the paper form that is filled out manually by the Marine Chemist at the completion of the inspection.

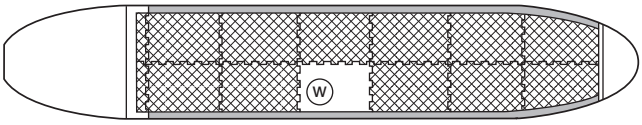
C.2 Computer-Generated Marine Chemist's Certificate Form. The Certificate shown in Figure C.2 is a sample of the computer-generated form that is created by the Marine Chemist at the completion of the inspection. The printed form can be produced on letter or legal size paper and can be printed in color or in black and white.



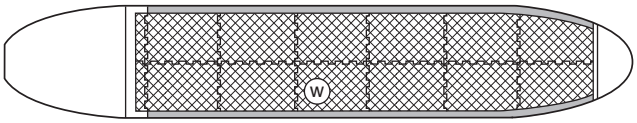
Side and cross-section view of a double-hulled tank ship. The overhead view of the vessel is used in examples (a) through (e) below:



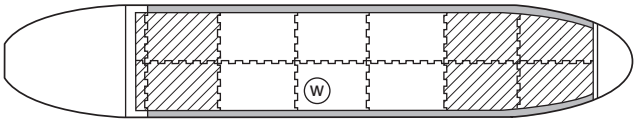
(a) Section 5.1: Safe condition obtained by cleaning all cargo tanks, slop tanks, and wing and double-bottom ballast tanks.



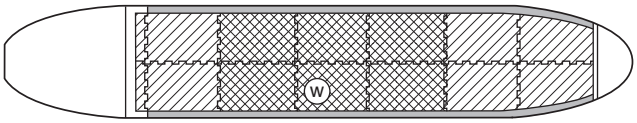
(b) Section 5.2: Safe condition obtained by cleaning the subject space and inerting other cargo tanks and slop tanks. All wing and double-bottom ballast tanks are filled with water.



(c) Section 5.2: Safe condition obtained by inerting the subject space and other cargo tanks and slop tanks. All wing and double-bottom ballast tanks are filled with water.



(d) Section 5.3: Safe condition obtained entirely by cleaning the subject space and adjacent cargo tanks and securing all other cargo tanks and slop tanks. All wing and double-bottom ballast tanks are filled with water.



(e) Section 5.4: Safe condition obtained by inerting the subject space and adjacent cargo tanks and securing all other cargo tanks and slop tanks. All wing and double-bottom ballast tanks are filled with water.

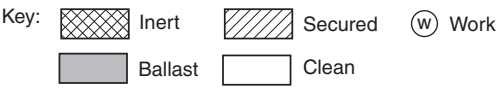


FIGURE B.1 Illustrations of Safe Conditions.

Marine Chemist's Name: _____
(Print)

Marine Chemist's Contact Information: _____
(Telephone/Pager/Email)

MARINE CHEMIST CERTIFICATE
SERIAL NO. B 00000

Survey Requested by	Vessel Owner or Agent	Date
Vessel	Type of Vessel	Specific Location of Vessel
Last Three (3) Loadings	Tests Performed	Time Survey Completed

In the event of physical or atmospheric changes affecting the STANDARD SAFETY DESIGNATIONS assigned to any of the above spaces, those spaces so affected are voided; spaces not listed on the Certificate are not to be entered unless authorized on another Certificate and/or maintained in accordance with OSHA 29 CFR 1915; or if in any doubt, immediately stop all work and contact the undersigned Marine Chemist. Unless otherwise stated on the Certificate, all spaces and affected adjacent spaces are to be reinspected daily or more often as necessary by the competent person in support of work prior to entry or recommencement of work. For spaces certified for hot work, the hot work is to be stopped while opening adjacent spaces, pipe lines, or hollow structures whose concentration of flammable liquids or gases are unknown.

QUALIFICATIONS: Transfer of ballast, cargo, fuel, or manipulation of valves or closure equipment tending to alter conditions in pipelines, tanks, or compartments subject to gas accumulation, unless specifically approved in this Certificate, requires inspection and a new Certificate for spaces so affected. All lines, vents, heating coils, valves, and similar enclosed appurtenances are considered "not safe" unless otherwise specifically designated. Movement of the vessel from its specific location voids the Certificate unless shifting of the vessel within the facility has been specifically authorized on this Certificate.

STANDARD SAFETY DESIGNATIONS (partial list, paraphrased from NFPA 306):

ATMOSPHERE SAFE FOR WORKERS: 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; (b) the concentration of flammable materials is below 10 percent of the lower explosive limit; (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.

NOT SAFE FOR WORKERS: In the compartment or space so designated, entry is not permitted.

ENTER WITH RESTRICTIONS: In the compartment or space so designated, entry for work is permitted only if conditions of proper protective equipment, or clothing, or time, or all of the aforementioned, as appropriate, are as specified.

SAFE FOR HOT WORK: In the compartment or space so designated (a) the oxygen content of the atmosphere is not greater than 22 percent by volume; (b) the concentration of flammable materials in the atmosphere is less than 10 percent of the lower explosive limit; (c) the residues, scale, or preservative coatings are cleaned sufficiently to prevent the spread of fire and are not capable of producing a higher concentration than permitted by (a) or (b); (d) all adjacent spaces containing or having contained flammable or combustible materials are sufficiently cleaned of residues, scale, or preservative coatings to prevent the spread of fire, or they are to be inerted. Ship's fuel tanks, lube tanks, or engine room or fire room bilges, or other machinery spaces, are to be treated in accordance with the Marine Chemist's requirements.

NOT SAFE FOR HOT WORK: In the compartment or space so designated, hot work is not permitted.

SAFE FOR LIMITED HOT WORK: In the compartment or space so designated (a) portions of the space are to meet the requirements for SAFE FOR HOT WORK AND PARTIAL CLEANING, as applicable; (b) the space is to be inerted, adjacent spaces are to meet the requirements for SAFE FOR HOT WORK, and hot work is restricted to specific locations; (c) portions of the space are to meet the requirements for Safe for Hot Work, as applicable, and the nature or type of hot work is to be limited or restricted.

SAFE FOR SHIPBREAKING: Unless otherwise stated on the Certificate, the duration of a Certificate for shipbreaking shall be RESTRICTED TO THREE DAYS.

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, *Standard for the 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 NFPA 306 and understands conditions and limitations under which it was issued, and the requirements for maintaining its validity.

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.

VESSEL POSTING

 NFPA 306

Δ FIGURE C.1 Sample of the Paper Form to Be Filled Out After Inspection for Certification.

Marine Chemist's Name
Address, City, State, Zip Code
Tel:
Email:

MARINE CHEMIST CERTIFICATE

SERIAL 000-00000
Page 1 of 1

Survey Requested by	Vessel Owner or Agent	Date
Vessel	Type of Vessel	Specific Location of Vessel
Last Three 3 Loadings	Tests Performed	Time Survey Completed

Inspected Spaces: % 0_2 % LEL Toxic-1 Toxic-2 Toxic-3 Toxic-4 **Safety Designations:**

Instructions:

In the event of physical or atmospheric changes affecting the STANDARD SAFETY DESIGNATIONS assigned to any of the above spaces, those spaces so affected are voided; spaces not listed on the Certificate are not to be entered unless authorized on another Certificate and/or maintained in accordance with OSHA 29 CFR 1915; or if in any doubt, immediately stop all work and contact the undersigned Marine Chemist. Unless otherwise stated on the Certificate, all spaces and affected adjacent spaces are to be reinspected daily or more often as necessary by the competent person or the authority have jurisdiction as applicable in support of work prior to entry or recommencement of work. For spaces certified for hot work, the hot work is to be stopped while opening adjacent spaces, pipe lines, or hollow structures whose concentration of flammable liquids or gases are unknown.

QUALIFICATIONS: Transfer of ballast, cargo, fuel, or manipulation of valves or closure equipment tending to alter conditions in pipelines, tanks, or compartments subject to gas accumulation, unless specifically approved on this Certificate, requires inspection and a new Certificate for spaces so affected. All lines, vents, heating coils, valves, and similar enclosed appurtenances shall be considered "not safe" unless otherwise specifically designated. Movement of the vessel from its specific location voids the Certificate unless shifting of the vessel within the facility has been specifically authorized on this certificate.

STANDARD SAFETY DESIGNATIONS: (partial list, paraphrased from NFPA 306)

ATMOSPHERE SAFE FOR WORKERS: 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; (b) the concentration of flammable materials is below 10 percent of the lower explosive limit; (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.

NOT SAFE FOR WORKERS: In the compartment or space so designated, entry shall not be permitted.

ENTER WITH RESTRICTIONS: In the compartment or space so designated, entry for work is permitted only if conditions of proper protective equipment, or clothing, or time, or all of the aforementioned, as appropriate, are as specified.

SAFE FOR HOT WORK: In the compartment or space so designated (a) the oxygen content of the atmosphere is not greater than 22 percent by volume; (b) the concentration of flammable materials in the atmosphere is less than 10 percent of the lower explosive limit; (c) the residues, scale, or preservative coatings are cleaned sufficiently to prevent the spread of fire and are not capable of producing a higher concentration than permitted by (a) or (b); (d) all adjacent spaces, containing or having contained flammable or combustible materials shall be sufficiently cleaned of residues, scale, or preservative coatings to prevent the spread of fire, or they are inerted. Ship's fuel tanks, lube tanks, or engine room or fire room bilges, or other machinery spaces, are to be treated in accordance with the Marine Chemist's requirements.

SAFE FOR LIMITED HOT WORK: In the compartment or space so designated (a) portions of the space meet the requirements for Safe for Hot Work and Partial Cleaning, as applicable; or (b) the space is inerted, adjacent spaces meet the requirements for Safe for Hot Work, and hot work is restricted to specific locations; (c) portions of the space shall meet the requirements for Safe for Hot Work, as applicable, and the nature or type of hot work shall be limited or restricted.

NOT SAFE FOR HOT WORK: In the compartment or space so designated, hot work is not permitted.

SAFE FOR SHIPBREAKING: Unless otherwise stated on the Certificate, the duration of a Certificate for shipbreaking shall be RESTRICTED TO THREE DAYS.

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, *Standard for the 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 NFPA 306 and understands conditions and limitations under which it was issued, and the requirements for maintaining its validity.

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 _____
Authorized Representative Company Date

Signed _____
Marine Chemist CMC No.

 NFPA 306

Δ FIGURE C.2 Sample of the Computer-Generated Form to Be Filled Out After Inspection for Certification.

Annex D Guidance to Vessel Owners and Operators When Hot Work and/or Enclosed/Confined Space Entry Is Conducted on a Vessel at Sea and a Marine Chemist Is Not Required

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

D.1 General. This standard is not written to specifically address how to perform atmospheric monitoring that is necessary to achieve safe conditions related to gas freeing, tank entry, and hot work. This standard contains guidance on the criteria for a safe condition for entry and hot work. For guidance on performance of atmospheric testing by tank vessel personnel at sea when a Marine Chemist is not required, tank vessel owners and operators can reference the following documents:

(1) API 1141, *Guidelines for Confined Space Entry On Board Tank Ships in the Petroleum Industry*
(2) *International Safety Guide for Oil Tankers and Terminals* (ISGOTT)
(3) *International Safety Guide for Inland Navigation Tank-barges and Terminals* (ISGINTT)
(4) *Recommendations for Entering Enclosed Spaces Aboard Ships*
(5) *Tanker Handbook for Deck Officers*
(6) *Tanker Safety Guide* (Liquid or Chemical)
(7) 29 CFR 1915, Subpart B
(8) Individual company safety policies and practices

Training is viewed by the committee as a very important aspect of a successful program for entering and working in confined or enclosed spaces. Specifying "how to" perform atmospheric monitoring in the context of this document is not appropriate but should be included in the training that all responsible personnel should receive.

Annex E Limiting Oxidant Concentrations

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

E.1 Limiting Oxidant Concentration for Flammable Gases When Using Nitrogen or Carbon Dioxide as Diluents. Table E.1(a) and Table E.1(b) will enable Marine Chemists to quickly reference certain inert gases and the corresponding limiting oxygen concentrations.