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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NFPA 1925

Standard on

Marine Fire-Fighting Vessels

2004 Edition

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.

Technical Committee on Marine Fire-Fighting Vessels

Walter A. Damon, *Chair*
Schirmer Engineering Corporation, IL [I]

John D. Badgett, Los Angeles City Fire Department, CA [E]
Jack A. Ballinger, Tampa Fire Department, FL [U]
V. Frank Bateman, Kidde Fire Fighting, CA [M]
Richard E. Chester, Jr., Seattle Fire Department, WA [U]
Cory E. Clarkston, Zodiac of North America, CA [M]
Douglas Dillon, Tri-State Maritime Safety Association, DE [U]
Paul V. Fleury, Marine Services, MD [SE]
Alan Ross Hugenot, Alan Ross Hugenot, Inc., CA [IM]
John F. Lewis, John Lewis & Associates, Canada [SE]
Johnny M. Porter, City of Port Neches, TX [E]
Douglas A. Remaley, Dare County, NC [E]
Rep. International Association of Fire Chiefs
John W. Waterhouse, Elliott Bay Design Group, WA [SE]
Samuel L. Wilkin, Broward County Fire Rescue, FL [E]

Alternates

Douglas L. Barry, Los Angeles City Fire Department, CA [E]
(Alt. to J. D. Badgett)
Jon T. Harris, National Foam, Inc., PA [M]
(Alt. to V. F. Bateman)
Douglas Wolff, Elliott Bay Design Group, WA [SE]
(Alt. to J. W. Waterhouse)

Martha H. Curtis, NFPA Staff Liaison

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 rodes, 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 ft^3).

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 ½ 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/ft^2, protected
= 10.0 lb/ft^2, partially protected
= 15.0 lb/ft^2, 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

6.4.2 Where the vessel has a limited ability for emergency towing of other vessels or objects, a placard shall be posted near the operating station clearly stating the towing limitations.

6.5 Monitor Heel.

6.5.1 The heel produced by all monitors operating at maximum output in the direction most unfavorable to the stability of the vessel shall not exceed the limits given in Table 6.1.2.

6.5.2 The builder shall provide calculations covering all of the normal range of operating weights as given in Table 6.5.2(a) and Table 6.5.2(b).

Table 6.5.2(a) Normal Vessel Loads

Full load
95% fuel
100% foam concentrate
100% potable water
100% stores
Normal crew and their effects
50% load
50% fuel
100% foam concentrate
50% potable water
50% stores
Normal crew and their effects
10% consumables
10% fuel
100% foam concentrate
10% potable water
10% stores
Normal crew and their effects

Table 6.5.2(b) Fire-Fighting Loads

Maximum load
Same as full load in Table 6.5.1(a), plus
Water in fire main
Elevating tower or platform at maximum extension
Extra crew and their effects
Minimum load
Same as 10% consumables in Table 6.5.1(a), plus
Foam concentrate 10%
Water in fire main
Elevating tower or platform at maximum extension
Extra crew and their effects

6.5.3 Where the vessel has an elevating monitor, this monitor shall be assumed to be at its maximum elevation.

6.6 Turning Criteria. The heel produced by maneuvering the vessel at maximum speed at maximum rudder angle shall not exceed 50 percent of the at-rest freeboard or the angle at which equipment might become damaged.

6.7 Lifting Criteria.

6.7.1 Where the vessel is equipped with a crane or lifting apparatus, the heel produced by such equipment operating with a maximum lifting load at maximum outreach shall not exceed the lesser of either 50 percent of the freeboard or 14 degrees.

6.7.2 A placard shall be placed at the operating station that clearly states the lifting limits.

6.8 Subdivision Standard.

6.8.1 Where the vessel classification requires compliance with a one-compartment subdivision standard, the hull volume below the main deck shall be divided into transverse watertight compartments such that the vessel will remain floating upright, with a minimum freeboard of 3 in. (7.6 cm), when the total buoyancy between each set of two adjacent transverse watertight bulkheads is lost.

6.8.2 The permeability for each compartment shall be taken as 95 percent, other than for machinery spaces, which shall be taken as 85 percent.

6.8.3 The vessel shall be presumed to be in a full-load condition when damage occurs.

6.8.4 As demonstration that this requirement is met, a floodable length curve drawing shall be prepared based on the full-load condition.

6.9 Collision Bulkhead.

6.9.1 Where the vessel classification requires a collision bulkhead, the collision bulkhead shall be located at least 5 percent of the length between perpendiculars and no more than 5 percent plus 10 ft (3 m) from the point where the stem intersects the waterline.

6.9.2 Penetrations or openings in the collision bulkhead shall be watertight and placed as high and as far inboard as practicable.

6.10 Flotation.

6.10.1 Where the vessel classification requires the vessel to carry flotation, the flotation shall be equivalent to the weight of the fully loaded vessel in fresh water plus 10 percent.

6.10.2 The vessel shall be assumed to be intact but completely swamped.

6.10.3 The flotation shall be permitted to be in the form of buoyancy tanks, foam blocks, or hull structure.

6.10.4 The flotation shall be secured in place and shall retain its effectiveness after 24 hours' submergence in fresh water.

6.11 Loading Conditions.

6.11.1 The loading conditions to be evaluated for the intact stability calculations shall include those listed in Table 6.5.2(a) and Table 6.5.2(b).

6.11.1.1 Where asymmetric loading conditions can occur due to tank configurations, their effect on stability shall also be calculated.

6.11.1.2 Calculations showing the maximum passenger capacity on deck, the maximum equipment weight on deck, and the total of the two parameters previously cited shall be prepared.

6.12 Sea Keeping.

6.12.1 All Class A and Class B vessels shall be equipped with freeing ports and deck drains to provide drainage of water from the weather deck.

6.12.2 For vessels operating in other than protected waters, all access openings and vents shall be placed as high and as far inboard as practicable.

6.12.2.1 All tank vents shall be fitted with nonreturn devices.

6.12.2.2 Doors leading off the deck on vessels in ocean service shall be weathertight with sills a minimum of 18 in. (46 cm) above the deck.

6.12.2.3 Doors leading off the deck on vessels operating in partially protected waters shall be weathertight with sills a minimum of 6 in. (15 cm) above the deck.

6.13 Stability Tests.

6.13.1 Inclining Test.

6.13.1.1 Class A vessels shall be required to have an inclining test.

6.13.1.2 The inclining test shall be conducted in accordance with the requirements of 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.*

6.13.2 Deadweight Survey.

6.13.2.1 All vessels required to have a deadweight survey shall be tested when the vessel is complete, all ballast is aboard, and the vessel is floating.

6.13.2.2 The test shall consist of recording all tank levels to establish quantities of liquids, measuring the freeboard at three evenly spaced locations along the hull on each side, and calculating the vessel's resulting weight after accounting for the specific gravity of the water in which it is floating.

6.13.2.3 Alternatively, the vessel shall be permitted to be physically weighed using a certified scale.

6.13.2.4 The tested weight shall be within 5 percent of the weight used in the stability calculations for the calculations to be valid.

Chapter 7 Main Propulsion and Auxiliary Engines

7.1 General.

7.1.1 Installation requirements for marine propulsion systems that include engines, reduction gears, power takeoffs, and final drives shall be incorporated by reference to Chapter 3 of NFPA 302, *Fire Protection Standard for Pleasure and Commercial Motor Craft*, and other standards for the type of vessel and intended use.

7.1.2 Installation requirements for marine auxiliary engine systems that include engines, power takeoffs, and auxiliary machinery shall be incorporated by reference to Chapters 3 and 8 of NFPA 302, *Fire Protection Standard for Pleasure and Commercial Motor Craft*, and other standards for the type of vessel and its intended use.

7.1.3 Marine propulsion systems and auxiliary engine systems shall conform to the component manufacturer's installation requirements and proposed operating requirements.

7.1.4 The marine propulsion system(s) duty rating shall meet the component manufacturer's requirement for vessel use, considering factors such as time at full throttle, annual operating hours, final drive horsepower requirements, hull type, and probable time at severe load conditions.

7.1.5 Vessel propulsion engines shall be powered by either gasoline or diesel fuel. As constrained by Sections 7.2 and 7.3, auxiliary engines on Class A and Class B vessels shall be of the diesel fuel type.

7.2 Outboard Engines.

7.2.1 Outboard engines shall be permitted to be gasoline fueled and shall comply with ABYC H-26, *Powering of Boats*, and ABYC P-4, *Marine Inboard Engines and Transmissions.*

7.2.2 Vessels shall be required to have fuel systems that are permanently affixed within the vessel.

7.2.3 Steering systems shall comply with ABYC P-17, *Steering Systems for Outboard Inboard Sterndrive and Water Jet Drive Boats*, and ABYC P-18, *Cable Over Pulley Steering Systems for Outboard Motors.*

7.2.4 Mountings of the outboard engines and fit of the outboard(s) with a transom shall comply with ABYC S-12, *Outboard Motor Transom and Motor Well Dimensions.*

7.3 Inboard Engines.

7.3.1 Inboard propulsion and auxiliary engines shall be of the diesel fuel type and comply with *ABS Rules for Building and Classing Steel Vessels for Service on Rivers and Intracoastal Waterways*, and ABYC P-4, *Marine Inboard Engines and Transmissions.*

7.3.2 An engine governor shall be provided to limit the speed of the engine to that speed established by the manufacturer as the no-load governed speed.

7.3.3* Propulsion Engine Horsepower.

7.3.3.1 Propulsion engines, designed for also powering one or more fire pumps, shall be rated for horsepower required from the front of the engine to drive the fire pump at its rated capacity.

7.3.3.2 Horsepower requirements for pumping at capacity while simultaneously using 10 percent of the rated horsepower for station keeping shall not exceed the rated horsepower of the engine(s).

7.3.4 Engine Shutdown.

7.3.4.1 Automatic engine shutdown shall not be permitted.

7.3.4.2 Audible and visual warning devices for high engine temperature and low oil pressure, convenient to the operator's position at the helm, shall be installed for each engine.

7.3.5 Where ambient temperatures warrant, inboard engines shall be provided with thermostatically controlled block heaters energized from a shore power cable for heating while the engines are shut down and the vessel is moored.

7.4 Power Trains Using Inboard Engines.

7.4.1 Inboard-mounted propulsion assemblies including the diesel engine, reduction gear, PTO or clutch, couplings, shafting, and final drive system shall have a torsional vibration analysis and linear vibration analysis conducted during the design stage to verify component compatibility and suitability for the service intended.

7.4.1.1 The requirement in 7.4.1 shall also comply with *ABS Rules for Building and Classing High Speed Craft.*

7.4.2 Outdrive systems shall have horsepower and speed ratings compatible with the supplied propulsion engine.

7.4.3 The reduction gear cooling system, controls, and instruments shall conform to *ABS Rules for Building and Classing Steel Vessels for Service on Rivers and Intracoastal Waterways* and to the manufacturers' installation and proposed operating requirements.

7.4.4 Shafting Requirements.

7.4.4.1 Shafting requirements shall conform to one of the following documents: *ABS Rules for Building and Classing Steel Vessels for Service on Rivers and Intracoastal Waterways*, *ABS Rules for Building and Classing High Speed Craft*, or ABYC P-6, *Propeller Shafting Systems*.

7.4.4.2 The factor of safety (F_s) shall be 10.

7.4.5 Propellers.

7.4.5.1 Propeller systems shall conform to the standards within *ABS Rules for Building and Classing Steel Vessels for Service on Rivers and Intracoastal Waterways* or *ABS Rules for Building and Classing High Speed Craft*.

7.4.5.2 Propellers shall be sized and pitched to allow the engine to operate above the rated rpm under the vessel's most severe load conditions.

7.4.6 Steering systems shall comply with ABYC P-17, *Steering Systems for Outboard Inbound Sterndrive and Water Jet Drive Boats*, *ABS Rules for Building and Classing Steel Vessels for Service on Rivers and Intracoastal Waterways*, or *ABS Rules for Building and Classing High Speed Craft*.

7.4.7 Where a jet drive engine is also used to drive the fire pump, jet drives shall have infinite control capability for reversing the discharge flow to provide station-keeping ability.

7.4.8 Jet pump inlet grill(s) shall have provisions for clearing the intake area.

7.5 Engine Systems.

7.5.1 General.

7.5.1.1 Required engine fuel, exhaust, cooling, starting, ventilation, control, and instrument systems shall be in accordance with Chapters 2, 3, 4, 5, and 8 of NFPA 302, *Fire Protection Standard for Pleasure and Commercial Motor Craft*.

7.5.1.2 The required engine fuel, exhaust, cooling, starting, ventilation, control, and instrument systems shall conform to the engine manufacturer's installation and operating requirements.

7.5.1.3 Each inboard propulsion and auxiliary engine shall be equipped with an emergency engine shutdown system that restricts engine intake air.

7.5.2 Fuel System.

7.5.2.1 Fuel systems shall comply with Chapter 5 of NFPA 302, *Fire Protection Standard for Pleasure and Commercial Motor Craft*.

7.5.2.2 Fuel Capacity.

7.5.2.2.1 The fuel capacity shall be sufficient to provide for the transit fuel consumption to and from the scene plus 8 hours of operation mode for Class A and Class B vessels.

7.5.2.2.2 For the purpose of fuel capacity calculation, the following transit fuel consumption shall be used:

(1) Responding is the amount of fuel needed to reach the furthermost point in the jurisdiction at the maximum sustainable speed.
(2) Return is the amount of fuel needed to return from the furthermost point in the jurisdiction or assigned response area at the speed that produces the best fuel consumption.
(3) Operation mode is when all fire pumps are operating at maximum capacity, all propulsion engines that are separate from fire pump drive engines are operating at 10 percent of their maximum rating, and generator sets are operating at their full capacity.

7.5.2.3 Design consideration shall be given for refueling at the scene or increasing fuel capacity if operations are expected to require more fuel.

7.5.2.4 Safety considerations shall limit gasoline refueling at the scene to nonfire areas.

7.5.3 Exhaust Systems.

7.5.3.1 Exhaust systems shall comply with Chapter 4 of NFPA 302, *Fire Protection Standard for Pleasure and Commercial Motor Craft*.

7.5.3.2 Exhaust systems shall be so arranged as to minimize the intake of exhaust gases into occupied spaces, air-conditioning systems, and engine intakes.

7.5.4 Cooling Systems.

7.5.4.1 Cooling system sea suctions shall comply with *ABS Rules for Building and Classing Steel Vessels Under 90 Meters (295 ft) in Length*, *ABS Rules for Building and Classing Steel Vessels for Service on Rivers and Intracoastal Waterways*, or *ABS Rules for Building and Classing High Speed Craft*.

7.5.4.2 Adequate cooling arrangements shall be provided so as to maintain all lubricating oil and engine temperatures within the manufacturer's recommended limits during all operations for which the craft is intended.

7.5.5 Starting Systems.

7.5.5.1 Air, electric, or hydraulic-starting systems shall comply with NFPA 302, *Fire Protection Standard for Pleasure and Commercial Motor Craft*, *ABS Rules for Building and Classing Steel Vessels for Service on Rivers and Intracoastal Waterways*, or *ABS Rules for Building and Classing High Speed Craft*.

7.5.5.1.1 Starting systems shall have sufficient capacity without recharging for starting each main engine.

7.5.5.1.2 At least six consecutive starts shall be required for nonreversing engines.

7.5.5.1.3 At least 12 consecutive starts shall be required for reversing engines.

7.5.5.2 For vessels fitted with multiple propulsor units, the capacity of the starting system shall be ⅔ the number of propulsor units times the number of starts required for each engine.

7.5.6 Ventilation Systems.

7.5.6.1 All machinery spaces should be adequately ventilated and comply with Chapter 2 of NFPA 302, *Fire Protection Standard for Pleasure and Commercial Motor Craft*.

7.5.6.2 Ventilation systems relative to gasoline-powered vessels shall be in accordance with Chapters 2 and 5 of NFPA 302, *Fire Protection Standard for Pleasure and Commercial Motor Craft*.

7.5.7 Controls and Instruments.

7.5.7.1* Controls and instruments shall conform to *ABS Rules for Building and Classing Steel Vessels for Service on Rivers and Intracoastal Waterways*, *ABS Rules for Building and Classing High Speed Craft*, or ABYC P-14, *Propulsion Control Systems*.

7.5.7.2 Minimum helm-mounted instruments for each propulsion and auxiliary engine provided shall consist of coolant temperature gauge, oil pressure gauge, tachometer, and hourmeter.

7.5.7.3 A helm-mounted AC voltmeter shall be provided for onboard auxiliary AC systems, if furnished, and a DC voltmeter or ammeter shall be provided for DC systems.

7.5.7.4 A helm-mounted pump pressure gauge shall be provided to monitor fire main pressure from the fire pump(s).

7.5.7.5 Minimum helm-mounted instruments for each reduction gear provided shall consist of an oil temperature gauge.

7.5.7.5.1 Reduction gears with controllable slippage at output shall be provided with a shaft tachometer at the helm for each propeller shaft.

7.5.7.6 Helm-mounted instruments and audible and visual warning devices shall be well marked, illuminated, and visible from the operator's position.

7.5.7.7 Minimum helm-mounted controls shall consist of engine start/stop control(s), emergency engine shutdown, throttle control and transmission shift/engagement control(s) for each propulsion system, and control(s) for variable-pitch propellers where provided.

7.5.7.7.1 Steering control and rudder angle indicator shall be provided.

7.5.7.8 Where inboard and auxiliary engine locations are not convenient to the operator's position at the helm, additional engine-mounted controls and instruments shall be provided, consisting of an engine start/stop system, an oil pressure gauge, a coolant temperature gauge, and a tachometer.

7.6 Auxiliary Engine Systems.

7.6.1 Auxiliary AC generator system(s) shall be rated for marine use and 110 percent rated output. Marine AC generator systems shall conform to Chapter 8 of NFPA 302, *Fire Protection Standard for Pleasure and Commercial Motor Craft*.

7.6.2 Auxiliary engine(s) for powering fire pumps shall be marine-rated for the required horsepower to drive the fire pump(s) at its rated capacity at 110 percent of the rated discharge pressure.

7.6.3 An engine governor shall be provided to limit the speed of auxiliary engine(s) to that speed established by the manufacturer as the no-load governed speed.

7.6.4 Auxiliary air compressor system(s) shall be rated for marine use and shall conform to *ABS Rules for Building and Classing Steel Vessels for Service on Rivers and Intracoastal Waterways* or *ABS Rules for Building and Classing High Speed Craft*.

Chapter 8 Auxiliary Machinery and Systems

8.1 General.

8.1.1* Auxiliary machinery and systems on Class A vessels shall comply with 46 CFR Subchapter T, *Small Passenger Vessels (Under 100 Gross Tons); ABS Rules for Building and Classing Steel Vessels*; NFPA 302, *Fire Protection Standard for Pleasure and Commercial Motor Craft*; or 46 CFR 197, *Marine Occupational Safety and Health Standards*.

8.1.2* Class B and Class C vessels shall comply with 33 CFR 183, *Boats and Associated Equipment*.

8.2 Alarm Systems.

8.2.1 Alarm systems shall be designed to provide the vessel's crew with adequate warning of impending danger to themselves or their vessel.

8.2.2 All vessels with enclosed bilges or engine and machinery compartments shall be equipped with bilge alarms that are mounted and installed to indicate objectionable or dangerous amounts of liquids in the vessel's bilges, machinery spaces, or engine room and other compartments containing fire main piping other than the forepeak.

8.2.2.1 Audible and visual indicators shall be located in the vicinity of the helm.

8.2.2.2 Bilge alarm sending units shall be buffered to compensate for roll or pitching of the vessel.

8.2.3 Generators and other machinery shall be equipped with warning devices to indicate overheating, overspeed, or lack of proper lubrication.

8.2.4 Class A and Class B vessels with accommodation spaces shall be equipped with suitable smoke alarms to provide the indication and warning of abnormal conditions, the summoning of appropriate aid, and the control of occupancy facilities to enhance protection of life.

8.2.5 Vessels provided with permanently installed gasoline systems shall be provided with flammable vapor detection system(s).

8.2.5.1 Visual and audible indicators shall be located in the vicinity of the helm.

8.2.6 Class A vessels shall be equipped with a general alarm in accordance with Subchapter J of 46 CFR, *Electrical Engineering*.

8.3 Compressed Air Systems.

8.3.1 Where vessels are equipped with service air systems that are used for propulsion control, engine starting, or fire main operation, such service air systems shall be equipped with a low-pressure alarm.

8.3.2 Where vessels are equipped with breathing air systems, such breathing air systems shall deliver Type I, Grade D quality or better air as specified in ANSI/CGA G-7.1, *Commodity Specifications for Air*.

8.4 Steering Systems.

8.4.1 All rudders shall have an emergency means of steering.

8.4.2 Where provided, secondary steering locations shall include engine start/stop and clutch/throttle controls.

8.5 Bilge Systems.

8.5.1 Vessels less than 26 ft (8 m) in length shall have, at the least, a portable hand bilge pump with a minimum capacity of 5 gpm (20 L/min).

8.5.2 Vessels at least 26 ft (8 m) but less than 40 ft (12 m) in length shall have a fixed hand bilge pump or a fixed power bilge pump system having a minimum capacity of 10 gpm (40 L/min) measured at the terminus of the system.

8.5.2.1 Where a fixed hand pump is installed, it shall be operable from on deck.

8.5.3 Vessels of at least 40 ft (12 m) but less than 65 ft (20 m) in length shall have a fixed power bilge pump system having a minimum capacity of 25 gpm (100 L/min) measured at the terminus of the system.

8.5.4 Vessels of at least 65 ft (20 m) but less than 120 ft (37 m) in length shall have two fixed power bilge pumps having a combined minimum capacity of 50 gpm (200 L/min) measured at the terminus of the system.

8.5.5 Vessels 120 ft (37 m) or greater in length shall have two fixed power pumps and shall comply with 46 CFR Part 56.50-55, *Bilge Pumps*, depending on the classification of the vessel.

8.6 Sanitary Systems. Design and construction of marine sanitation devices shall meet the requirements of the Federal Water Pollution Control Act, 33 CFR Part 159, *Marine Sanitation Devices*, and other government requirements.

8.7 Hydraulic Systems. All pressure piping materials and components used in power-driven pressure systems shall comply with 46 CFR Subchapter F, *Marine Engineering*.

8.8 Wiper Systems.

8.8.1 Hand or mechanical windshield wiper systems shall be provided on all forward-facing windshields.

8.8.2 Windshields equipped with a windshield wiper system on Class A and Class B vessels shall be provided with a means of defrosting and washing.

8.8.3* Windshield wiper types installed shall ensure maximum clear window area for each window on which they are utilized.

8.8.4* Windshield washing fluid shall be permitted to be drawn from the potable water system, provided that the water supply is filtered.

8.9 Thruster Systems Not Involving the Fire Main System. Vessels equipped with thrusters not supplied by the vessel's fire main system that are used for station keeping shall comply with the requirements of Section 2 of *ABS Building and Classing Steel Vessels Under 90 Meters (295 ft) in Length*.

8.10 Freeze Protection Systems. All piping and appliances designed to remain "wet" during freezing temperatures shall be protected to prevent freeze damage.

Chapter 9 Electrical Systems

9.1 General.

9.1.1 Electrical systems for vessels under 100 international gross tons shall comply with Chapters 7 and 8 of NFPA 302, *Fire Protection Standard for Pleasure and Commercial Motor Craft*, and ABYC E-11, *Alternating Current (AC) and Direct Current (DC) Electrical Systems on Boats*.

9.1.1.1 DC electrical systems shall comply with Chapter 7 of NFPA 302, *Fire Protection Standard for Pleasure and Commercial Motor Craft*, and ABYC E-11, *Alternating Current (AC) and Direct Current (DC) Electrical Systems on Boats*.

9.1.1.2 AC electrical systems shall comply with Chapter 8 of NFPA 302, *Fire Protection Standard for Pleasure and Commercial Motor Craft*, and ABYC E-11, *Alternating Current (AC) and Direct Current (DC) Electrical Systems on Boats*.

9.1.2 Electrical systems for vessels 100 international gross tons and above shall comply with *ABS Rules for Building and Classing Steel Vessels Under 90 Meters (295 ft) in Length*, or with 46 CFR 111, *Electric Systems — General Requirements*, and 46 CFR 112, *Emergency Lighting and Power Systems*.

9.1.3 All vessels shall be provided with emergency lighting below deck, in accommodation spaces, at the first aid station, and in the engine room.

9.1.3.1 The duration of the emergency lighting for Class A vessels shall be at least 3 hours.

9.1.3.2 The duration of the emergency lighting for Class B and Class C vessels shall be at least 1 hour.

9.1.3.3 The power source shall be permitted to be any one of the following:

(1) An automatically connected or manually controlled storage battery
(2) An automatically or manually started generator
(3) Relay-controlled, battery-operated lanterns

9.2 Battery Systems.

9.2.1 All vessels with battery-starting systems shall be provided with a starting battery that is separate and independent of the ship service load and that can be isolated from the ship service load when the engine is not running.

9.2.2 Battery Banks.

9.2.2.1 Class A and Class B vessels with battery-starting systems shall have a minimum of two battery banks, either of which shall be capable of starting the engine(s).

9.2.2.2 A master switch shall allow selection of either bank.

9.3 Navigation Lights.

9.3.1 Mast head, port, starboard, and stern lights shall be provided and shall be controlled by a running light indicator panel.

9.3.2 A fused-feeder disconnect switch shall be provided on the indicator panel.

9.3.2.1 The rating of the fuses shall be at least twice that of the largest branch fuse and greater than the maximum panel load.

9.4 Searchlights.

9.4.1 Class A and Class B vessels shall be equipped with at least two mounted searchlights with candlepower suitable for the intended use, one of which shall be a spotlight and the other shall be a floodlight.

9.4.1.1 Mounted searchlights shall be capable of rotating approximately 360 degrees and shall be mounted to permit the illumination of the water as close to the vessel as possible.

9.4.2 Class C vessels shall be equipped with at least one portable searchlight with candlepower suitable for the intended use.

Chapter 10 External Fire-Fighting Pumps, Piping, and Discharge Devices

10.1 General.

10.1.1 The selection of pumps and design of distribution piping shall be based on the following:

(1) Number, sizes, and types of distribution devices expected to be used simultaneously
(2) Pressure required at the inlets of the discharge devices
(3) Required capacity (flow) of the vessel for external fire fighting

10.1.1.1 Where the fire pumps and distribution piping are used to supply thrusters for station keeping, the fire pump capacity and distribution pipe size shall be increased to permit station keeping without decreasing fire flow capacity.

10.1.1.2 Where the distribution piping from the fire pumps also supplies the vessel protection systems, the demand for those vessel protection systems shall be added to the fire pump distribution piping to permit simultaneous use without decreasing the fire flow capability of the vessel.

10.1.2 All piping, fittings, and valves shall be constructed of similar materials that will resist galvanic corrosion.

10.2 Components.

10.2.1 All components shall have design pressure ratings equal to or greater than the maximum pump pressure.

10.2.2 Pump discharge piping shall include a check valve and isolation valve for each pump.

10.2.3 All valves used in the pump piping system shall be equipped with an operating mechanism that indicates the position of the valve closure member.

10.2.4* Where a vessel's pumping capacity exceeds 3000 gpm (11,500 L/min), two or more pumps shall be provided.

10.2.5 Isolation Valves.

10.2.5.1 Discharge piping shall be provided with valves to isolate a portion of the piping in case of piping failure.

10.2.5.2 In Class A and Class B vessels, not more than 50 percent of the pumping capacity shall be lost due to any single piping failure beyond the isolation valve on the pump discharge.

10.3 Suction Arrangement.

10.3.1 The suction arrangements for each pump shall include at least one sea chest with screened inlet, with a valved outlet.

10.3.1.1 Where looped sea chest outlet piping is provided, a valve shall be provided at or near the suction inlet of each pump.

10.3.2 The open area of the screen shall be at least two times the cross-sectional area of the suction pipe.

10.3.3 Backflush System.

10.3.3.1 The sea chest shall be provided with a backflush system.

10.3.3.2 The backflush system shall use either air or water to clear the inlet screen.

10.4 Piping.

10.4.1 Pipe used in pump and distribution systems shall meet or exceed the standard(s) referenced in 2.3.4 and 2.3.5 or be in accordance with 10.4.3 through 10.4.4.

10.4.2 Where steel pipe is used and joined by welding as referenced in Section 10.8, the minimum nominal wall thickness for pressures up to 300 psi (20.7 bar) shall be in accordance with Schedule 40 for sizes up to 6 in. (150 mm) and Schedule 30 for 8-in. (203-mm) and 10-in. (250-mm) pipe.

10.4.3 Where steel pipe is joined by threaded fittings referenced in 10.5.1, the minimum wall thickness shall be in accordance with Schedule 40, in sizes less than 4-in. (100-mm) pipe for pressures up to 300 psi (20.7 bar).

10.4.4 Bending of Schedule 40 steel pipe and Types K and L copper tube and copper nickel tube shall be permitted when bends are made with no kinks, ripples, distortions, reductions in diameter, or noticeable deviations from round.

10.4.4.1 The minimum radius of a bend shall be six pipe diameters for pipe sizes 2 in. (50 mm) and smaller and five pipe diameters for pipe sizes 2½ in. (65 mm) and larger.

10.5 Fittings.

10.5.1 Fittings used in distribution systems shall meet or exceed the standards referenced in 2.3.4 and 2.3.5.

10.5.2 Fittings shall be permitted for system pressures up to the limits specified in the fitting manufacturer's listings.

10.5.3 Screwed unions shall not be used on pipe larger than 2 in. (50 mm).

10.5.4 A one-piece reducing fitting shall be used wherever a change is made in the size of the pipe.

10.5.4.1 Hexagonal or face bushings shall be permitted in reducing the size of openings of fittings when standard fittings of the required size are not available.

10.6 Valves.

10.6.1 A shutoff valve shall be provided in the supply to each monitor.

10.6.2 All valves shall be provided and shall be arranged so that either the open or closed position is clearly indicated.

10.6.3 Discharge valves shall be capable of being opened and closed smoothly and readily at flow velocities of 20 ft/sec (6 m/sec).

10.6.3.1 The flow-regulating element of each discharge piping valve shall not change its position under any condition of operation involving discharge pressures to the maximum pressure of the pump.

10.6.3.2 The means to prevent a change in position shall be incorporated in the operating mechanism and shall be either manually or automatically controlled.

10.6.3.3 Each 3-in. (76-mm) or larger discharge piping valve shall have an operating mechanism that will not permit changing the position of the flow regulating element of the valve from full closed to full open, or vice versa, in less than 3 seconds.

10.6.4 Suction valves shall be capable of being opened and closed smoothly and readily at flow velocities of 15 ft/sec (5 m/sec).

10.6.5 Valves that are remotely controlled shall have a manual override feature located at the valve.

10.7 Threaded Pipe and Fittings.

10.7.1 All threaded pipe and fittings shall have threads cut according to ANSI/ASME B1.20.1, *Pipe Threads, General Purpose (Inch).*

10.7.2 Piping larger than 4 in. (10 cm) shall not be threaded.

10.7.3 Steel pipe with wall thicknesses less than Schedule 40 shall not be joined by threaded fittings.

10.8 Welded Pipe and Fittings.

10.8.1 Welding to join pipes and fittings shall be permitted provided that the welding methods comply with 10.8.2.

10.8.2 Welding methods shall comply with all the requirements of AWS B 2.1, *Specification for Welding Procedure and Performance Qualification.*

10.9 Brazed and Soldered Joints.

10.9.1 Joints for the connection of copper tube larger than ½ in. (13 mm) shall be brazed.

10.9.2 Highly corrosive fluxes shall not be used.

10.9.3 Welding and brazing shall be in accordance with Subchapter F of 46 CFR 56.70, *Welding*.

10.10 Piping System.

10.10.1 Piping Support.

10.10.1.1 Piping shall be supported from the vessel structure to carry the load of the water-filled pipe plus a minimum 50 percent overload applied at the point of support.

10.10.1.2 Where flanges are used to join piping or to facilitate removal of valves for service, a support shall be provided not more than 2 ft (0.6 m) from the joint.

10.10.1.3 Bracing shall be provided to resist the nozzle reaction of discharge devices.

10.10.1.4 Provision shall be made for the expansion or contraction of piping and for stresses in the piping due to temperature changes or working of the hull.

10.10.1.4.1 Slip joints shall be permitted in systems in locations where possible leaking will not be hazardous.

10.10.2 Drains.

10.10.2.1 Drains shall be provided to drain all portions of the discharge and distribution piping.

10.10.2.2 A small valved drain line that bypasses each pump check valve shall be provided to permit drainage of the discharge piping.

10.10.3 Flushing. All vessels operating in salt or brackish water shall have a means of flushing the distribution system with fresh water.

10.10.4 Relief Systems.

10.10.4.1 Automatic pressure relief valve(s) shall be provided on Class A and Class B vessels in the discharge piping system.

10.10.4.2* Piping from the relief valve outlet shall discharge outside the vessel above the maximum vessel load waterline.

10.10.5 System Design.

10.10.5.1* Piping shall be sized to limit velocities as indicated in 10.10.5.2, 10.10.5.3, and 10.10.5.4.

10.10.5.2 Velocities in suction piping shall not exceed 15 ft/sec (4.6 m/sec) with the pump operating at 125 percent of rated capacity.

10.10.5.2.1 Where a common suction header supplies more than one pump, velocities in that header shall not exceed 15 ft/sec (4.6 m/sec) with all pumps supplied operating simultaneously at 125 percent of the rated capacities.

10.10.5.3 Velocities in discharge piping from the pump to the distribution piping shall not exceed 20 ft/sec (6 m/sec) with the pump operating at 125 percent of its rated capacity.

10.10.5.4 Where more than one distribution main exists, all distribution mains shall be interconnected to supply all discharge devices.

10.10.5.4.1 Isolation valves shall be provided to facilitate repairs or control water loss from piping failure.

10.10.5.4.2 Velocities in any portion of the distribution loop shall not exceed 20 ft/sec (6 m/sec) at 125 percent of capacity with any combination of pumps and discharge devices operating under normal rated conditions.

10.10.5.5 Class A vessels shall have a looped distribution piping system.

10.10.5.6 The installed discharge piping shall be hydrostatically tested for 1 hour at not less than 200 psi (13.8 bar) or at 100 psi (6.9 bar) in excess of the maximum pump discharge pressure, whichever is greater.

10.11 Pumps.

10.11.1 Pump materials shall be galvanic compatible and shall be suitable for the pump's rated capacity, pressure, speed, ambient water temperature, and corrosiveness.

10.11.2 Pumps shall be designed to operate at rated capacity with a total suction lift not to exceed 10 ft (3 m).

10.11.3 Rated net pump pressure at rated capacity shall be 150 psi (10.34 bar) or greater for all vessels.

10.11.4 The pump manufacturer shall hydrostatically test the pump at twice the rated discharge pressure of the pump, but not less than 400 psig (27 bar ga).

10.11.5 Certification.

10.11.5.1 The pump manufacturer shall test each pump prior to shipping and shall certify that the pump meets the provisions of this standard.

10.11.5.2 The certification for each pump shall be provided to the buyer.

10.12 Pumping Engine.

10.12.1 The pumping engine shall meet the requirements for propulsion engines and accessories specified in Chapter 7.

10.12.2 The engine, with all engine-driven accessories operating, shall have sufficient horsepower to drive the pump at its rated capacity at 110 percent of rated discharge pressure.

10.12.3 Where the pump is driven by a vessel propulsion engine, the pump shall be equipped with a clutch that can be engaged or disengaged while the engine is running only at idle.

10.13 Controls, Gauges, and Instruments.

10.13.1 Class A and Class B vessels shall have gauges, controls, and instruments as listed in ABYC P-4, *Marine Inboard Engines and Transmissions*, and as recommended by the engine manufacturer.

10.13.2 Class C vessels shall require at least oil pressure and temperature gauges at the engine. Engine room controls shall not be required for Class C vessels.

10.13.3 For Class A and Class B vessels, engine room controls such as start, stop, and throttles shall be readily accessible.

10.13.4 For Class A and Class B vessels, instruments to monitor engine conditions, including, but not limited to, a tachometer, shall be provided adjacent to the controls in the engine room.

10.13.5 Controls for starting, stopping, and adjusting the speed of the engine shall be provided in the pilothouse.

10.13.5.1 A tachometer, discharge pressure gauge, and engine trouble warning light shall be located adjacent to the engine controls.

10.13.5.2 Each remote control station shall include a permanent sign identifying the pump being controlled.

10.13.5.3 Remote controls shall not be required for a staffed engine room.

10.13.6 All master fire pump pressure gauges shall have a dial not less than 3½ in. (90 mm) in diameter.

10.13.6.1 Gauge connections shall be accessible to permit back flushing of pressure tubing from remote gauge locations.

10.13.7 The suction gauge shall be a compound type ranging from 30 in. Hg (760 mm Hg) to 15 psi (1 bar).

10.13.7.1 Where pumps are arranged to operate in series, the suction gauge range shall be 30 in. Hg (760 mm Hg) to twice the maximum suction pressure.

10.13.7.2 Class C vessels shall not require a suction gauge.

10.13.8 The discharge pressure gauge range shall be from 0 psi (0 bar) to twice the maximum pressure the pump will produce under maximum suction conditions.

10.13.9 Test Gauge Connection.

10.13.9.1 The pressure gauge connections at each pump shall include a test gauge connection for original and periodic testing of the pump's performance.

10.13.9.2 The gauge cock shall be located for accessibility above deck plates, as close to the gauge tap on the pump flange as possible.

10.14 Discharge Devices.

10.14.1* General.

10.14.1.1 Where the discharge devices are to be used with fire-fighting foams, the devices shall be designed for and compatible with the type of foam concentrate to be used.

10.14.1.2 Discharge devices shall be selected based on the vessel's class and shall be installed in accordance with the manufacturer's instructions.

10.14.1.3 A readily accessible isolation valve shall be provided for each device or outlet.

10.14.1.4 All discharge devices shall be supported by the vessel structure to minimize stresses on piping and valves.

10.14.1.5 Discharge outlets and all fire hose connections shall have connections as specified in NFPA 1963, *Standard for Fire Hose Connections*.

10.14.2 Monitors.

10.14.2.1 The monitor system shall meet the minimum flow requirements for the class of vessel on which it is installed.

10.14.2.2* For Class A and Class B vessels, a single monitor or combination of monitors shall be located to allow for an unobstructed range of horizontal operation of at least 270 degrees centered on the bow of the vessel and shall have a vertical coverage of at least 60 degrees above and 15 degrees below horizontal.

10.14.2.3 Means shall be provided to prevent damage to the vessel's structure or equipment from the operation of the monitors.

10.14.2.4 Monitor supports shall be designed for all operational loadings at maximum flows and pressures.

10.14.2.5 Monitors and monitor nozzles shall have connections as specified in NFPA 1963, *Standard for Fire Hose Connections*.

10.14.2.6 Controls for nozzle rotation, elevation, and discharge pattern shall be located not less than 3 ft (0.9 m) and not more than 6 ft (1.8 m) above the deck or platform that serves as the operator's station for that monitor.

10.14.2.7 Monitors equipped with remote controls shall be designed so that each can be operated manually.

10.14.2.8 Remote control stations for monitors shall have operational visibility substantially equal to the operational range of the monitor.

10.14.2.9 Each monitor operator position shall have direct communication with the vessel's operator position.

10.14.2.10 Control systems for remote controlled monitors shall be protected with overload or circuit breaker protection.

10.14.3 Discharge Outlets.

10.14.3.1 Sufficient hose connections shall be provided to discharge 100 percent of the rated pump capacity into hose lines.

10.14.3.2 The minimum numbers and sizes of hose connections shall be as specified in Section 4.1.

10.14.3.3 On vessels where a fixed foam system is installed, a means of providing foam to one or more hose outlets shall be provided.

10.14.4 Water Thrusters.

10.14.4.1 The minimum water discharge rate for the class of vessel shall be available for fire-fighting purposes with one-half the vessel's water thrusters, if so equipped, operating at their maximum discharge rate.

10.14.4.2 Where the vessel's fire-fighting system is provided by water from the main propulsion system, the discharge rate consumed through propulsion discharges for station keeping shall be deducted from the actual fire pump capacity when calculating total fire-fighting capacity of the vessel.

Chapter 11 Foam Systems

11.1 General.

11.1.1 Where the vessel is equipped with a fixed foam system, the requirements of this chapter and NFPA 11, *Standard for Low-, Medium-, and High-Expansion Foam*, shall apply.

11.1.2* The selection of the foam-proportioning system shall be made only after a complete review of the foam performance necessary to satisfy the requirements of the mission and capability study.

11.1.2.1 The purchaser shall provide the foam system manufacturer with accurate fire water flow and pressure capabilities.

11.1.2.2 The purchaser shall provide the following minimum performance requirements for the installed system:

(1) Minimum and maximum flow rates
(2) Proportioning rate or range
(3) Minimum operating time required
(4) Minimum performance requirements of system discharge devices including at least flow, pressure, range/reach, whether aspirated or non-aspirated

11.2 Design and Performance Requirements.

11.2.1 The vessel shall be capable of supplying the power required by the foam-proportioning system in addition to the requirements of the other power-dependent systems installed on the vessel.

11.2.2 The foam-proportioning system shall be designed to operate with the type(s) of foam concentrate specified by the purchaser.

11.2.3* The materials and system components used in the construction of the foam-storage and proportioning and delivery system shall be compatible with the concentrate as specified by the foam manufacturer.

11.2.4 The foam-proportioning system shall be an integral part of the water delivery system.

11.2.4.1 The vessel builder shall demonstrate the following:

(1) Maximum rate of foam solution delivery capable of being discharged from the system at a given rate of proportioning
(2) Maximum operating pressure of the foam-proportioning system
(3) The minimum and maximum rate of foam solution discharge available at each individual outlet equipped with a foam-proportioning device

11.2.5 Discharge or pressure lines in the foam-proportioning system shall be designed and installed so that the velocity of the foam concentrate in the lines does not exceed 25 ft/sec (8 m/sec) at the maximum design flow.

11.2.6 Suction lines in the foam-proportioning system shall be designed and installed so that the velocity of the foam concentrate in the lines does not exceed 15 ft/sec (5 m/sec) at the maximum design flow.

11.2.7 The operating characteristics of the selected individual foam system components shall be reviewed to ensure that the installed system will meet or exceed the design performance requirements.

11.2.8 Components that can be flushed with water after use shall be constructed of materials that are resistant to corrosion after being flushed with fresh water and allowed to dry.

11.2.8.1 The components in 11.2.8, including, but not limited to, gaskets, seals, and binding of moving parts, shall also be constructed of materials resistant to deterioration by foam concentrates.

11.2.9 Where eductors are used, their flow rating shall be matched with the flow rating of the delivery devices they serve.

11.3 Controls.

11.3.1 All foam-proportioning system controls shall be clearly identified and readily accessible.

11.3.2 Foam-proportioning systems that incorporate a foam concentrate pump and tank shall include provisions to allow resupply while the system is in operation.

11.3.3 Foam-proportioning systems that require flushing after use shall include readily accessible controls that allow the system to be flushed completely with fresh water according to the manufacturer's instructions.

11.3.4 Foam systems that incorporate automatic proportioning features shall be equipped with controls that allow the automatic feature to be bypassed for manual operation.

11.3.5 For foam-proportioning systems that incorporate foam concentrate metering valves, each metering valve shall be calibrated and marked to indicate the range of foam concentrate proportioning rate(s) available as determined by the design of the system.

11.4 Gauges, Flowmeters, and Indicators.

11.4.1 All gauges, flowmeters, and indicators shall be located so they are readily visible.

11.4.2 All gauges or flowmeters shall be mounted in a manner to protect the gauge from physical damage and from excessive vibration.

11.4.3 Foam concentrate tanks with a capacity of 500 gal (2000 L) or more shall be provided with a gauging device for determining remaining foam concentrate volume in the tank.

11.5 Nameplates and Instruction Plates.

11.5.1 All labels and marking shall be of a type permanent in nature, shall be capable of withstanding the effects of extreme weather and temperature, and shall be attached in a manner that requires mechanical means to remove.

11.5.2 A nameplate shall be provided for each control, gauge, and indicator that is clearly marked with the identification and function of that device.

11.5.3 An instruction plate shall be provided for the foam-proportioning system that includes, as a minimum, a piping schematic of the system and basic operation instructions.

11.5.3.1 Foam concentrate trade names shall not be substituted for foam solution percentage ratios on instruction plates.

11.5.4 A label that reads "Foam Tank Fill" shall be provided at any foam tank fill opening and shall indicate the type and proportioning percentage of concentrate required.

11.6 Atmospheric Foam Concentrate Tank.

11.6.1 Where the vessel's foam-proportioning system incorporates an atmospheric foam concentrate tank, the requirements of this section shall apply.

11.6.2 The foam concentrate tank and associated piping shall be constructed of materials in accordance with 11.2.3.

11.6.3 The foam concentrate tank shall be provided with a protected fill opening that is designed to facilitate the operator's filling the tank from 5-gal (19-L) foam concentrate containers.

11.6.3.1 Foam concentrate tanks larger than 200 gal (800 L) shall incorporate a fill opening with an area of at least 36 in.^{2} (232 cm^2).

11.6.3.1.1 Where a fill opening is less than 36 in.^{2} (232 cm^2), a fill funnel with strainer shall be provided with a neck to fit the fill opening and a minimum 36-in.^{2} (232-cm^2) fill cup.

11.6.3.2 Foam concentrate tanks of 200 gal (800 L) or less shall incorporate a fill opening with an area not less than 4 in.^{2} (26 cm^2).

11.6.4 The tank opening shall be protected by a removable cover and screen.

11.6.4.1 The cover shall be attached to the tank fill by mechanical means such as a threaded cap or a hinged cover with a mechanical latching device.

11.6.5 Where the foam concentrate tank is over 100 gal (400 L), it shall incorporate an expansion compartment or dome located so that foam concentrate will enter this compartment only after the entire main tank compartment is completely filled.

11.6.5.1 The volume of this expansion compartment shall be not less than 2 percent of the total foam concentrate tank volume.

11.6.6 Pressure/Vacuum Vent.

11.6.6.1 The foam concentrate tank shall be equipped with a pressure/vacuum vent that allows the tank to adjust automatically for changes in pressure when filling or withdrawing foam concentrate from the tank.

11.6.6.2 The pressure/vacuum vent shall not permit outside air to enter the tank freely except during operation or for normal changes in volume due to changes in temperature.

11.6.7 The foam concentrate tank shall not be equipped with an overflow pipe or any direct opening to the atmosphere that is not gasketed or provided with a check valve device.

11.6.8* The foam concentrate tank shall be designed and constructed to facilitate cleaning the inside of the tank as required.

11.6.8.1 Foam concentrate tanks larger than 200 gal (800 L) with more than one internal compartment shall incorporate a removable top allowing access to each compartment or a removable personnel access hatch with a minimum inside diameter of 20 in. (51 cm).

11.6.8.2 Tanks equipped with a personnel access hatch shall also be equipped with a 20-in. (51-cm) minimum inside diameter opening through any internal baffles to allow personnel access to the entire tank interior.

11.6.8.3 Single-compartment foam concentrate tanks shall incorporate a removable hatch or fill opening that allows personnel access to the entire interior of the tank.

11.6.9 Swash Partitions.

11.6.9.1 The foam concentrate tank shall have a sufficient number of swash partitions so that the maximum dimension of any space in the tank, either transverse or longitudinal, shall not exceed 48 in. (122 cm) and shall be not less than 23 in. (58 cm).

11.6.9.2 The swash partitions shall have suitable vents and openings at the top and bottom to permit movement of air and foam concentrate between compartments to meet the maximum flow requirements of the foam-proportioning system.

11.6.10 Discharge.

11.6.10.1 The foam concentrate tank outlet connection shall be connected to a sump located in the bottom of the tank and shall permit discharge of at least 95 percent of the tank's capacity.

11.6.10.2 The discharge shall be protected by an antiswirl baffle in systems where the foam concentrate delivery rate exceeds 5 gpm (20 L/min).

11.6.11 The foam concentrate tank inlet connection shall terminate within 2 in. (5 cm) of the tank bottom to prevent aerating the foam concentrate.

11.6.12 Valved Drain.

11.6.12.1 A minimum 1-in. (2.5-cm) valved drain shall be provided in the sump of any foam concentrate tank of 20 gal (80 L) or more.

11.6.12.2 A minimum ½-in. (13-mm) valved drain shall be provided in the sump of any foam concentrate tank of less than 20 gal (80 L).

11.7 Foam Concentrate Pump.

11.7.1* Where the vessel's foam-proportioning system incorporates a foam concentrate pump, the requirements of this section shall apply.

11.7.2 The foam concentrate pump shall operate at a design speed that prevents cavitation and foaming in the concentrate system when delivering maximum design flow.

11.7.3 Drive train components required to transmit power to the foam concentrate pump shall be capable of transmitting the power required by the pump under the maximum design condition.

11.7.4 The foam concentrate pump shall deliver the flow and pressure required by the system when it is operating at 110 percent of rated capacity.

11.7.5 A relief valve or other overpressure limiting device shall be provided in the foam-proportioning system to protect the foam concentrate pump.

11.7.6* A strainer designated by the foam concentrate manufacturer shall be installed on the intake side of the foam concentrate pump so that any foam concentrate entering the system must pass through the strainer.

Chapter 12 Fire Protection Equipment for the Vessel

12.1 General.

12.1.1* The requirements of this chapter shall apply to all classes of fire-fighting vessels.

12.1.2* Only metallic piping and components shall be used in the fire protection systems.

12.1.3 The melting point of the materials shall be greater than that of the hull structure material.

12.2 Fire Detection and Alarm Systems.

12.2.1 Machinery, accommodation, and service spaces shall be provided with an approved automatic detection system and alarms that indicate at the control station the location of outbreak of a fire in all normal operating conditions.

12.2.2 Ventilation arrangements to the machinery, accommodation, and service spaces containing the fire detection equipment shall be such as to preclude, as far as practicable, the possibility of smoke from the fire being drawn into those spaces.

12.2.3 Fire detectors shall be of an approved or listed type.

12.2.4 Detector Location.

12.2.4.1 Detectors shall be located for optimum performance.

12.2.4.2 Positions near beams and ventilation ducts where air flow could adversely affect performance shall be avoided.

12.2.5 Control Panel.

12.2.5.1 Visual and audible alarm signal panels shall be arranged on the vessel's pilothouse and main control center.

12.2.5.2 The control panel shall indicate where the detection unit has operated.

12.2.6 All detectors shall be of a type such that they can be tested and reset to normal surveillance without the renewal of any component.

12.2.7 Class A and Class B vessels shall have at least two sources of power for the electrical equipment used in the operation of the fire detection and fire alarm systems, one of which shall be an emergency power source.

12.2.8 All electrical components shall meet the requirements found in Chapter 9.

12.2.9 Fire detectors shall be activated by heat or smoke or other products of combustion, by flame, or by any combination of these factors.

12.2.10 Detectors in machinery spaces shall be placed no more than 30 ft (9 m) apart.

12.2.11 In periodically unattended machinery space, heat and smoke detectors shall be placed no more than 30 ft (9 m) apart.

12.2.11.1 Where a fixed gas fire extinguishing system is installed, access doors to the space shall be such that they remain closed at all times with no holdback arrangements.

12.2.11.2 Doors to the protected space shall open outward.

12.2.12 At least one fire detector shall be provided in each crew accommodation space.

12.2.13 In service spaces, at least one fire detector shall be provided in each enclosed space not normally entered.

12.2.13.1 Detectors shall be placed not more than 30 ft (9 m) apart.

12.3 Fire Protection Water Piping and Pumps.

12.3.1 All vessels shall have at least one fire protection pump.

12.3.2 The fire protection pump shall have at least the capacity and shall at least be powered as shown in Table 12.3.2.

12.3.3 Where sanitary, ballast, bilge, or general service pumps are used as a vessel's fire pump, such pumps shall meet the capacities given in Table 12.3.2 for fire protection.

12.3.4 All Class A and Class B vessels shall be fitted with a fire protection main.

12.3.5 The fire protection main shall have drains installed for maintenance and protection from freezing.

12.3.6 All piping shall be tested in accordance with 10.10.5.6.

12.4 Hose Stations.

12.4.1 The number and position of hose stations shall be sufficient to reach any part of the vessel with an effective stream of water from a single length of hose.

12.4.1.1 The pipes and hose stations shall be so placed that the fire hoses can be easily coupled to them.

12.4.1.2 All hose couplings and nozzles shall be interchangeable throughout the vessel.

12.4.2 Fire hose shall have a minimum diameter of 1 in. (2.5 cm) and a maximum length of 75 ft (23 m).

12.4.3 Each fire hose shall be provided with a nozzle and couplings constructed of a compatible and noncorrosive material.

12.4.4 All fire hoses attached to hose stations in the machinery spaces shall be fitted with combination nozzles.

12.5 Fixed Inert Gas Extinguishing Systems.

12.5.1 A manually activated fixed inert gas extinguishing system shall be installed for all machinery spaces in Class A vessels.

12.5.2 Audible and visual alarms shall automatically sound and illuminate for at least 20 seconds prior to the discharge of an extinguishing medium into the space.

12.5.3 The system shall have two control stations.

12.5.3.1 One station shall be located near the entrance to the protected space, and the second station shall be located near the helm at the designated fire control station.

12.5.3.2 These controls shall be protected to prevent accidental discharge of an inert gas extinguishing system into the space.

12.5.3.3 Operating instructions shall be posted at all control stations.

Table 12.3.2 Fire Protection Pump Capacity and Power Source

Minimum Pump Capacity			Vessel Length			
			Greater than		Less than or equal to	
gpm	L/min	Power Source	ft	m	ft	m
5	20	Hand, electric, or engine driven	20	6	40	12
25	100	Electric or engine driven	40	12	65	20
50	200	Electric or engine driven	65	20	100	31
66.6	255	Electric or engine driven	100	31	—	—

12.5.4 Means shall be provided for stopping all ventilating fans, securing the protected space, closing all openings that would permit air to enter the space, and shutting down the main engines within the affected space.

12.5.4.1 Necessary controls shall operate from outside the space.

12.5.5 CO_2 or inert extinguishing gas cylinders shall meet the U.S. Coast Guard, Canadian Transportation Commission, or American Bureau of Shipping requirements and shall be maintained in accordance with NFPA 12, *Standard on Carbon Dioxide Extinguishing Systems*, or NFPA 2001, *Standard on Clean Agent Fire Extinguishing Systems*, as applicable.

12.5.6 Cylinders and associated controls shall be securely mounted and protected from weather, corrosion, mechanical damage, and temperatures outside the system's operating range.

12.5.7 A method of ascertaining the quantity of an inert extinguishing gas within the cylinders shall be provided.

12.5.8 Piping, valves, and fittings shall meet the requirements of Subchapter F of 46 CFR Part 56, *Piping Systems and Appurtenances*; *ABS Rules for Building and Classing Steel Vessels*; NFPA 12, *Standard on Carbon Dioxide Extinguishing Systems*; and NFPA 2001, *Standard on Clean Agent Fire Extinguishing Systems*, as applicable.

12.5.9 Piping shall be arranged and discharge nozzles positioned such that uniform distribution of the medium is attained.

12.5.10 Fixed inert gas extinguishing systems shall have sufficient quantity of inert gas to provide at least the minimum effective concentration for the gross volume of the protected space.

12.5.11 Discharge nozzles shall be listed and approved for discharge characteristics.

12.5.12 Each discharge nozzle shall be permanently marked to identify the equivalent single orifice diameter.

12.5.13 The total area of all discharge nozzles shall not exceed 85 percent or be less than 35 percent of nominal cylinder outlet area or the area of the supply pipe, whichever is smaller.

12.5.14 All dead-end lines shall extend 2 in. (50 mm) beyond the last orifice and shall be closed with a cap or plug.

12.5.15 All piping, valves, and fittings shall be securely supported and, where necessary, protected against mechanical damage.

12.5.16 Drains and dirt traps shall be fitted where necessary to prevent the accumulation of dirt or moisture and shall be readily accessible.

12.6 Hand-Portable/Semiportable Fire Extinguishers.

12.6.1* Portable fire extinguishers shall be provided, located, and maintained in accordance with Chapter 10 of NFPA 302, *Fire Protection Standard for Pleasure and Commercial Motor Craft*.

12.6.2 Whenever propulsion or pumping engines and generator sets are enclosed in housings, an extinguishing agent access port shall be provided so that the extinguishing agent can be discharged into the enclosure without opening it.

Chapter 13 Fire-Fighting Equipment

13.1 General Fire-Fighting and Emergency Equipment.

13.1.1 Fire-fighting equipment that is specified in this chapter and required for a given class of vessel shall be supplied and mounted or stowed prior to the vessel being placed in operation.

13.1.2 Brackets or compartments shall be provided as necessary to properly mount or stow all equipment as required in the purchase contract.

13.1.3 Class A vessels shall be outfitted with a minimum of one straight 14-ft (4.5-m) ladder equipped with roof hooks and one 35-ft (10.5-m) ground extension ladder.

13.1.3.1 Class B vessels shall be outfitted with one 14-ft (4.5-m) straight ladder equipped with roof hooks and one 24-ft (7.5-m) ground extension ladder.

13.1.3.2 Required ladders shall meet the requirements of NFPA 1931, *Standard on Design of and Design Verification Tests for Fire Department Ground Ladders*.

13.1.4 Class A and Class B vessels shall be outfitted with one portable fire-fighting pump having a minimum capacity of 250 gpm (1000 L/min) at 150 psi (10 bar) net pump pressure and supplied with 25 ft (7.5 m) of suction hose with strainer.

13.1.4.1 These pumps shall be gasoline or diesel powered and supplied with 25 ft (7.5 m) of suction hose with strainer.

13.1.4.2 Portable pumps shall have a minimum capacity of 250 gpm (1000 L/min) at 150 psi (10 bar).

13.1.5 Smoke Ejectors.

13.1.5.1 Class A vessels shall be outfitted with two smoke ejectors rated at no less than 5000 ft^3/min (142 m^3/min).

13.1.5.2 Class B vessels shall be outfitted with one smoke ejector rated at no less than 5000 ft^3/min (142 m^3/min).

13.1.6 Class A vessels shall be equipped with at least the following equipment:

(1) Four life rings
(2) One line gun
(3) Two 6-ft (2-m) pry bars
(4) One 24-in. (610-mm) bolt cutter
(5) Two 15-ft (4.5-m) pike poles
(6) Two 6-ft (2-m) pike poles
(7) Two scoop shovels
(8) One adjustable hydrant wrench
(9) Four sprinkler shutoffs
(10) One 100-ft (30-m) utility rope
(11) Two floating stretchers with harness
(12) Four portable extinguishers, 2-A:20-B:C
(13) Two 100-ft (30-m) electrical extension cords
(14) Two 6-lb (3-kg) flathead axes
(15) Two 6-lb (3-kg) Halligan tools or equivalent
(16) Eight spanner wrenches
(17) One 10-lb (4.5-kg) sledge hammer
(18) Two 100-ft (30-m) electrical extension cords
(19) Two grappling hooks
(20) Two 75-ft (23-m) ropes in throw bag
(21) Two 75-ft (23-m) heaving lines
(22) One 100-ft (30-m) NFPA 1983 life safety rope
(23) Two 2½-in. to 3½-in. (65-mm to 90-mm) or larger jet siphons
(24) Two 1½-in. to 2½-in. (38-mm to 65-mm) jet siphons

13.1.7 Class B vessels shall be equipped with at least the following equipment:

(1) Two sprinkler shutoffs
(2) Two life rings
(3) One line gun
(4) One 6-ft (2-m) pry bar
(5) One 24-in. (610-mm) bolt cutter
(6) One 10-lb (4.5-kg) sledge hammer
(7) Four grappling hooks
(8) One 15-ft (4.5-m) pike pole
(9) One 6-ft (2-m) pike pole
(10) One adjustable hydrant wrench
(11) One floating stretcher with harness
(12) Two portable extinguishers, 4-A:30-B:C
(13) One 6-lb (3-kg) flathead axe
(14) One 6-lb (3-kg) Halligan tool or equivalent
(15) One scoop shovel
(16) Two 50-ft (15-m) electrical extension cords
(17) Four spanner wrenches
(18) One 75-ft (23-m) rope in throw bag
(19) One 75-ft (23-m) heaving line
(20) One 100-ft (30-m) utility rope
(21) One 100-ft (30-m) NFPA 1983 life safety rope
(22) One 2½-in. to 3½-in. (65-mm to 90-mm) or larger jet siphon
(23) One 1½-in. to 2½-in. (38-mm to 65-mm) jet siphon

13.1.8 Class C vessels shall be equipped with at least the following equipment:

(1) One 6-lb (3-kg) flathead axe
(2) One 6-ft (2-m) pry bar
(3) One 24-in. (610-mm) bolt cutter
(4) One 10-lb (4.5-kg) sledge hammer
(5) One 8-ft (2.5-m) or longer pike pole
(6) One adjustable hydrant wrench
(7) Two portable extinguishers, 2-A:10-B:C
(8) One life ring
(9) One 100-ft (30-m) utility rope
(10) One 100-ft (30-m) NFPA 1983 life safety rope
(11) One 75-ft (23-m) rope in throw bag
(12) Two spanner wrenches
(13) Two grappling hooks
(14) One 500-gph (2000-L/hr) dewatering device

13.2 Self-Contained Breathing Apparatus (SCBA).

13.2.1 There shall be at least one SCBA provided for each crew member aboard Class A, B, and C fire-fighting vessels.

13.2.2* At least two spare SCBA cylinders shall be available for each SCBA carried on Class A and Class B vessels, and one spare SCBA cylinder shall be available for each SCBA carried on Class C vessels.

13.2.3* All SCBA shall meet the requirements of NFPA 1981, *Standard on Open-Circuit Self-Contained Breathing Apparatus for Fire and Emergency Services*, and shall be of an approved type for marine use.

13.3 Fire Hose and Appliances.

13.3.1 Fire Hose.

13.3.1.1 Class A vessels shall be outfitted with the following hose, meeting requirements of NFPA 1961, *Standard on Fire Hose*, as follows:

(1) 600 ft (200 m) — 3½-in. (90-mm) or larger supply hose
(2) 600 ft (200 m) — 2½-in. or 3-in. (65-mm or 76-mm) hose
(3) 600 ft (200 m) — 1½-in., 1¾-in., or 2-in. (38-mm, 45-mm, or 50-mm) attack hose

13.3.1.2 Class B vessels shall be outfitted with the following hose, meeting requirements of NFPA 1961, *Standard on Fire Hose*, as follows:

(1) 400 ft (125 m) — 3½-in. (90-mm) or larger supply hose
(2) 400 ft (125 m) — 2½-in. or 3-in. (65-mm or 76-mm) hose
(3) 400 ft (125 m) — 1½-in., 1¾-in., or 2-in. (38-mm, 45-mm, or 50-mm) attack hose

13.3.1.3 Class C vessels shall be outfitted with 300 ft (100 m) of 1½-in., 1¾-in., or 2-in. (38-mm, 45-mm, or 50-mm) attack hose.

13.3.2 Couplings. All couplings on fire hose shall be 2½ in. or 1½ in. (65 mm or 38 mm) and constructed of corrosion-resistant material and shall meet the requirements of NFPA 1963, *Standard for Fire Hose Connections*.

13.3.3 Nozzles.

13.3.3.1 Class A Vessels.

13.3.3.1.1 Class A vessels shall be outfitted with the following nozzles:

(1) Four 2½-in. (65-mm) combination with shutoff
(2) Four 1½-in. (38-mm) combination with shutoff
(3) Four 2½-in. (65-mm) cellar or distributor
(4) Two 2½-in. (65-mm) foam eductor with matching nozzle
(5) Two 1½-in. (38-mm) foam eductor with matching nozzle

13.3.3.1.2 All nozzles and accessories shall be of corrosion-resistant construction and shall meet the applicable requirements of NFPA 1964, *Standard for Spray Nozzles*.

13.3.3.2 Class B Vessels.

13.3.3.2.1 Class B vessels shall be outfitted with the following nozzles:

(1) Two 2½-in. (65-mm) combination with shutoff
(2) Two 1½-in. (38-mm) combination with shutoff
(3) Two 2½-in. (65-mm) cellar or distributor
(4) One 2½-in. (65-mm) foam eductor with matching nozzle
(5) One 1½-in. foam (38-mm) eductor with matching nozzle

13.3.3.2.2 All nozzles and accessories shall be of corrosion-resistant construction complying with NFPA 1964, *Standard for Spray Nozzles*.

13.3.3.3 Class C Vessels.

13.3.3.3.1 Class C vessels shall be outfitted with two 1½-in. (38-mm) combination nozzles with shutoff.

13.3.3.3.2 All nozzles and accessories shall be of corrosion-resistant construction complying with NFPA 1964, *Standard for Spray Nozzles*.

13.3.4 Appliances for Class A and Class B Vessels.

13.3.4.1 Class A and Class B vessels shall be outfitted with at least the following appliances:

(1) One large-diameter double male
(2) One large-diameter double female
(3) Two 2½-in. (65-mm) double males
(4) Two 2½-in. (65-mm) double females
(5) Two large-diameter to 2½-in. (65-mm) reducers
(6) Two 2½-in. to 1½-in. (65-mm to 38-mm) reducers
(7) Two 2½-in. (65-mm) to large-diameter increasers

(8) Two 2½-in. (65-mm) plugs
(9) Two 2½-in. (65-mm) caps
(10) Two 2½-in. (65-mm) siamese
(11) Two 2½-in. (65-mm) gated wyes
(12) Two 2½-in. × 1½-in. × 1½-in. (65 mm × 38 mm × 38 mm) gated reducing wyes
(13) At least two international shore connections

13.3.4.2 The connections on these appliances shall comply with the requirements of NFPA 1963, *Standard for Fire Hose Connections*.

13.3.5 Couplings and Appliances for Class C Vessels. Class C vessels shall be outfitted with the following couplings and appliances complying with NFPA 1963, *Standard for Fire Hose Connections*:

(1) One 2½-in. (65-mm) double male
(2) One 2½-in. (65-mm) double female
(3) One 2½-in. to 1½-in. (65-mm to 38-mm) reducer
(4) One 2½-in. × 1½-in. × 1½-in. (65 mm × 38 mm × 38 mm) gated reducing wye

13.4 Rescue Tools and Equipment.

13.4.1 Class A vessels shall be outfitted with a motorized rescue/work vessel capable of carrying two fire fighters in full protective clothing and SCBA, and having a minimum weight-bearing capacity of 600 lb (272 kg).

13.4.2 Class A and Class B vessels shall be equipped with a manually operated portable hydraulic rescue tool kit.

13.4.3 Lifeline.

13.4.3.1 Class A and Class B vessels shall be outfitted with two 150-ft (45-m) lengths of nonconducting lifeline.

13.4.3.2 Class C vessels shall be outfitted with one 150-ft (45-m) length of nonconducting lifeline.

13.4.4 Saw.

13.4.4.1 Class A and Class B vessels shall be outfitted with one gasoline-powered saw suitable for cutting wood, fiberglass, metal, and masonry.

13.4.4.2 Class C vessels shall be outfitted with one handsaw capable of cutting wood or fiberglass.

13.4.5 Class A and Class B vessels shall be outfitted with one portable oxygen gas cutting set.

Chapter 14 Anchoring, Mooring, and Towing

14.1 Ground Tackle.

14.1.1 Each vessel shall be equipped with fittings, ground tackle, and lines compatible with its intended use.

14.1.2 All Class A vessels shall carry at least one set of ground tackle that shall comply with the requirements of *ABS Rules for Building and Classing Steel Vessels Under 90 Meters (295 ft) in Length* or ABYC H-40, *Anchoring, Mooring, and Lifting*.

14.1.3 All Class B and Class C vessels shall carry at least one set of ground tackle that shall comply with the requirements for storm anchors of ABYC H-40, *Anchoring, Mooring, and Lifting*.

14.1.4 When selecting an anchor, consideration shall be given to the type of bottom, type of rode, and the factors of size, weight, and design of anchor.

14.1.5* The anchor rode for Class A and Class B vessels shall be a minimum of 300 ft (91 m) in length and for Class C vessels a minimum of 200 ft (61 m) in length.

14.1.6 The anchor rode shall provide for shock absorption, rot, and decay resistance at least equivalent to that of nylon.

14.1.7 Anchor Storage.

14.1.7.1 The anchor shall be stowed in such a manner that it cannot break loose under storm conditions.

14.1.7.2 The anchor and its rode shall be located where they are readily accessible and can be rapidly deployed.

14.1.8 Rodes, when attached to anchors, shall be attached by means of shackles and swivels.

14.1.8.1 Fiber rodes shall also incorporate thimbles.

14.1.8.2 The bitter end of the rode shall be securely attached to the vessel.

14.1.9 The anchor shackles and other means of attaching the anchor to the rode shall exceed the recommended working strength of the rode.

14.1.10 All ground tackle components shall be constructed of corrosion-resistant material or be protectively coated for use in the marine environment.

14.1.10.1 Combinations of materials shall be galvanically compatible.

14.1.11 Vessels shall be fitted with a windlass or winch to recover the anchor and rode following anchoring operations when anchors more than 50 lb (23 kg) are used.

14.1.12 Care shall be taken to ensure an unobstructed path for the rode from the windlass to the hawse pipe or chocks.

14.1.13 The windlass shall be secured to a foundation that is tied into an underdeck structure and is of adequate strength to carry the anchoring loads.

14.2 Mooring Lines.

14.2.1 Dock lines shall be no less than the diameter required for the anchor rode.

14.2.2 The vessel shall be provided with a minimum of four dock lines.

14.2.3 Each dock line shall be at least as long as the vessel, and one shall be at least 1.5 times the vessel's length.

14.2.4 Mooring bitts and cleats shall be of sufficient size to accommodate the recommended diameter of the anchor rode or the dock lines.

14.2.4.1 The designed working surfaces and edges shall be smooth and rounded.

14.2.4.2 The mooring bitt or cleats shall be secured to a foundation that is tied into an underdeck structure and is of adequate strength to carry the mooring loads.

14.3 Emergency Towing. All vessels shall be equipped to permit emergency short-distance tows of other vessels.

Chapter 15 Life Saving and Rescue Equipment

15.1 General.

15.1.1 Capacity Number.

15.1.1.1 All vessels shall have a posted capacity number.

15.1.1.2 This number shall be the sum of the assigned crew, anticipated supplementary crew, and anticipated passengers.

15.1.2 All vessels shall be outfitted with equipment to provide basic first aid, to provide body removal from the water, and to protect crew members who intentionally or unintentionally enter the water.

15.1.3 Medical Equipment.

15.1.3.1 All Class C vessels shall be provided with a first aid kit.

15.1.3.2 All Class A and Class B vessels shall be equipped with basic life support (BLS) equipment.

15.1.4 All vessels shall carry at least two boat hooks with a minimum length equal to the freeboard of the vessel plus 5 ft (1.5 m).

15.1.5 Where the vessel is intended to be operated more than 3 miles (5 km) from shore, it shall carry an emergency position indicator radio beacon (EPIRB).

15.1.6* All pyrotechnic emergency signaling devices, including, but not limited to, flares and explosive devices, shall be stored in containers designed to prevent their accidental discharge and to protect the devices from moisture.

15.1.7* Personal Flotation Devices.

15.1.7.1* Where the vessel will operate in waters over 3 miles (5 km) from shore or in waters north of the 38th parallel, the vessel shall carry immersion suits for each crew member.

15.1.7.2* A person overboard recovery system shall be provided.

15.1.7.3 Class A vessels shall have at least four Type IV throwable flotation devices provided on the vessel, Class B vessels shall have at least two, and Class C vessels shall have at least one.

15.1.8 Life Rafts.

15.1.8.1 Where provided, all life rafts, buoyant apparatus, and vessels to be used only in emergencies shall be provided with secure storage on the vessel in a manner that will allow quick removal and placement in the water.

15.1.8.2 Life rafts, buoyant apparatus, and boats shall be of sufficient size to hold the posted capacity of the vessel.

Chapter 16 Communications Equipment and Systems

16.1 General.

16.1.1* Fire Department Radio Systems.

16.1.1.1 Fire department radio systems shall be installed on the vessel.

16.1.1.2 These systems shall be capable of operating on the frequencies assigned to the fire department, on area mutual aid frequencies, and with any fire department with which a mutual aid agreement is in force.

16.1.2* Maritime VHF-FM Radio.

16.1.2.1 Class A and Class B vessels shall be provided with two maritime VHF-FM radios.

16.1.2.2 Class C vessels shall be provided with one maritime VHF-FM radio.

16.1.3 All vessels shall be equipped with a weather radio capable of receiving the local National Oceanic and Atmospheric Administration (NOAA) weather broadcasts or other weather reporting equivalents.

16.1.4 A cellular telephone shall be provided where service is available in the operating area.

16.1.5 All vessels shall be equipped with a public address system for giving audible signals to persons on the vessel and for short-range direct voice communications.

16.1.6 Class A and Class B vessels shall be provided with an onboard emergency system alarm to signal abnormal conditions including, but not limited to, flooding, fire aboard, and the necessity to abandon ship.

Chapter 17 Navigation Equipment and Systems

17.1 General.

17.1.1* For the purpose of navigation only, requirements for vessels shall be established according to the intended navigational areas as follows:

(1) A Category 1 vessel is any vessel whose operational area would include any waters.
(2) A Category 2 vessel is any vessel whose operational area would include any waters other than ocean waters.

17.1.2 All Category 1 vessels shall have a work area or chart table for navigational chart work and chart navigation tools and an area of sufficient size to store navigational charts.

17.1.3* All Category 1 and Category 2 vessels shall carry adequate and up-to-date navigational publications as appropriate for the intended operational area.

17.1.4 All vessels shall be fitted with an illuminated compass.

17.1.5* All vessels shall be fitted with a marine radar system for surface navigation.

17.1.6 Depth Sounding Apparatus.

17.1.6.1 All vessels shall be fitted with an electronic depth sounding apparatus and a second independent means of obtaining depth soundings.

17.1.6.2 The second independent means of obtaining depth soundings shall be permitted to be a hand lead line.

Chapter 18 Protective Coatings and Corrosion Protection

18.1 General.

18.1.1 All construction materials for the vessel and the systems shall be selected to minimize the effects of corrosion.

18.1.2 All machinery shall be bonded to the hull or isolated from the hull to minimize stray electric currents.

18.1.3 All metal hulls and appurtenances shall be protected with a corrosion-resistant coating and shall be fitted with sacrificial anodes or an impressed current cathodic protection system.

18.1.4 The use of graphite packing in the stern tube stuffing box shall be prohibited.

18.1.5 The forward and after ends of propellers shall be sealed.

18.1.6 Vessels equipped with shore power connections shall be galvanically isolated in accordance with ABYC E-2, *Cathodic Protection*, and ABYC E-11, *Alternating Current (AC) and Direct Current (DC) Electrical Systems on Boats*.

18.2 Sacrificial Anodes.

18.2.1* The anode system shall be sized to provide corrosion protection for the time periods between dry-dockings and anode replacement.

18.2.2 Anodes shall be bonded directly to the hull to ensure good electrical continuity and stamped with the words "Do Not Paint."

18.2.3 Where anode collars are fitted to propulsion shafting, they shall be installed so as not to inhibit water flow to strut bearings.

18.3 Impressed Current System.

18.3.1 Impressed current systems shall comply with ABYC E-2, *Cathodic Protection*, and the manufacturer's recommendations.

18.3.1.1 The type, size, and quantity of anodes and reference electrodes shall be determined by a NACE certified corrosion engineer or specialist.

18.3.2 The anodes shall be separated from the hull by an insulating material.

18.3.2.1 A dielectric barrier shall be located directly beneath and extend beyond the edges of the anodes to protect the hull and its coating system from chemical attacks.

18.3.3* Anodes and reference electrodes shall be constructed and installed so that they will not loosen or fail structurally when subjected to the normal working of the hull.

18.3.4 The impressed current systems controller shall automatically regulate the impressed current to the anode electrodes.

18.3.4.1 Where the signal from the reference electrode is disrupted due to grounding or damage to the wire leads, the controller shall eliminate or reduce the impressed current.

18.3.5 All AC and DC electrical connections and wiring shall meet the requirements of Chapter 9.

18.3.5.1 Appropriate steps shall be made to eliminate the effects of a magnetic field generated by the impressed current system upon the vessel's compass.

18.3.6 Hull Potential Meters.

18.3.6.1 All metallic fire-fighting vessels and vessels with outdrives and jet drives shall be equipped with a hull potential meter.

18.3.6.2 When an analog meter is utilized, it shall have an impedance of 20,000 ohms per volt.

18.3.6.3 When an analog meter is used with silver/silver chloride reference electrode, the circuit shall have a push-to-test switch.

18.4 Coating System.

18.4.1* All surfaces that receive coating shall be properly cleaned and prepared in accordance with the coating manufacturer's instructions.

18.4.2 The coating shall be applied in accordance with the coating manufacturer's instructions.

Chapter 19 Tests and Trials

19.1 General.

19.1.1 The vessel shall be thoroughly inspected or tested to demonstrate conformance to this standard and to regulatory body requirements.

19.1.2 Builder's and acceptance trials shall be conducted to determine that the vessel and its equipment conform with the contract, the drawings, and the specifications.

19.1.3 The builder shall develop a schedule for performance testing during construction of the vessel and shall submit a copy to the owner prior to any tests or trials.

19.1.3.1 During construction, the builder shall be responsible for giving the owner advance notice of any tests or trials to be performed to allow the owner to witness the same on a noninterference basis.

19.1.3.2 The owner shall be accompanied by the builder during any and all tests and trials.

19.1.4 Test Records.

19.1.4.1 The builder shall provide test records for all testing activity.

19.1.4.2 The records shall include data pertinent to the test, description of the test, and signature blanks for the builder and owner.

19.1.5 The test results shall be recorded on the test record and dated as the tests are performed and signed by the owner.

19.1.6 All trial instrumentation and personnel necessary to conduct the trials in accordance with the specifications shall be furnished by the builder.

19.1.6.1 Qualified personnel shall perform all tests.

19.1.7 All instrumentation and gauges used during tests shall be calibrated to provide accurate data by which to analyze the performance of systems, machinery, and equipment.

19.1.8 After satisfactory completion of the tests, all trial instrumentation shall be removed.

19.2 Testing During Construction.

19.2.1 The builder shall inspect and test as necessary during construction all portions of the vessel and work thereon, including structure, fittings, systems, equipment, and machinery to demonstrate satisfactory workmanship, proper working order, alignment of moving parts, tightness, and compliance with the specifications.

19.2.2 The builder shall correct any deficiencies that appear during inspection and testing and reinspect or test until proven satisfactory before the vessel shall be permitted to proceed to yard trials.

19.3 Yard Trials.

19.3.1 Yard trials shall be conducted at the builder's facility to ensure that all systems and equipment are in proper operating condition and that the craft can be expected to successfully pass the builder's trials.

19.3.2 Any deficiencies found during yard trials shall be corrected before builder's trials commence.

19.3.3 The vessel's dry weight and longitudinal center of gravity shall be determined to demonstrate that they are consistent with naval architecture requirements for displacement and load distribution.

19.3.4 Prior to weighing, all permanently installed equipment shall be in place and all normally carried loose equipment stored or secured.

19.3.4.1 Where the weight is determined by hoisting the vessel with spreader bars forward and aft, a calibrated weight scale shall be connected to each spreader bar or sling, the locations noted, and the weights recorded.

19.3.5 The trial weight shall be determined by adding fuel, personnel, tools, equipment, and any other weights such as potable water, ballast, and so forth, to the dry weight of the vessel.

19.3.6 No personnel shall be aboard the vessel during weighing.

19.3.7 Where weighing takes place outside, the test shall not be performed during adverse weather conditions.

19.4 Builder's Trials.

19.4.1 On satisfactory completion of yard trials, the vessel shall be placed in the water for builder's trials to ensure that all systems and equipment are in proper operating condition, that the vessel is in accordance with the specification, and that the craft can be expected to successfully pass acceptance trials.

19.4.2 The tests shall be conducted in an area with sufficient water depth and maneuvering room to enable a complete and unrestricted test of all propulsion, steering, and fire-fighting systems.

19.4.3 The vessel's draft and freeboard, both forward and aft, shall be measured and recorded.

19.4.3.1 The maximum height of fixed structure above the water shall be determined and recorded.

19.4.4 Deficiencies that appear during builder's trials shall be corrected by the builder and the appropriate trials rerun to the owner's satisfaction.

19.4.5 The builder shall provide documentation of the results of all tests performed during builder's trials.

19.4.6 When all known deficiencies have been corrected, the vessel will be ready for acceptance trials.

19.4.7 Tightness Test.

19.4.7.1 A tightness test shall be conducted to determine that all tested components of the craft do not leak.

19.4.7.2 All watertight closures, topside structures, windows, weathertight doors, ports, and deck penetrations shall be tested.

19.4.7.2.1 This test shall be conducted using a hose with a ¾-in. (19-mm) minimum diameter smooth bore nozzle with at least 35 psi (2.4 bar) freshwater pressure at a distance not exceeding 10 ft (3 m).

19.4.7.2.2 The water shall be directed in a manner to maximize the possibility of a leak.

19.4.7.3 The opposite side of the tested area shall be inspected for leaks.

19.4.7.4 All bilges, welds, rudders, and shafts shall be inspected for leaks or water accumulation.

19.4.8 Main Propulsion System Test.

19.4.8.1 The main propulsion system shall be tested to determine that the system components and controls are functioning properly in accordance with manufacturer's specifications.

19.4.8.2 Where the vessel is propelled by inboard engines using shaft drives, the shaft coupling shall be disconnected and checked to ensure proper alignment prior to starting the engine(s).

19.4.8.3 The engine(s) shall be started and all gauges, alarms, and controls observed for proper operation and normal indications.

19.4.8.4 The controls shall be checked for ease of operation.

19.4.8.5 The engine(s) shall be allowed to warm up to normal operating temperature as specified in the engine operating manual prior to getting under way.

19.4.9 Engine Starting System Test.

19.4.9.1 The engine starting system shall be tested to demonstrate that it is functioning properly in accordance with the engine manufacturer's specifications.

19.4.9.2 Fluid levels such as freshwater cooling and oil shall be checked and fluids added as necessary prior to starting.

19.4.9.3 Each engine shall be started three times from each starting location at 2-min intervals.

19.4.9.3.1 The starting time shall be recorded and cranking time limited to 15 sec.

19.4.9.3.2 During at least one of these startings, the engine shall be allowed to crank for a minimum of 15 sec prior to being allowed to start.

19.4.9.3.3 The starting motor shall be observed for any evidence of smoke or overheating.

19.4.9.4 Once started, if an engine overheats or if the lubricating oil pressure does not rise to the normal operating pressure, the engine shall be shut down and no restarts attempted until the trouble has been remedied.

19.4.10 Wire and Cable Inspection.

19.4.10.1 All wire and cable shall be tested to determine that each wire and cable has been properly installed.

19.4.10.2 All wire and cable shall be tested and inspected for proper installation, grounding, and entry into junction boxes and equipment and through watertight decks and bulkheads.

19.4.10.3 All wire and cable shall be properly marked or color coded and verified against the electrical drawings of the vessel.

19.4.11 Engine-Driven DC Generator/Alternator Test.

19.4.11.1 Engine-driven DC generator/alternator shall be tested to verify satisfactory installation and performance in accordance with the generator/alternator manufacturer's instructions.

19.4.11.2 Before starting the engine, the generator/alternator shall be inspected to ensure proper alignment.

19.4.11.3 The engine shall be started and run at idle rpm.

19.4.11.4 The generator/alternator shall be inspected for any noticeable vibrations or misalignments.

19.4.11.5 The rpm, voltage, and current output shall be observed.

19.4.11.5.1 The engine shall then be run at maximum rpm, and the rpm, voltage, and current output shall be observed again.

19.4.12 AC Generator Test.

19.4.12.1 AC generator tests shall be performed to verify satisfactory installation and performance of the AC generator in accordance with the generator manufacturer's instructions.

19.4.12.2 The AC load shall be disconnected at the vessel's breaker panel, and the engine shall be started. The engine shall be run until all oil and water temperatures have stabilized.

19.4.12.3 The proper operation of all instruments and switches associated with the generator being tested shall be verified.

19.4.12.4 The engine speed shall be increased and run at rated rpm.

19.4.12.5 The rpm, voltage, current, and frequency at 0, ⅓, ⅔, and full rated loads shall be measured and compared with the manufacturer's specifications.

19.4.12.6 The presence of unusual noise, vibration, oil pressure, and temperature during testing shall be recorded.

19.4.13 Electrical Power Distribution Test.

19.4.13.1 An electrical power distribution test shall be performed to verify proper installation, voltage, and phase and polarity of each AC/DC circuit and proper distribution through switchboards or power panels.

19.4.13.2 Each power circuit shall be energized to verify proper control from the switchboard or power panel.

19.4.13.3 Voltage shall be measured for each circuit and shall be verified for correct phase and polarity.

19.4.13.4 The voltage drop between the distribution panel and each load shall be measured and recorded.

19.4.13.5 The secure mounting of each item of equipment shall be verified.

19.4.13.6 The shore power feeder shall be connected and the power transfer switch shall be operated to verify proper transfer from generator to shore power.

19.4.13.6.1 The voltage at the control panel shall be measured and the proper phasing shall be verified.

19.4.14 Lighting System Test.

19.4.14.1 All lighting switches, circuit breakers, and cables shall be inspected for proper installation, functioning, and labeling.

19.4.14.2 Each lamp shall be inspected for proper size and type.

19.4.14.3 Each light fixture shall be tested to determine proper operation and satisfactory control from the designated switch or circuit breaker.

19.4.14.4 All portable cord-connected lighting fixtures shall be connected and operated to determine satisfactory operation.

19.4.14.5 The arcs of coverage of the navigation lights shall be observed to ensure that required arc is not obstructed by the vessel's structure or other equipment.

19.4.14.6 Interior lighting in the pilothouse shall be observed during the hours of darkness for identification of gauges, switches, and controls.

19.4.14.6.1 Capacity for limiting the brightness of all lighting for nighttime navigation shall be observed.

19.4.14.6.2 Deficiencies for nighttime navigation and operations will be corrected to the owner's satisfaction.

19.4.15 Navigation Equipment Test.

19.4.15.1 All navigation equipment shall be tested to verify proper installation, operation, and alignment of the navigation radar, depth finder, and compass in accordance with the manufacturer's instructions.

19.4.15.2 The location of the radar display unit shall be inspected for efficient operation and positioning.

19.4.15.3 The radar power switch shall be placed in the "stand-by" mode, and sufficient time shall be allowed for the circuits to stabilize.

19.4.15.3.1 The power switch shall be placed in the "transmit" or "on" position and the indicator lights on the display unit observed for proper illumination.

19.4.15.4 The radar tuning control shall be checked for optimum tuning.

19.4.15.5 The radar intensity control shall be adjusted for satisfactory brightness.

19.4.15.6 The radar sweep linearity and amplitude on all ranges shall be observed.

19.4.15.7 The clarity of radar range rings shall be observed.

19.4.15.8 The radar synchronization and heading marker alignment shall be verified.

19.4.15.9 The accuracy of the radar range rings shall be verified.

19.4.15.10 The vessel's depth finding system shall be tested by operating the vessel in areas of known depth and comparing the depth finding system readings with actual depth at various locations.

19.4.15.11 The vessel's compass shall be tested by locating the vessel at a known heading using survey points or reference lines.

19.4.15.11.1 The vessel shall be turned a full 360 degrees, and the headings shall be recorded at 30-degree increments.

19.4.16 Communications and Signaling System Test.

19.4.16.1 Where there is an interior communication system, it shall be tested to verify that the interior communications equipment is installed and operating properly.

19.4.16.2 The siren, where provided, shall be tested to demonstrate that it is installed and operating properly.

19.4.16.3 The public-address (PA) system, where provided, shall be tested to demonstrate sound level and clarity at each speaker station.

19.4.16.4 The navigational horn shall be operated to demonstrate proper sound and intensity.

19.4.17 Electronic Communications Equipment Test.

19.4.17.1* The electronic communications equipment shall be inspected to verify installation in accordance with the manufacturer's instructions and to provide a complete, operable, and functional system.

19.4.17.2 Receivers shall be tuned to a local channel, frequency, or signal of opportunity.

19.4.17.2.1 Transmitters shall be keyed, and the modulation shall be checked.

19.4.17.2.2 The audio shall be clear with no distortion.

19.4.18 Pump Test.

19.4.18.1 Pumps shall be tested to demonstrate that they perform in accordance with the manufacturer's specifications.

19.4.18.2 There shall be sufficient fluid at the pump suction to verify proper pump operation at its rated flow.

19.4.18.3 The pump shall be operated at its rated rpm, and the flow rate shall be measured.

19.4.19 Instruments and Indicators Test.

19.4.19.1 Instruments and indicators shall be tested to determine that they are installed and functioning properly.

19.4.19.2 All instruments shall be verified to be of a type suitable for use in the particular vessel.

19.4.19.3 The dimmer control shall be operated and observed to determine that the instruments are properly lighted and that lighting can be varied from maximum intensity to completely off.

19.4.19.4 The engine shall be operated to verify tachometer readings.

19.4.19.5 The engine water temperature gauge, engine oil pressure gauge, and gear oil pressure gauge shall be checked for normal indications as specified in the engine operating manual.

19.4.19.6 Voltmeter operations shall be verified.

19.4.19.7 The fuel gauge accuracy shall be verified.

19.4.20 Piping System Tests.

19.4.20.1 Piping systems shall be tested for leaks.

19.4.20.2 The freshwater piping system, compressed air piping system, fuel piping system, bilge piping system, sanitation system, and sea-water piping system shall be pressurized or operated.

19.4.20.3 Fire pump piping and distribution piping to discharge devices shall be hydrostatically tested in accordance with 10.10.5.6.

19.4.20.4 Pressurization or operation shall be continued for 30 minutes during and after which all pipes, connections, tanks, and welds shall be inspected for leaks, distortion, and deformation.

19.4.20.5 Where any leaks are detected, the test shall be stopped, and the leak(s) shall be repaired and then the system shall be retested.

19.4.20.6 All tanks, valves, pumps, and lines shall be checked for secure mounting, supports, and serviceability.

19.4.21 Heating, Ventilation, and Air-Conditioning Tests.

19.4.21.1 Heating, ventilation, and air-conditioning (HVAC) systems shall be tested for proper operation in accordance with the manufacturer's instructions.

19.4.21.2 All components shall be inspected for security of mounting.

19.4.21.3 HVAC units shall be energized and checked for proper operation and thermostat control.

19.4.21.4 Fan motors shall be operated and verified for balance of airflow and delivery of designed air quantities.

19.4.21.5 HVAC units shall be operated until the desired temperature is reached.

19.4.21.6 All refrigerant lines, connections, and joints shall be inspected for leaks.

19.4.21.7 The voltage and current shall be measured and compared with the manufacturer's specifications.

19.4.22 Fire-Extinguishing System Test.

19.4.22.1 The fire-extinguishing system shall be tested to demonstrate performance in accordance with design performance standards.

19.4.22.2 All components shall be checked for security of mounting.

19.4.22.3 Connections and their placements shall be checked to determine they are in accordance with the manufacturer's instructions.

19.4.22.4 The manufacturer's procedures for testing the system shall be followed.

19.4.22.5 All placards shall be inspected to verify they are installed in proper locations.

19.4.23 Steering Gear Test.

19.4.23.1 The steering gear shall be tested to verify proper installation and operation in normal and emergency modes.

19.4.23.2 Fluid levels, fitting connections, and mountings shall be checked.

19.4.23.3 The steering gear shall be operated from hardover to hardover to verify alignment, and the number of turns of the wheel from hardover to hardover shall be recorded.

19.4.23.4 The vessel shall be operated ahead at full speed with rudder dead ahead, and the vessel speed shall be recorded.

19.4.23.4.1 The rudder shall be moved hardover to port, and the diameter of the vessel's turning circle and speed shall be recorded.

19.4.23.5 The rudder shall be moved hardover to starboard, and the diameter of the vessel's turning circle and speed shall be recorded.

19.4.23.6 The vessel shall be operated ahead at full speed on a straight course, then the steering wheel shall be released, and any deviation from straight ahead shall be recorded in time and degrees.

19.4.23.7 The rudder angle indicator (RAI) readout display shall be checked for accuracy with the rudder position.

19.4.23.8* To determine the maximum safe astern speed, the vessel shall be operated astern with rudder hardover to port, and then the wheel shall be pulled out of hardover position and returned to straight astern.

19.4.23.8.1 During this test, the engine speed shall be increased cautiously to determine the maximum safe rpm.

19.4.23.8.2 Once determined, the maximum safe astern rpm shall be recorded.

19.4.23.9 To determine the maximum safe astern speed, the vessel shall be operated at 25 percent over idle speed astern with rudder hardover to starboard, and then the wheel shall be pulled out of hardover position and returned to straight astern.

19.4.23.9.1 The astern speed shall be recorded.

19.4.24 Mechanical Handling System Tests.

19.4.24.1 The mechanical handling system shall be tested to verify it meets specified requirements and operates without damage or distortion to the structure or vessel.

19.4.24.2 Where machinery is hydraulically operated, the hydraulic fluid level shall be checked before operating equipment.

19.4.24.3 The equipment shall be operated with the maximum rated load capacity.

19.4.24.4 Equipment, structure, foundation, and deck shall be inspected from above and below for damage, distortion, or deformation.

19.4.25 Anchor Stowage and Handling Test.

19.4.25.1 Anchor stowage and handling shall be tested to ensure efficient handling and securing of anchor and associated equipment.

19.4.25.2 The anchor, rode, and line shall be inspected.

19.4.25.3 The anchor equipment shall be inspected to determine that it is arranged for efficient handling and securing.

19.4.25.4 The anchor shall be dropped with rode and line attached.

19.4.25.5 The anchor, rode, and line shall be inspected to verify they do not foul or damage deck equipment, fittings, hull, hull appendages, or equipment when dropping or riding at anchor.

19.4.25.6 The anchor shall be hoisted and secured.

19.4.25.7 Where the vessel is equipped with an anchor winch, it shall be tested at its maximum rated capacity.

19.4.25.8 Where the winch is equipped with a brake system, the brake shall be tested.

19.4.26 Towing Fitting Test.

19.4.26.1 The towing tackle and fitting shall be tested to verify that they meet specified strength requirements.

19.4.26.2 A line shall be attached to the towing fitting and connected to the pier, keeping the line parallel to the deck.

19.4.26.3 A strain gauge shall be attached to the line.

19.4.26.3.1 Force shall be applied to the line, and results shall be recorded.

19.4.26.4 The fitting shall be inspected from both sides for cracking, distortions, or any other damage due to the load.

19.4.27 Windshield Wiper Test.

19.4.27.1 The windshield wipers, washers, and defog systems shall be tested to determine that the equipment is operating properly.

19.4.27.2 Wipers shall be operated and wiper performance shall be tested using a water hose to simulate foul weather conditions.

19.4.28 Galley Unit Test.

19.4.28.1 Where provided, the galley unit shall be tested to determine that the equipment is operating properly.

19.4.28.2 Where the galley unit uses gas or propane, the gas system shall be inspected for leaks, and the emergency shutoff function shall be verified prior to beginning testing.

19.4.28.3 Refrigerator and freezer unit temperatures shall be recorded.

19.4.28.4 The proper control of thermostats shall be verified at various settings.

19.4.28.5 Range and oven units shall be operated to verify proper control of each heating element by designated switch.

19.4.28.6 The oven temperature shall be measured at various thermostat settings to demonstrate proper thermostat control.

19.4.28.7 Where provided, the microwave oven shall be tested by bringing one cup of water to a boil.

19.4.29 Noise Evaluation Test.

19.4.29.1 The sound level inside the pilothouse, crew cabin, and all normally staffed stations shall be measured and recorded while under way at full speed and while pumping full capacity at rest.

19.4.29.2 All doors, windows, and hatches shall be tightly closed while sound levels are being measured.

19.4.30 Hull Inspection.

19.4.30.1 The vessel hull shall be inspected for defects while under way.

19.4.30.2 The vessel shall be inspected to verify structural integrity and proper installation of deck coverings, fittings, equipment, outfit, furniture, machinery, and appliances.

19.4.30.3 Each compartment or area and the overboard sides of the vessel shall be inspected at varying speeds for damage caused by unusual vibrations, and any other conditions, due to the speeds that would adversely affect operation.

19.4.31 Propulsion System Test.

19.4.31.1 The propulsion system shall be tested to demonstrate satisfactory operation.

19.4.31.2 The propulsion system shall be operated for a continuous period of 4 hours in accordance with the manufacturer's recommendations.

19.4.31.2.1 At 15-min intervals, the engine oil pressure, rpm, water temperature, and gear oil pressure shall be recorded.

19.4.32 Propeller or Jet Pump Evaluation and Speed Trials.

19.4.32.1 Propeller or jet pump evaluation and speed trials shall be performed to demonstrate that the selected propeller or jet pump allows the engine to develop its rated shaft horsepower at its rated rpm when the vessel is in the trial condition and to determine the speed of the vessel and dynamic trim angle.

19.4.32.2 The following information shall be recorded before beginning trial:

(1) Depth of water on measured course at time of trial
(2) Displacement of craft in pounds
(3) Static trim angle at time of trial
(4) Manufacturer and model number of installed engine
(5) Propeller manufacturer, type, number of blades, diameter, and pitch
(6) Gear manufacturer and model number and ratio
(7) Jet pump manufacturer and model number

19.4.32.3 One run shall be made in each direction over the measured course.

19.4.32.3.1 Engine rpm shall be within the manufacturer's specifications.

19.4.32.4 The average speed of the two runs shall be recorded as the craft's speed, rpm, and running trim angle.

19.4.33 Fire Pump Test.

19.4.33.1* The fire pump shall be tested to demonstrate satisfactory installation and operation of the fire pump system in accordance with the specification.

19.4.33.2* Each fire pump shall be individually run at its rated capacity and pressure for 3 hours.

19.4.33.2.1 The pump pressures taken near the pump discharge and pitot readings for capacity flows taken at the nozzle tips shall be recorded.

19.4.33.3 All pumps shall be run together simultaneously for a period of 1 hour at their rated capacities and pressures to determine the full capacity of the vessel.

19.4.33.3.1 The pump pressures and flow capacities shall be recorded.

19.4.33.4 The vessel shall be able to demonstrate its maneuverability and station-keeping ability while pumping.

19.4.33.5 The vessel builder shall furnish a certificate of flushing and hydrostatic testing of pump suction, discharge, and distribution piping prior to the pump test.

19.4.33.6 A copy of the pump manufacturer's certification for each pump shall be used for comparison of results of the acceptance test.

19.4.33.6.1 The pump's performance shall be equal to that performance indicated on the pump manufacturer's certified performance test, within the accuracy limits of the test equipment used.

19.4.33.7 For the pump test, a copy of the pump manufacturer's factory performance test data shall be obtained.

19.4.33.7.1 When the test data have been developed using fresh water and the vessel operates in and pump testing is done in salt water, the performance curve shall be permitted to be derated by 1.21 percent.

19.4.33.8 Each pump and engine system shall perform at 50 percent, 70 percent, 100 percent, and 110 percent of rated capacity at rated discharge pressure without exceeding the component manufacturer's rating of any component used in the pumping system.

19.4.33.9 Vibrations of the pumping system shall not cause potential damage to any pump component.

19.4.34 Fire Protection Systems Test.

19.4.34.1 All fire protection systems shall be tested to verify satisfactory installation and operation in accordance with the specifications.

19.4.34.2 Where a system is water-based, it shall be run for a minimum of 1 hour.

19.4.34.3 All system discharges shall be observed to determine that the system provides proper and adequate coverage.

19.4.34.4 The system shall be inspected during the test to establish that it is free from leaks.

19.4.35 Foam Systems.

19.4.35.1 The installed foam system shall be tested in accordance with relevant NFPA standards.

19.4.35.1.1 The test program shall include each proportioning device installed in the system and any corresponding discharge devices.

19.4.35.1.2 The system shall demonstrate its capability to proportion and to operate at discharge design pressures.

19.4.35.2 A representative of the foam system manufacturer shall be present for acceptance testing of the installed system.

19.4.36 Other Devices.

19.4.36.1 Tests shall be performed to demonstrate satisfactory installation and operation of any other device not listed in this chapter.

19.4.36.2 All devices shall be checked and tested in accordance with the device manufacturer's installation and operation specifications or procedures.

19.5 Acceptance Tests.

19.5.1 Where acceptance tests are specified at the point of delivery, they shall be run in accordance with the provisions of this chapter.

19.5.2 The owner shall specify which tests will be required to be performed prior to delivery.

Chapter 20 Storage and Maintenance

20.1 Normal Storage.

20.1.1* While the vessel is in storage, it shall be kept in a state of readiness.

20.1.2 The storage area shall be in a safe and secured area.

20.2 Haul-Out for Maintenance and Inspection.

20.2.1 A plan for maintenance and inspection shall be developed during the design stage of the vessel.

20.2.1.1* A location shall be designated to handle the haul-out for the vessel as needed.

20.2.2 The removal of the vessel from the water shall be done in accordance with the manufacturer's instructions and shall be done by experienced personnel.

20.2.3 The owner's manual shall have a maintenance section including a schedule for when the haul-out is to be done and what equipment needs to be checked during the haul-out.

20.3 Maintenance Schedules.

20.3.1* A complete manual for the care and maintenance of the vessel shall be provided by the builder.

20.3.2 All equipment installed by the manufacturer or by the owner after purchase shall have a schedule of maintenance assigned for it.

20.3.2.1 The schedule shall specify what must be done to maintain each piece of equipment, including the types of filters and types and amounts of grease, oil, and other fluids that are recommended for use by the different systems.

20.4 Docking and Access.

20.4.1* The vessel's normal berth shall meet the requirements of NFPA 303, *Fire Protection Standard for Marinas and Boatyards.*

20.4.2 Where the vessel is kept on a trailer and is towed to a launch area, the launch area shall be a safe and accessible area where the vessel can be launched during any stage of the tide.

20.5 Trailers.

20.5.1* Where a trailer will be used for the vessel, the trailer shall be designed for the intended purpose of the vessel.

20.5.2 The trailer shall be designed and constructed to accommodate the total weight of the vessel with a full complement of tools and equipment installed.

20.5.3 The trailer shall be used in accordance with the manufacturer's instructions for safe operation.

20.6 Maintenance Tests.

20.6.1* Tests shall be conducted at least annually on all equipment, or after major repairs, after overhaul, or when there is reason to believe that usage has exceeded the manufacturer's instructions for safe operating procedures.

20.6.2 The inspection and tests specified herein shall be used to supplement, not to replace or modify, any instructions or recommendations of the manufacturer's maintenance manual.

20.6.3* Full operational tests shall be performed at least monthly to ensure that all equipment is functioning properly and that all safety equipment is in place and in proper working order.

20.6.4 The fire pump shall be tested to the manufacturer's specifications and shall include routine testing of the pump and accessories.

20.6.4.1 These tests shall include a vacuum test, if appropriate, a pressure test, and a running test.

20.6.4.2 An annual test shall be conducted to determine whether the pump is meeting the requirements established for a vessel of its particular rating.

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.3.2.1 Approved. The National Fire Protection Association does not approve, inspect, or certify any installations, procedures, equipment, or materials; nor does it approve or evaluate testing laboratories. In determining the acceptability of installations, procedures, equipment, or materials, the authority having jurisdiction may base acceptance on compliance with NFPA or other appropriate standards. In the absence of such standards, said authority may require evidence of proper installation, procedure, or use. The authority having jurisdiction may also refer to the listings or labeling practices of an organization that is concerned with product evaluations and is thus in a position to determine compliance with appropriate standards for the current production of listed items.

A.3.2.2 Authority Having Jurisdiction (AHJ). The phrase "authority having jurisdiction," or its acronym AHJ, is used in NFPA documents in a broad manner, since 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.3.2.4 Listed. The means for identifying listed equipment may vary for each organization concerned with product evaluation; some organizations do not recognize equipment as listed unless it is also labeled. The authority having jurisdiction should utilize the system employed by the listing organization to identify a listed product.

A.3.3.24 Eductor. Typical uses include foam mixing, dewatering, and bilge pumping, and so forth.

A.3.3.61 Net Pump Pressure. When operating with the pump intake (suction) below the waterline (flooded intake), the net pressure can be less than the discharge pressure. For example, if the discharge pressure gauge reads 150 psig (10 bar) and the pump intake gauge reads 2 psig (0.1 bar), the net pump pressure equals 148 psi (10 bar). When operating with the pump intake above the waterline (operating from draft), the net pump pressure will be more than the pump discharge pressure. For example, if the discharge pressure gauge reads 145 psig (10 bar) and the intake gauge reads 10 in. (255 mm) of mercury (Hg), the net pump pressure will be 150 psig (10 bar) (1 in. Hg = 0.5 psi).

A.4.2.3 On longer vessels, consideration should be given to providing access from both sides.

A.5.1 This standard has been prepared to provide the owner or operator with the minimum requirements specific to marine fire-fighting vessels. It is written with the understanding that it is incumbent on the owner or operator to provide information, instructions, data, and training for vessel fire-fighting operations to help ensure that the loading and operational limits on which the vessel's classification are based are not exceeded.

A.5.1.4.4 Enclosed pilothouses should be protected by an onboard exterior sprinkler or spray system.

A.7.3.3 For vessels with displacement hulls where propulsion engines are used to drive fire pumps, provisions for station keeping while pumping at total vessel capacity should be considered.

NOTE: The lack of availability of smaller reduction gears with controllable slippage output, suitable for operating at predictable (1500–1800) input rpm for pumping, and the lack of availability of smaller, controllable pitch propellers to control propeller speed, presently limit the capability for station keeping for most planing hull designs. Also, using fire main thrusters equal to the flow of monitors to compensate for nozzle reaction is contrary to the efficient and safe use of fire pumps.

A.7.5.7.1 For further information on controls and instruments, see ABYC T-9, *Recommended Practice for Instrument Panel and Speedometer Installation.*

A.8.1.1 Auxiliary machinery and systems should be designed or specified with space availability, weight, and environmental compatibility in mind. The purchaser should indicate the type and performance required.

A.8.1.2 See A.8.1.1.

A.8.8.3 Pantograph wipers are superior to pendulum type for this application.

A.8.8.4 Filtering is essential to prevent clogging of small-diameter spray nozzles.

A.10.2.4 It is recommended that pumps of equal pumping capacity be provided to maximize redundancy benefits. Where a large pump and small pump are used, more than 50 percent of pumping capacity would be lost in the event of the large pump's failure.

A.10.10.4.2 The location of the relief valve discharge outlet above the load waterline should permit removal of the valve for maintenance without having the vessel in dry dock. Consideration should be given to the hazard to personnel or property in the vicinity of the vessel when the relief valve operates.

A.10.10.5.1 Fittings and valves that are designed for low friction losses should be selected. Elbows should be of the long radius pattern.

A.10.14.1 See Section 4.1 for numbers of discharge devices required for each vessel classification.

A.10.14.2.2 See also stability requirements for all marine fire-fighting vessels in Chapter 6.

A.11.1.2 It is recommended that the purchaser discuss the "foam specific" requirements, from the mission and capability study, with the foam system manufacturer(s) prior to development of the final purchase specification.

A.11.2.3 Examples of adverse reactions from foam concentrates coming into contact with noncompatible materials are corrosion, formation of harmful solids, deterioration of gaskets and seals, binding of moving parts, and the deterioration of the foam concentrate.

A.11.6.8 A removable top is recommended; however, alternative systems are acceptable for special tanks such as oval tanks and tanks less than 200 gal (800 L).

A.11.7.1 The foam concentrate pump is a critical component of both balanced pressure and direct injection foam-proportioning systems. Positive displacement pumps are recommended for several reasons. Positive displacement pumps are relatively slow speed when compared to centrifugal pumps, which are desirable with viscous foam concentrates that are difficult to shear. Centrifugal pumps can become air bound when trying to pump viscous foam concentrates, resulting in a complete shutdown of the system. The self-priming feature of positive displacement pumps allows them to draw foam concentrate from drums or any external source without priming the pump.

A.11.7.6 Where the foam concentrate pump is used with a pressure balance system, a minimum of one 2½-in. (65-mm) external gated intake connection for foam concentrate should be provided. A 2-in. (50-mm) pickup device with a 2½-in. (65-mm) adapter should be provided to supply the system from drums or pails through the external intake connection. At least one 1½-in. (38-mm) external gated foam concentrate pump discharge connection should also be provided.

A.12.1.1 In addition to the required fire protection systems, it is recommended that all Class A vessels be fitted with a fixed water spray system to provide exterior cooling of the main hull and superstructure. The following recommended criteria should be considered:

(1) A power-driven pump having adequate volume and pressure should supply the spray system. A water fire-fighting pump, fire protection pump, or bilge pump could be acceptable for this service. Where one of these pumps is selected, it should be of sufficient capacity to deliver water for its intended service and water spray system simultaneously. Valves should be installed to isolate the water spray system from pump discharge.
(2) The spray nozzles should be spaced at distances no greater than 10-ft (3-m) centers. The minimum coverage rate should be 0.25 gpm/ft^2 (10 L/min/m^2) of exposed structure.
(3) A strainer should be fitted in the piping system to prevent clogging of the spray heads. The strainer's design should allow easy access for cleaning.
(4) Drainage arrangements should be fitted to protect the piping system against freezing and to facilitate maintenance.

A.12.1.2 The U.S. Coast Guard Regulations, 46 CFR 181, *Fire Protection Equipment*; NFPA 302, *Fire Protection Standard for Pleasure and Commercial Motor Craft*; or *ABS Rules for Building and Classing Steel Vessels* should be consulted.

A.12.6.1 The principal difference in extinguishers approved for marine use is in the mounting bracket, which is designed to firmly clamp the extinguisher in place.

A.13.2.2 Class A vessels should have onboard provision for the refilling of all assigned SCBA at a rate where 50 percent of the SCBA are available for use. Class A vessels should be capable of refilling six cylinders every 15 minutes for at least 2 hours.

A.13.2.3 It is recommended that where 30-minute-rated service life cylinders are provided with the SCBA, 60-minute-rated service life cylinders also be provided for use during extended fire-fighting operations. Typically, 30-minute cylinders do not allow fire fighters enough air to reach the seat of the fire, extinguish, and return to a safe environment. Long-duration, closed-circuit SCBA should also be considered.

A.14.1.5 Where it is necessary to anchor in deeper water, additional lengths of anchor rode should be provided to accommodate those depths.

A.15.1.6 All assigned crew members should be trained in the proper firing of all pyrotechnic devices used on the vessel. All devices should be checked at regular intervals to ensure they are properly protected and in operational condition.

A.15.1.7 All marine fire-fighting vessels must carry one Type I, II, III, or V personal flotation device (PFD) for each person on board, plus at least one Type IV (throwable) device. See below for limitations on the acceptability of Type Vs. Personal flotation device descriptions are as follows:

(1) Type I is an offshore PFD that will turn an unconscious person's face upward and will keep the face and mouth out of the water.

(2) Type II is a bib-style jacket, usually attached with a strap across the back. It is less likely to keep the face out of the water, especially in rough water.
(3) Type III includes many float coats, fishing vests, and water-skiing jackets. They are good for calm, inland water, where help will come quickly. They will not turn a person's face upward, but they have the same buoyancy as a Type II. Type IIIs are meant to be worn at all times when under way.
(4) Type IV is a "throwable" device: a life ring, horseshoe buoy, or flotation cushion. As of May 1, 1995, Type IVs no longer fulfill the one-per-person requirement. However, at least one Type IV is required, immediately available for a person overboard.
(5) Type V PFDs are intended for specific activities. Many deck suits, sailboard vests, and exposure suits are of this type. They can be carried instead of another PFD only if used according to the approval conditions on the label.

Type V inflatable jackets or vests count toward the minimum requirement if they are worn at all times. Inflatables require more maintenance than any other type and are more expensive. When worn, however, they offer better comfort and buoyancy than any other kind. Even if Type Vs are selected, it is prudent to have a Type I or II onboard as well.

The crew should be trained on the use and donning of PFDs and their limitations. The power supplies for the strobe lights attached to the PFD should be checked regularly, and the batteries replaced in accordance with the manufacturer's instructions.

A.15.1.7.1 Immersion suits should be considered as standard equipment on all vessels to aid in water rescue operations.

A.15.1.7.2 A written plan should be prepared for person overboard operations, and regular training should be conducted in the equipment and procedures.

A.16.1.1 Where emergency medical procedures are to be carried out onboard the vessel, a medical multichannel radio should be provided. Also, if citizens band (CB) radios are commonly used in the area, a CB radio should be provided. Where the fire department has wired communication systems, such systems should be available at the vessel berth and to the vessel.

A.16.1.2 One radio should be permanently set on marine channel 16 (156.800 MHz FM), the international distress and calling frequency.

One radio (power limited to one watt) should be set on the marine bridge-to-bridge channel. This channel should be on a dedicated hand portable radio that is used for no other purpose.

A multichannel marine radio capable of operating on at least the 10 most locally used marine channels should include the U.S. Coast Guard channel 22 (157.100 MHz FM) and the intership channel 6 (156.300 MHz FM).

A.17.1.1 Ocean waters are defined as "A route that is more than 20 nautical miles off shore on any of the following waters: any ocean, the Gulf of Mexico, the Caribbean Sea, the Gulf of Alaska, and such other similar waters as may be designated by a Coast Guard District Commander."

A.17.1.3 Navigational publications should include the following:

(1) Charts of the area waters
(2) Sailing directions
(3) Coast pilots
(4) Light lists
(5) Notices to mariners
(6) Tide tables
(7) Current tables
(8) Other necessary nautical publications

In addition to a compass, a global positioning system (GPS) is recommended. A global positioning system is a satellite-supported navigation system. Installation of a GPS for assistance in the navigation of the vessel is not required. However, the accuracy of this system is well established, and it is common to interface the GPS with onboard systems such as autopilots, plotters, and so forth.

Installation of a long-range navigation (LORAN) system is not required. However, LORAN is a well-known aid to navigation and can be interfaced with other onboard systems such as autopilots, plotters, radar, and so forth.

A.17.1.5 The term RADAR (radio detecting and ranging) refers to a method of detecting distant objects and determining their distance, velocity, or other information by analysis of very high frequency radio waves.

A.18.2.1 Anodes should be arranged to minimize hull drag and positioned to avoid contact with lifting slings or dry-dock blocks.

A.18.3.3 The anode system and reference electrodes should provide corrosion protection for the time periods between dry-dockings and anode replacement.

A.18.4.1 The surface should be inspected and approved by the coating manufacturer's representative prior to application of the coating. Where multiple coats are applied, the coating manufacturer's representative should inspect and approve the surface prior to each application.

A.19.4.17.1 Equipment locations should be inspected for efficient operations and positioning.

A.19.4.23.8 The test itself ensures function and stability of the rudder and props.

A.19.4.33.1 Representatives of the pump manufacturer and pump driver manufacturer should be present for the acceptance test.

A.19.4.33.2 The acceptance test should indicate that the pump as installed will perform as specified. Annual retests should determine whether the pump performance has deteriorated due to wear or to an obstruction within the pump.

Flow tests are made by measuring discharge from one or more monitors flowing through smooth bore nozzle tip(s). The flows are determined using a pitot tube and gauge and taking the flow [gpm (L/min)] from a chart for the noted pressure and tip diameter.

Pump speed (rpm) and suction and discharge pressures should be recorded for each flow.

To avoid creating excess pressure in the discharge and distribution piping, the pump being tested should be run at a speed that will produce rated pump discharge pressure for each flow point tested.

During the test, each monitor should be flowed at least once. This will indicate conditions on the piping supplying that monitor.

Following the test, flows and net pressures should be plotted on a copy of the performance curve. The test results should have pressure and flow corrected to rated speed using the pump affinity laws.