

NFPA 1925

Standard on Marine Fire-Fighting Vessels

2004 Edition



NFPA, 1 Batterymarch Park, Quincy, MA 02169-7471
An International Codes and Standards Organization

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This edition of NFPA 1925, *Standard on Marine Fire-Fighting Vessels*, was prepared by the Technical Committee on Marine Fire-Fighting Vessels and acted on by NFPA at its November Association Technical Meeting held November 15–19, 2003, in Reno, NV. It was issued by the Standards Council on January 16, 2004, with an effective date of February 5, 2004, and supersedes all previous editions.

This edition of NFPA 1925 was approved as an American National Standard on January 16, 2004.

Origin and Development of NFPA 1925

This standard resulted from a request by the NFPA Fire Service Training Committee stating there was a need for a document addressing construction, testing, and operation of marine fire-fighting vessels. The Technical Committee on Marine Fire-Fighting Vessels was appointed and began work on developing this document in 1991. The committee met many times during the 1990s to draft the first edition of the standard, which was issued by NFPA in the summer of 1998.

The 2004 edition of NFPA 1925 is a complete revision of the document to comply with the NFPA *Manual of Style*. Many of the changes in the document are editorial in nature and include updating definitions for consistency with the NFPA *Glossary of Terms*. In addition, the Committee eliminated waterline length as a consideration of the designation of class of fire-fighting vessel to focus on vessel functionality; operational requirements were streamlined to eliminate those provisions not essential as design considerations by marine fire-fighting vessel designers; and some existing requirements were reworded to state equipment usage in performance language so the requirement would be applicable to the activity being conducted by the designated class of marine fire-fighting vessel.

Dedication

The Marine Fire-Fighting Vessels Committee wishes to dedicate this second edition of the standard to the late Timothy Stillman, who was a member of the Committee from its start-up in January 1991 until his death in 2001.

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This list represents the membership at the time the Committee was balloted on the final text of this edition. Since that time, changes in the membership may have occurred. A key to classifications is found at the back of the document.

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

Committee Scope: This Committee shall have primary responsibility for documents on the design, construction, performance, and operation of marine vessels for fire fighting and related emergency operations.

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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. As an aid to the user, Annex C lists the complete title and edition of the source documents for both mandatory and nonmandatory extracts. Editorial changes to extracted material consist of revising references to an appropriate division in this document or the inclusion of the document number with the division number when the reference is to the original document. Requests for interpretations or revisions of extracted text shall be sent to the technical committee responsible for the source document.

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

Chapter 1 Administration

1.1 Scope.

1.1.1 This standard shall provide minimum requirements for marine fire-fighting vessels.

1.1.2 This standard shall also provide minimum maintenance and testing requirements.

1.2 Purpose.

1.2.1 The purpose of this standard shall be to provide the minimum requirements for the construction of new marine fire-fighting vessels or for the conversion of existing vessels to become marine fire-fighting vessels.

1.2.2 This standard is not intended to serve as a detailed manufacturing or purchase specification, but it shall be permitted to be referenced in purchase specifications as minimum requirements.

1.3 Application. This standard shall apply to both the construction of new vessels and the conversion of existing vessels for fire-fighting purposes.

1.4 Retroactivity. This standard shall not be retroactive unless an existing vessel is undergoing a major conversion to become a marine fire-fighting vessel.

1.5 Equivalency.

1.5.1 Nothing herein shall be construed as reducing relevant government regulations regarding marine fire-fighting vessels.

1.5.2 Nothing herein shall restrict any jurisdiction or manufacturer from exceeding these minimum requirements.

1.6 Units.

1.6.1 In this standard, values for measurement are followed by an equivalent in SI units, but only the first stated value shall be considered as the requirement.

1.6.2 Equivalent values in parentheses shall not be considered as the requirement as these values might be approximate.

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 11, *Standard for Low-, Medium-, and High-Expansion Foam*, 2002 edition.

NFPA 12, *Standard on Carbon Dioxide Extinguishing Systems*, 2000 edition.

NFPA 302, *Fire Protection Standard for Pleasure and Commercial Motor Craft*, 1998 edition.

NFPA 303, *Fire Protection Standard for Marinas and Boatyards*, 2000 edition.

NFPA 1931, *Standard on Design of and Design Verification Tests for Fire Department Ground Ladders*, 1999 edition.

NFPA 1961, *Standard on Fire Hose*, 2002 edition.

NFPA 1963, *Standard for Fire Hose Connections*, 2003 edition.

NFPA 1964, *Standard for Spray Nozzles*, 2003 edition.

NFPA 1981, *Standard on Open-Circuit Self-Contained Breathing Apparatus for Fire and Emergency Services*, 2002 edition.

NFPA 1983, *Standard on Fire Service Life Safety Rope and System Components*, 2001 edition.

NFPA 2001, *Standard on Clean Agent Fire Extinguishing Systems*, 2004 edition.

2.3 Other Publications.

2.3.1 ABS Publications. American Bureau of Shipping, 16855 Northchase Drive, Houston, TX 77060.

ABS Rules for Building and Classing High Speed Craft, 2001.

ABS Rules for Building and Classing Steel Vessels, 2003.

ABS Rules for Building and Classing Steel Vessels for Service on Rivers and Intracoastal Waterways, 1997.

ABS Rules for Building and Classing Steel Vessels Under 90 Meters (295 ft) in Length, 2001.

2.3.2 ABYC Publications. American Boat and Yacht Council, 3069 Solomon's Island Road, Edgewater, MD 21037. Website: www.abycinc.org.

ABYC E-2, *Cathodic Protection*, July 2001.

ABYC E-11, *Alternating Current (AC) and Direct Current (DC) Electrical Systems on Boats*, July 2003.

ABYC H-24, *Gasoline Fuel Systems*, December 1996.

ABYC H-25, *Portable Gasoline Fuel Systems*, July 2003.

ABYC H-26, *Powering of Boats*, May 1996.

ABYC H-33, *Diesel Fuel Systems*, July 1998.

ABYC H-40, *Anchoring, Mooring, and Lifting*, July 2003.

ABYC H-41, *Reboarding Means, Ladders, Handholds, Rails, and Lifelines*, July 1998.

ABYC P-4, *Marine Inboard Engines and Transmissions*, May 1996.

ABYC P-6, *Propeller Shafting Systems*, July 2002.

ABYC P-14, *Propulsion Control Systems*, December 1996.

ABYC P-17, *Steering Systems for Outboard Inboard Sterndrive and Water Jet Drive Boats*, July 2001.

ABYC P-18, *Cable Over Pulley Steering Systems for Outboard Motors*, July 2003.

ABYC S-12, *Outboard Motor Transom and Motor Well Dimensions*, July 2002.

2.3.3 ANSI Publications. American National Standards Institute, Inc., 25 West 43rd Street, 4th Floor, New York, NY 10036.

ANSI/ASME B1.20.1, *Pipe Threads, General Purpose (Inch)*, 1983/2001.

ANSI/CGA G-7.1, *Commodity Specifications for Air*, 1997.

2.3.4 ASTM Publications. American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

ASTM F 683, *Standard Practice for Selection and Application of Thermal Insulation for Piping and Machinery*, 2003.

ASTM F 1321, *Standard Guide for Conducting Stability Test (Lightweight Survey and Inclining Experiment) to Determine the Light Ship Displacement and Centers of Gravity of a Vessel*, 1992.

2.3.5 AWS Publications. American Welding Society, 550 N.W. LeJeune Road, Miami, FL 33126.

AWS B2.1, *Specification for Welding Procedure and Performance Qualification*, 2000.

2.3.6 U.S. Government Publications. U.S. Government Printing Office, Washington, DC 20402.

Title 33, Code of Federal Regulations, Part 159, *Marine Sanitation Devices*, July 2001.

Title 33, Code of Federal Regulations, Part 183, *Boats and Associated Equipment*, July 2001.

Title 46, Code of Federal Regulations, Part 56, *Piping Systems and Appurtenances*, Oct. 2002.

Title 46, Code of Federal Regulations, Part 56.50-55, *Bilge Pumps*, Oct. 2002.

Title 46, Code of Federal Regulations, Part 56.70, *Welding*, Oct. 2002.

Title 46, Code of Federal Regulations, Part 111, *Electric Systems — General Requirements*, Oct. 2002.

Title 46, Code of Federal Regulations, Part 112, *Emergency Lighting and Power Systems*, Oct. 2002.

Title 46, Code of Federal Regulations, Part 177, *Construction and Arrangement*, Oct. 2002.

Title 46, Code of Federal Regulations, Part 184, *Vessel Control and Miscellaneous Systems and Equipment*, Oct. 2002.

Title 46, Code of Federal Regulations, Part 197, *Marine Occupational Safety and Health Standards*, Oct. 2002.

Title 46, Code of Federal Regulations, Parts 24-28 (Subchapter C), *Uninspected Vessels*, Oct. 2001.

Title 46, Code of Federal Regulations, Parts 50-64 (Subchapter F), *Marine Engineering*, Oct. 2001.

Title 46, Code of Federal Regulations, Parts 110-113 (Subchapter J), *Electrical Engineering*, Oct. 2001.

Title 46, Code of Federal Regulations, Parts 175-187 (Subchapter T), *Small Passenger Vessels (Under 100 Gross Tons)*, Oct. 2001.

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 included, common usage of the terms shall apply.

3.2 NFPA Official Definitions.

3.2.1* Approved. Acceptable to the authority having jurisdiction.

3.2.2* 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.

3.2.3 Labeled. Equipment or materials to which has been attached a label, symbol, or other identifying mark of an organization that is acceptable to the authority having jurisdiction and concerned with product evaluation, that maintains periodic inspection of production of labeled equipment or materials, and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner.

3.2.4* Listed. Equipment, materials, or services included in a list published by an organization that is acceptable to the authority having jurisdiction and concerned with evaluation of products or services, that maintains periodic inspection of production of listed equipment or materials or periodic evaluation of services, and whose listing states that either the equipment, material, or service meets appropriate designated standards or has been tested and found suitable for a specified purpose.

3.2.5 Shall. Indicates a mandatory requirement.

3.2.6 Should. Indicates a recommendation or that which is advised but not required.

3.2.7 Standard. A document, the main text of which contains only mandatory provisions using the word "shall" to indicate requirements and which is in a form generally suitable for mandatory reference by another standard or code or for adoption into law. Nonmandatory provisions shall be located in an appendix or annex, footnote, or fine-print note and are not to be considered a part of the requirements of a standard.

3.3 General Definitions.

3.3.1 Acceptance. Agreement between the purchasing authority and the contractor that the terms and conditions of the contract have been met.

3.3.2 Acceptance Tests. In marine fire fighting vessels, tests performed on behalf of the purchaser by the manufacturer's representative at the time of delivery to determine compliance to the authority having jurisdiction requirements.

3.3.3 Accessible. Capable of being reached for inspection, maintenance, or removal without disturbing the permanent structure.

3.3.3.1 Readily Accessible. Capable of being reached quickly for operation, renewal, or inspections, without requiring those to whom ready access is requisite to climb over or remove obstacles or to resort to portable ladders, etc. [70:3.3]

3.3.4 Accommodation Spaces. Spaces designed for human occupancy as living spaces for persons aboard a vessel.

3.3.5 Anchor. A device designed to engage the bottom of a waterway and, through its resistance to drag, maintain a vessel within a given radius.

3.3.6 Anchor Chocks. Fittings on a deck of a vessel used to stow an anchor when it is not in use.

3.3.7 Anchor Rode. The line connecting an anchor with a vessel.

3.3.8 Anode. A metal that in an electrolyte assumes a more electronegative charge than one to which it is coupled. This metal tends to corrode or dissolve in an electrolyte. (See *Cathode*.)

3.3.9 Bilge. The lowest inner part of a ship's hull. [1405:1.3]

3.3.10 Bitt. Any of the deck posts, often found in pairs, around which ropes or cables are wound and held fast.

3.3.11 Bitter End. That end of a rope or cable that is wound around a bitt, for example, the onboard end of the anchor rode, which is usually permanently attached to the vessel.

3.3.12 Boarding Ladder. A device used for boarding a vessel from the water, including handles, rails, ladders, steps, or platforms.

3.3.13 Bridge. The vessel's command and control area, usually enclosed, containing the principal helm, navigation systems, communications systems, and monitoring equipment for the vessel's operating systems. Also called the pilothouse.

3.3.14 Cathode. A metal that in an electrolyte assumes a more electropositive charge than one to which it is coupled. This metal tends not to corrode or dissolve in an electrolyte. (See *Anode*.)

3.3.15 Chocks. Fittings usually found on the rail or deck of a vessel having jaws that serve as fair leads for anchor rode and other lines.

3.3.16 Class A or Class B Foams. See Foam.

3.3.17 Cleat. Fitting attached to the vessel used to secure an anchor rode or other line to the vessel.

3.3.18 Close-off Pressure. The maximum pressure the pump is capable of developing at zero discharge flow.

3.3.19 Convenient Reach. In marine fire fighting vessels, the ability to operate controls without excessive movement from a fixed position such as a seat or safety harness.

3.3.20 Crew. Anyone associated with the operation of the vessel.

3.3.21 dBA. Decibel, "A" scale.

3.3.22 Deck Rail. See Life Rail, Deck Rail, or Lifeline.

3.3.23 Dynamic Suction Lift. The sum of the vertical lift and the friction and entrance loss caused by the flow through the suction strainers, sea chest, and piping, expressed in feet (meters).

3.3.24* Eductor. A device that uses the Venturi principle to siphon a liquid in a water stream. The pressure at the throat is below atmospheric pressure, allowing liquid at atmospheric pressure to flow into the water stream.

3.3.25 Electrolyte. A liquid in which an electric current is easily conducted, for example, salt or brackish water.

3.3.26 EMS. Emergency medical services.

3.3.27 Fire-Fighting Vessel. Any vessel whose primary mission is fire-fighting and pumping operations, including emergency operations.

3.3.28 Fire Hazard Area.

3.3.28.1 Major Fire Hazard Area. Includes machinery spaces, engine casing, exhaust tunnels and equivalents, special category spaces, and any compartment where the proximity of combustible materials, flammable liquids, and potential sources of ignition can promote a fire.

3.3.28.2 Minor Fire Hazard Area. Accommodation, service, and public spaces.

3.3.29 Fire Monitor. See Monitor.

3.3.30 Foam. Fire-fighting foam, within the scope of this standard, is a stable aggregation of small bubbles of lower density than oil or water that exhibits a tenacity for covering horizontal surfaces. Air foam is made by mixing air into a water solution, containing a foam concentrate, by means of suitably designed equipment. It flows freely over a burning liquid surface and forms a tough, air-excluding, continuous blanket that seals volatile combustible vapors from access to air. It resists disruption from wind and draft or heat and flame attack and is capable of resealing in case of mechanical rupture. Fire-fighting foams retain these properties for relatively long periods of time. Foams also are defined by expansion and are arbitrarily subdivided into three ranges of expansion. These ranges correspond broadly to certain types of usage described below. The three ranges are as follows: (1) Low-expansion foam — expansion up to 20; (2) Medium-expansion foam — expansion from 20 to 200; (3) High-expansion foam — expansion from 200 to approximately 1000. [11:3.3]

3.3.31 Freeboard. The vertical distance between the sheer and the waterline measured at a stated point on the length of the vessel or at the lowest point of the sheer, and at designated displacement in fresh water.

3.3.32 Gallons. United States gallons.

3.3.33 Galvanic Corrosion. The corrosion that occurs at the anode of a galvanic couple caused by the flow of ions between dissolution metals in an electrolyte and electron flow within the dissimilar metals.

3.3.34 Galvanic Isolator. A device installed in series with the AC grounding (green) conductor of the shore power cable to block, in effect, the low voltage DC galvanic current flow, yet permit the passage of AC current normally associated with the AC grounding (green) conductor. [302:1.5]

3.3.35 Galvanically Compatible. Metals that are close to each other in the galvanic series.

3.3.36 GM. Abbreviation of metacentric height. (See *Metacentric Height*.)

3.3.37 gpm. Gallons per minute.

3.3.38 Grab Rail. See Handhold Device or Grab Rail.

3.3.39 Ground. In marine fire fighting vessels, a conducting connection, whether intentional or accidental, between an electrical circuit or equipment and the earth, or to some conducting body that serves in place of the earth, including any conductive part of the wetted surface of the hull.

3.3.40 Ground Tackle. A general term for the anchor, anchor rode, and fittings used for securing a vessel to anchor.

3.3.41 Grounded Conductor. In marine fire fighting vessels, a current-carrying conductor connected to the side of the electrical source that is intentionally maintained at ground potential.

3.3.42 Grounding Conductor. In marine fire-fighting vessels, a normally non-current-carrying conductor provided to connect the exposed metallic enclosures of electrical equipment to ground for the purpose of minimizing shock hazard to personnel.

3.3.43 Handhold Device or Grab Rail. Any fitting, assembly, or device, other than a lifeline or deck rail, that is intended for grasping with the hand. It can be of metal, wood, plastic, reinforced fiberglass, or any combination of materials suited for the purpose.

3.3.44 Hawse Pipe. A cylindrical or elliptical pipe or casting in a vessel's hull through which the anchor rode runs and within which the anchor shank can be housed.

3.3.45 Helm. The position that controls the direction and water speed of the vessel. The primary helm can be independent or located on the bridge. Secondary helms can be located for improved visibility for operations such as docking and towing.

3.3.46 Hull Potential Monitor. A DC meter, analog or digital, that measures the potential of a metallic hull or metallic hull fittings as compared to a reference electrode.

3.3.47 Impressed Current System. A cathodic protection system that uses an external power source to induce a DC electric current through an electrode (anode) that suppresses galvanic corrosion of the craft's hull. Typical power sources are batteries, alternators, and rectified output from alternating current generators.

3.3.48 Inclining Test. A test to determine the vessel displacement and center of gravity.

3.3.49 Inflatable Boat (IB). Any boat which achieves and maintains its intended shape and buoyancy through the medium of inflation.

3.3.50 Jet Drives. A vessel propelled by reaction to a water stream.

3.3.51 Life Rail, Deck Rail, or Lifeline. A single rail or the entire assembly of stanchions, lines, or rails, including hardware, gates, and so forth, surrounding weather decks and designed to reduce falls overboard.

3.3.52 Limber Holes. Holes in hull framing members to permit draining of liquids.

3.3.53 Line. Rope, when in use. [1983:3.3]

3.3.54 Major Conversion. A change in service of the vessel from some other use to use as a marine fire-fighting vessel.

3.3.55 Manufacturer. The person or persons, company, firm, corporation, partnership, or other organization responsible for taking raw materials or components and constructing a finished product.

3.3.56 Metacentric Height. A movable point used to determine stability when related to the center of gravity and center of buoyancy.

3.3.57 Monitor. A fixed master stream device, manually or remotely controlled, or both, capable of discharging large volumes of water or foam.

3.3.58 Monitor Panel. A device that is located at a position remote from the system being monitored (usually at the bridge) and that indicates the condition of the system being monitored.

3.3.59 Moorings. Methods of securing a vessel within a given area.

3.3.60 National Standard Hose Thread (NH). A standard thread that has dimensions for inside and outside fire hose connection screw threads as defined by NFPA 1963, *Standard for Fire Hose Connections*. [1963:3.3]

3.3.61* Net Pump Pressure. The sum of the discharge pressure and the dynamic suction lift converted to psi when pumping at draft or the difference between the discharge pressure and the suction pressure when pumping from a hydrant or other source of water under positive pressure.

3.3.62 Personal Flotation Device (PFD). A displacement device worn to keep the wearer afloat in water.

3.3.63 PFD. See Personal Flotation Device.

3.3.64 psi. Pounds per square inch.

3.3.65 psig. Pounds per square inch gauge. [51:3.3]

3.3.66 Pump Operator's Position. The location from which the pump operator operates the pump. [1906:1.7]

3.3.67 Rigid Hull Inflatable Boat (RHIB). See Inflatable Boat.

3.3.68 rpm. Revolutions per minute.

3.3.69 Sacrificial Anode System. Galvanic corrosion protection that employs zinc, aluminum, or magnesium anodes connected to the vessel's hull. The anodes dissolve away over time.

3.3.70 Salvage. The restoration of a distressed vessel to normal condition, usually the removal of water from inside the hull.

3.3.71 Seaworthy. A vessel's capability to perform its mission in adverse sea or weather conditions.

3.3.72 Sheer. Upper edge of hull exterior at the intersection with the deck.

3.3.73 Special Purpose Fire-Fighting Vessel. Any vessel built for another purpose but provided with fixed fire fighting capabilities (e.g., fire tug, work boat, yard patrol boat, hovercraft).

3.3.74 Stem. The most forward portion of the hull.

3.3.75 Thimble. A grooved metal reinforcement fitted snugly into an eye splice of rope to reduce chafing and to spread the tensional loads.

3.3.76 Thruster. Controllable device used to assist in maneuvering and positioning the vessel.

3.3.77 Tonnage. A measurement to determine vessel capacity (1 ton = 100 ft³).

3.3.78 Ventilation. The changing of air within a compartment by natural or mechanical means. Ventilation can be achieved by introduction of fresh air to dilute contaminated air or by local exhaust of contaminated air. [302:1.5]

3.3.79 Weather Deck. Any deck that is exposed to the weather and normally accessible to personnel and that permits walking or moving around outboard of the superstructure.

3.3.80 Windlass. A mechanical device utilized in the recovery of anchor and chain by vessels following anchoring operations.

Chapter 4 General Provisions

4.1 Classification.

4.1.1 Marine fire-fighting vessels designated as Class A shall meet the following minimum requirements:

- (1) Minimum pumping capacity, 5000 gpm (20,000 L/min)
- (2) Minimum rated net pump pressure, 150 psi (10 bar)
- (3) Minimum number of pumps, 2
- (4) Minimum number of generators, 2
- (5) Minimum number of monitors, 4
- (6) Minimum crew, 3
- (7) Minimum number of hose connections, 6 [1½ in. (38 mm)]; 10 [2½ in. (65 mm) or larger]
- (8) Fuel capacity, 8 hours

4.1.2 Marine fire-fighting vessels designated as Class B shall meet the following minimum requirements:

- (1) Minimum pumping capacity, 2500 gpm (10,000 L/min)
- (2) Minimum rated net pump pressure, 150 psi (10 bar)
- (3) Minimum number of pumps, 1
- (4) Minimum number of generators, 1
- (5) Minimum number of monitors, 2
- (6) Minimum crew, 2
- (7) Minimum number of hose connections, 4 [1½ in. (38 mm)]; 8 [2½ in. (65 mm) or larger]
- (8) Fuel capacity, 8 hours

4.1.3 Marine fire-fighting vessels and special purpose fire-fighting vessels designated as Class C shall meet the following minimum requirements:

- (1) Minimum pumping capacity, 500 gpm (2000 L/min)
- (2) Minimum rated net pump pressure, 150 psi (10 bar)
- (3) Minimum number of pumps, 1
- (4) Minimum number of generators, 0
- (5) Minimum number of monitors, 1
- (6) Minimum crew, 2
- (7) Minimum number of hose connections, 2 [1½ in. (38 mm)]; 1 [2½ in. (65 mm) or larger]
- (8) Fuel capacity, 4 hours

4.1.4 Rigid hull inflatables that are built to recognized marine standards (e.g., SAE, CFR, ABYC, NMMA) shall be exempt from the prescriptive requirements for outfitting, mechanical, and electrical by this standard, but shall comply with the fire-fighting equipment requirements provided by Chapter 13 and shall be subject to the approval of the authority having jurisdiction.

4.1.5 Special-purpose vessels that are built to recognized marine standards (e.g., ABS, CFR) shall be exempt from the prescriptive requirements for outfitting, mechanical, and electrical by this standard, but shall comply with the fire-fighting equipment requirements provided by Chapter 13 and shall be subject to the approval of the authority having jurisdiction.

4.2 Design and Construction.

4.2.1 The vessel shall comply with all relevant governmental regulations governing the design, operation, and navigation of vessels.

4.2.2 All parts of the vessel shall be constructed of materials appropriate for the environment in which the vessel will operate.

4.2.3* Whenever the freeboard of the vessel exceeds 24 in. (61 cm), the vessel shall be equipped with means to facilitate boarding from smaller vessels or from the water.

4.2.4 The vessel shall be so designed that the various systems and parts are readily accessible for inspection, adjustment, maintenance, repair, and lubrication.

4.3 Delivery.

4.3.1 Special Tools. When special tools are required to maintain or service any component of the vessel, such tools shall be provided.

4.3.2 Manuals.

4.3.2.1 The builder shall supply at the time of delivery no fewer than two copies of a complete set of operation and equipment service manuals for the vessel and each of the vessel's major systems. (*See Section B.2 regarding training on operation, care, and maintenance.*)

4.3.2.2 The items addressed by the manuals shall include, but not be limited to, the following:

- (1) Navigation systems
- (2) Main propulsion systems
- (3) Pumps
- (4) Electrical systems
- (5) Lubrication systems
- (6) Fire-fighting systems
- (7) Fire-fighting equipment
- (8) Communication systems
- (9) Vessel-operating characteristics
- (10) Damage control procedures

Chapter 5 Arrangements and Outfitting

5.1* General.

5.1.1 Machinery Spaces.

5.1.1.1 Machinery spaces shall be designed so that each part that requires inspection, adjustment, or maintenance is readily accessible.

5.1.1.2 All equipment shall be arranged so that it cannot be damaged by bilge water.

5.1.1.3 Apparatus that might arc shall be ventilated or in ventilated compartments in which flammable gases, acid fumes, and oil vapors cannot accumulate.

5.1.1.4 Skylights and ventilators shall be arranged to prevent flooding of equipment.

5.1.2 Accommodation Spaces.

5.1.2.1 Means of Escape.

5.1.2.1.1 At least two means of escape to the main weather deck shall be provided from the main hull spaces.

5.1.2.1.2 The means of escape shall be as far apart as possible and shall be operable from both sides.

5.1.2.2 Bulkheads. Bulkheads shall be intact other than for approved pipe penetrations and shall extend to the main weather deck, preferably in one plane.

5.1.3 Void Spaces.

5.1.3.1 Access and lighting holes shall be arranged clear of concentrated loads or areas of high stresses.

5.1.3.2 Air and limber holes shall be arranged to eliminate air pockets and to avoid any accumulation of water or other liquids.

5.1.4 Command and Control Spaces.

5.1.4.1 All vessels shall have a field of vision from the helm suitable for safe navigation in all operating conditions.

5.1.4.2 Polarized or tinted windows that would interfere with navigational light interpretation shall not be fitted.

5.1.4.3 Fire-fighting control stations on Class A and Class B vessels shall be insulated from heat and protected from spray.

5.1.4.4* Dedicated Positions.

5.1.4.4.1 Vessel operations shall be controlled from dedicated positions.

5.1.4.4.2 Pilothouses and helm stations shall provide adequate visibility for safe and efficient operation of the vessel.

5.1.4.5 Control Centers.

5.1.4.5.1 Fire-fighting control centers shall provide complete control of the fire pump and associated automated equipment.

5.1.4.5.2 The control center shall provide maximum visual observation of fire-fighting operations.

5.1.4.5.3 When the control center is to be used as an incident command center, adequate communications for the incident commander shall be provided.

5.1.4.6 Machinery monitoring shall be provided at each operating station and be adequate for the safe and proper operation of the vessel.

5.1.4.7 Vessels that are not equipped with remote controls for machinery shall have an engine room communication system in accordance with 46 CFR 184, *Vessel Control and Miscellaneous Systems and Equipment*.

5.1.4.8 Communications.

5.1.4.8.1 Fire ground communications shall be provided at all operating centers.

5.1.4.8.2 Volume or speaker placement at all stations shall be adequate to be heard over any ambient noise.

5.1.4.8.3 Helicopter Operations. Vessels equipped for helicopter operations shall be provided with a communication system between the vessel operator and a deck person, which shall include hearing protection from excessive noise.

5.1.5 Tanks.

5.1.5.1 Portable fuel tanks shall comply with ABYC H-25, *Portable Gasoline Fuel Systems*.

5.1.5.2 Gasoline fuel systems shall comply with ABYC H-24, *Gasoline Fuel Systems*.

5.1.5.3 Diesel fuel systems shall comply with ABYC H-33, *Diesel Fuel Systems*.

5.1.5.4 Foam concentrate tanks, holding tanks, hydraulic oil tanks, and other miscellaneous tanks shall be designed for their specific intended use.

5.1.6 Open Decks. Openings in weather decks shall comply with *ABS Rules for Building and Classing High Speed Craft*.

5.1.7 Recovery of Persons from the Water.

5.1.7.1 Where the mission of a vessel includes water rescue or body recovery, suitable means, including, but not limited to, dive platform, transom gate, rescue slide, or chute, shall be provided.

5.1.7.2 A davit or mechanized crane, where provided, shall have a minimum capacity of 500 lb (227 kg), at full horizontal extension.

5.2 Access and Egress.

5.2.1 Escape from occupied compartments shall meet the requirements of 46 CFR 177, *Construction and Arrangement*.

5.2.2 Access for inspection of all equipment and structural members shall be provided, and where openings are provided, there shall be no sharp or protruding edges that can cause injury.

5.2.3 Access for maintenance of all equipment shall be as convenient as practicable and shall not compromise the structural strength of the vessel.

5.2.4 The builder shall exercise quality engineering principles to ensure minimal disassembly of equipment.

5.3 Rails, Ladders, and Lifelines.

5.3.1 Rails, guards, and lifelines shall comply with requirements of 46 CFR 177, *Construction and Arrangement*.

5.3.2 Hand grabs shall meet the requirements of 46 CFR 177, *Construction and Arrangement*, or “Handheld Devices,” of ABYC H-41, *Reboarding Means, Ladders, Handholds, Rails, and Lifelines*.

5.3.3 Fixed ladders shall meet the requirements of “Ladders,” of ABYC H-41, *Reboarding Means, Ladders, Handholds, Rails, and Lifelines*.

5.4 Deck Surfaces.

5.4.1 Areas subject to slipping shall have nonskid surfaces. As a minimum, nonskid surfaces shall be used in the following areas:

- (1) Exterior walkways and companionways
- (2) Shower areas
- (3) Weather decks
- (4) Ladder steps and rungs
- (5) Walkways adjacent to engines

5.4.2 Nonskid surfaces shall be considered to be any material, surface treatment, or a combination of the two that can be used, applied, or installed on a vessel or its equipment to increase traction.

5.5 Insulation.

5.5.1 Thermal insulation for piping and machinery shall meet the requirements of ASTM F 683, *Standard Practice for Selection and Application of Thermal Insulation for Piping and Machinery*.

5.5.2 Acoustical Insulation.

5.5.2.1 The vessel shall be insulated acoustically to provide a maximum of 85 dBA in the pilothouse, 75 dBA in living quarters, 90 dBA on exterior decks, and 95 dBA in the engine room.

5.5.2.2 Persons in areas that measure greater than 90 dBA shall be required to wear hearing protection according to OSHA standards.

5.5.3 All insulation for fire protection shall meet the requirements of 2.1.5, 2.1.6, and 2.1.7 of NFPA 302, *Fire Protection Standard for Pleasure and Commercial Motor Craft*.

5.6 Human Factors Engineering.

5.6.1 The vessel shall comply with the requirements in 46 CFR Subchapter C, *Uninspected Vessels*, or Subchapter T, *Small Passenger Vessels (Under 100 Gross Tons)*.

5.6.2 Instructions for operation of safety equipment shall be the equipment manufacturers' instructions and shall be adequately posted.

5.6.3 Escape plans, operating instructions, diagrams, safety checklists, and other pertinent data shall be mounted to provide instructions to the crew and passengers.

5.7 Crew Accommodations.

5.7.1 All accommodations for the crew shall comply with 46 CFR 177, *Construction and Arrangement*.

5.7.2 Sleeping accommodations shall comply with 46 CFR 177, *Construction and Arrangement*.

5.7.3 All accommodation spaces below the weather deck shall be provided with mechanical ventilation and emergency lighting.

5.7.4 Toilet Facilities.

5.7.4.1 Toilet facilities shall comply with 46 CFR 177, *Construction and Arrangement*.

5.7.4.2 Class A and Class B vessels shall have approved water closet(s) and sink(s) commensurate with the size of the crew and passengers.

5.8 Fire Pump Operator's Position.

5.8.1 The pump operator's position shall be located for maximum visibility while maintaining protection from heat, smoke, and weather.

5.8.2 The pump operator's position shall have pump engine controls, discharge pressure gauge, pump engine tachometer, oil pressure and temperature gauges, and relief valve position indicators.

5.8.3 On Class A and Class B vessels, a diagram of all controls shall be prominently mounted at the pump operator's station.

5.9 Maintenance.

5.9.1 Maintenance plans shall be developed from manufacturers' instructions and made part of the vessel's standard operating procedures.

5.9.2 Placement of equipment shall allow for its removal from the vessel without having to disturb permanently installed structural members, or equipment shall be situated to allow for in-place overhaul and repair.

5.9.3 Coating Systems. Anti-fouling coatings shall be of an approved type.

5.9.4 Spare parts required to provide in-service operational continuity shall be readily available.

5.9.5 Facilities to provide stowage of minimal operating spare parts shall be provided.

5.9.6 Stowage of combustible or flammable maintenance materials shall meet the requirements of NFPA 302, *Fire Protection Standard for Pleasure and Commercial Motor Craft*.

5.10 Stowage Compartments.

5.10.1 Fire Hose Stowage.

5.10.1.1 Fire hose shall be protected from weather while stowed.

5.10.1.2 Compartments, where provided, shall have drains and vents to retard mildew and rot.

5.10.2 Weather-protected stowage compartments shall be provided for fire-fighting equipment and appliances.

5.10.2.1 The equipment and appliances shall be arranged for quick accessibility.

5.10.2.2 Means shall be provided to prevent damage to equipment and appliances due to shifting.

5.10.3 Where portable ladders are aboard, they shall be stowed securely and shall not interfere with the operation of the vessel.

5.10.4 Compartments for marine gear shall provide stowage and quick access to ensure safe vessel operations.

5.10.5 Stowage of self-contained breathing apparatus (SCBA) in compartments shall use racks to allow rapid donning and shall provide for spare breathing air cylinders.

5.10.6 Clothing lockers and compartments shall be ventilated in accordance with the requirements of NFPA 302, *Fire Protection Standard for Pleasure and Commercial Motor Craft*.

Chapter 6 Stability and Subdivision

6.1 Stability.

6.1.1 Both intact and damaged stability shall be determined by calculation to meet the criteria listed in 6.1.2.

6.1.1.1 The accuracy of the weight and weight center calculations shall be verified by testing prior to delivery of the vessel.

6.1.1.2 Where a major modification is made with a weight change greater than 5 percent, the vessel's stability shall be recalculated and shown to meet the criteria specified in 6.1.2.

6.1.2 Vessels shall comply with the respective requirements of Table 6.1.2 for each vessel class.

Table 6.1.2 Vessel Stability by Class of Vessel

Requirements	Class A	Class B	Class C
Passenger heel	Full	Simple	Simple
Wind heel	Full	Simple	Simple
Towing criteria	Yes	Yes	No
Monitor heel	7 degree	½ freeboard	½ freeboard
Subdivision standard	One compartment	Collision bulkhead	10 percent
Reserve buoyancy stability test	Inclination exposure	Deadweight survey	Deadweight survey

6.2 Passenger Heel.

6.2.1 Where the vessel classification requires compliance with the full passenger heel criteria, the vessel shall have a minimum metacentric height (GM), measured in feet, given by the following equation:

$$GM \text{ (required)} \geq \frac{Nb}{K \times W \times \tan(T)}$$

where:

N = the total number of passengers and crew
 b = the distance in feet from the centerline of the vessel to the geometric center of the deck on one side of the centerline
 K = 24 passengers per long ton
 W = the displacement in long tons of the vessel
 T = 14 degrees or the angle of heel at which the deck edge is first submerged, whichever is less

6.2.2 Where the vessel classification requires compliance with the simple passenger heel criteria, the moment produced by the following formula shall not cause any of the given limits to be exceeded:

$$M_p = W \times \frac{B}{6}$$

where:

M_p = heeling moment (passenger heel criteria)
 W = the total passenger and crew weight based on 160 lb (73 kg) per person
 B = the maximum transverse distance in feet that is accessible

6.2.2.1 Limits shall be as follows:

- (1) For all vessels, angle of heel shall not be greater than 14 degrees.
- (2) For flush deck vessels, no more than 50 percent of the freeboard shall be immersed.
- (3) For cockpit vessels, no more than 50 percent of the freeboard minus 25 percent times the fraction of the vessel length that is cockpit shall be immersed.
- (4) For open vessels, no more than 25 percent the freeboard shall be immersed.

6.3 Wind Heel.

6.3.1 Where the vessel classification requires compliance with the full weather criteria, it shall have a minimum metacentric height (GM), measured in feet, given by the following equation:

$$GM \text{ (required)} \geq \frac{PAH}{W \tan(\sigma)}$$

where wind pressure (P) is dependent on operating area as follows:

Ocean, $P = 0.005 + (L/14,200)^2$

Partially protected, $P = 0.0033 + (L/14,200)^2$

Protected, $P = 0.0025 + (L/14,200)^2$

where:

L = vessel length

where:

Lateral area (A) = the longitudinal area in square feet of the hull above the waterline, including handrails, masts, and monitors

H = the vertical distance in feet between the centroid of the lateral area and $\frac{1}{2}$ the depth of hull measured at midships

Displacement (W) = the weight in pounds of the vessel at the operating condition

σ = the angle of heel where 50 percent of the freeboard is submerged or 14 degrees, whichever is less

6.3.2 Where the vessel classification requires compliance with the simple wind heel criteria, the moment produced by the following formula shall not cause any of the following limits to be exceeded:

$$M_w = P \times A \times H$$

where:

M_w = heeling moment (wind heel criteria)

P = wind pressure

= 7.5 lb/ft², protected

= 10.0 lb/ft², partially protected

= 15.0 lb/ft², exposed

A = the longitudinal area in square feet of the hull above the waterline, including handrails, masts, and monitors

H = the height in feet from the waterline to the center of the area above the waterline

6.3.2.1 Limits shall be as follows:

- (1) For all vessels, the angle of heel shall not be greater than 14 degrees.
- (2) For flush deck vessels, no more than 50 percent of the freeboard shall be immersed.
- (3) For cockpit vessels, no more than 50 percent of the freeboard minus 25 percent times the fraction of the vessel length that is cockpit shall be immersed.
- (4) For open vessels, no more than 25 percent of the freeboard shall be immersed.

6.4 Towing Criteria.

6.4.1 Where the vessel will be used to tow other vessels or objects without restriction, the minimum metacentric height (GM), measured in feet, shall be given by the following formula:

$$GM \text{ (required)} \geq \frac{(NP \times D)^{2/3} SH}{38 \Delta (f/b)}$$

where:

N = the number of propellers

P = the horsepower per shaft

D = the propeller diameter in feet

S = the fraction of the propeller circle intercepted by a rudder turned 45 degrees from centerline

H = the vertical distance in feet from the propeller shaft centerline at the rudder to the towing bitts

Δ = the vessel displacement in long tons

f = the minimum freeboard length in feet, along the length of the vessel

b = the length of the molded beam in feet