NFPA® 1925

Standard on Marine Fire-Fighting Vessels

2013 Edition

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

IMPORTANT NOTICES AND DISCLAIMERS CONCERNING NFPA® DOCUMENTS
NOTICE AND DISCLAIMER OF LIABILITY CONCERNING THE USE OF NFPA DOCUMENTS

NFPA® codes, standards, recommended practices, and guides ("NFPA Documents"), of which the document contained herein is one, are developed through a consensus standards development process approved by the American National Standards Institute. This process brings together volunteers representing varied viewpoints and interests to achieve consensus on fire and other safety issues. While the NFPA administers the process and establishes rules to promote fairness in the development of consensus, it does not independently test, evaluate, or verify the accuracy of any information or the soundness of any judgments contained in NFPA Documents.

The NFPA disclaims liability for any personal injury, property or other damages of any nature whatsoever, whether special, indirect, consequential or compensatory, directly or indirectly resulting from the publication, use of, or reliance on NFPA Documents. The NFPA also makes no guaranty or warranty as to the accuracy or completeness of any information published herein.

In issuing and making NFPA Documents available, the NFPA is not undertaking to render professional or other services for or on behalf of any person or entity. Nor is the NFPA undertaking to perform any duty owed by any person or entity to someone else. Anyone using this document should rely on his or her own independent judgment or, as appropriate, seek the advice of a competent professional in determining the exercise of reasonable care in any given circumstances.

The NFPA has no power, nor does it undertake, to police or enforce compliance with the contents of NFPA Documents. Nor does the NFPA list, certify, test, or inspect products, designs, or installations for compliance with this document. Any certification or other statement of compliance with the requirements of this document shall not be attributable to the NFPA and is solely the responsibility of the certifier or maker of the statement.

REMINDER: UPDATING OF NFPA DOCUMENTS

Users of NFPA codes, standards, recommended practices, and guides ("NFPA Documents") should be aware that NFPA Documents may be amended from time to time through the issuance of Tentative Interim Amendments or corrected by Errata. An official NFPA Document at any point in time consists of the current edition of the document together with any Tentative Interim Amendment and any Errata then in effect.

In order to determine whether an NFPA Document has been amended through the issuance of Tentative Interim Amendments or corrected by Errata, visit the Document Information Pages on NFPA's website. The Document Information Pages provide up-to-date, document specific information including any issued Tentative Interim Amendments and Errata.

To access the Document Information Page for a specific NFPA Document go to http://www.nfpa.org/document for a list of NFPA Documents, and click on the appropriate Document number (e.g., NFPA 101). In addition to posting all existing Tentative Interim Amendments and Errata, the Document Information Page also includes the option to sign-up for an "Alert" feature to receive an email notification when new updates and other information are posted regarding the document.

ISBN: 978-145590605-5 (Print)
ISBN: 978-145590651-2 (PDF)

IMPORTANT NOTICES AND DISCLAIMERS CONCERNING NFPA® DOCUMENTS

ADDITIONAL NOTICES AND DISCLAIMERS

Updating of NFPA Documents

Users of NFPA codes, standards, recommended practices, and guides ("NFPA Documents") should be aware that these documents may be superseded at any time by the issuance of new editions or may be amended from time to time through the issuance of Tentative Interim Amendments. An official NFPA Document at any point in time consists of the current edition of the document together with any Tentative Interim Amendments and any Errata then in effect. In order to determine whether a given document is the current edition and whether it has been amended through the issuance of Tentative Interim Amendments or corrected through the issuance of Errata, consult appropriate NFPA publications such as the National Fire Codes® Subscription Service, visit the NFPA website at www.nfpa.org, or contact the NFPA at the address listed below.

Interpretations of NFPA Documents

A statement, written or oral, that is not processed in accordance with Section 6 of the Regulations Governing Committee Projects shall not be considered the official position of NFPA or any of its Committees and shall not be considered to be, nor be relied upon as, a Formal Interpretation.

Patents

The NFPA does not take any position with respect to the validity of any patent rights referenced in, related to, or asserted in connection with an NFPA Document. The users of NFPA Documents bear the sole responsibility for determining the validity of any such patent rights, as well as the risk of infringement of such rights, and the NFPA disclaims liability for the infringement of any patent resulting from the use of or reliance on NFPA Documents.

NFPA adheres to the policy of the American National Standards Institute (ANSI) regarding the inclusion of patents in American National Standards ("the ANSI Patent Policy"), and hereby gives the following notice pursuant to that policy:

NOTICE: The user's attention is called to the possibility that compliance with an NFPA Document may require use of an invention covered by patent rights. NFPA takes no position as to the validity of any such patent rights or as to whether such patent rights constitute or include essential patent claims under the ANSI Patent Policy. If, in connection with the ANSI Patent Policy, a patent holder has filed a statement of willingness to grant licenses under these rights on reasonable and nondiscriminatory terms and conditions to applicants desiring to obtain such a license, copies of such filed statements can be obtained, on request, from NFPA. For further information, contact the NFPA at the address listed below.

Law and Regulations

Users of NFPA Documents should consult applicable federal, state, and local laws and regulations. NFPA does not, by the publication of its codes, standards, recommended practices, and guides, intend to urge action that is not in compliance with applicable laws, and these documents may not be construed as doing so.

Copyrights

NFPA Documents are copyrighted. They are made available for a wide variety of both public and private uses. These include both use, by reference, in laws and regulations, and use in private self-regulation, standardization, and the promotion of safe practices and methods. By making these documents available for use and adoption by public authorities and private users, the NFPA does not waive any rights in copyright to these documents.

Use of NFPA Documents for regulatory purposes should be accomplished through adoption by reference. The term "adoption by reference" means the citing of title, edition, and publishing information only. Any deletions, additions, and changes desired by the adopting authority should be noted separately in the adopting instrument. In order to assist NFPA in following the uses made of its documents, adopting authorities are requested to notify the NFPA (Attention: Secretary, Standards Council) in writing of such use. For technical assistance and questions concerning adoption of NFPA Documents, contact NFPA at the address below.

For Further Information

All questions or other communications relating to NFPA Documents and all requests for information on NFPA procedures governing its codes and standards development process, including information on the procedures for requesting Formal Interpretations, for proposing Tentative Interim Amendments, and for proposing revisions to NFPA documents during regular revision cycles, should be sent to NFPA headquarters, addressed to the attention of the Secretary, Standards Council, NFPA, 1 Batterymarch Park, P.O. Box 9101, Quincy, MA 02269-9101; email: stds_admin@nfpa.org

For more information about NFPA, visit the NFPA website at www.nfpa.org.

NFPA® 1925

Standard on

Marine Fire-Fighting Vessels

2013 Edition

This edition of NFPA 1925, *Standard on Marine Fire-Fighting Vessels*, was prepared by the Technical Committee on Marine Fire Fighting Vessels. It was issued by the Standards Council on November 27, 2012, with an effective date of December 17, 2012, and supersedes all previous editions.

This edition of NFPA 1925 was approved as an American National Standard on December 17, 2012.

Origin and Development of NFPA 1925

This standard resulted from a request by the NFPA Fire Service Training Committee stating that 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 was 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.

For the 2008 edition, the committee completely revised the standard to redesignate the marine fire-fighting vessel classifications and capabilities from three to five categories to be consistent with the NIMS DHS Table for Emergency Support Function (ESF) #4, shown in Chapter 5. With this change, the standard included vessels that had been designated as being equipped with fire-fighting capabilities according to the NIMS DHS Table for ESF #4. This effort provided a consistent methodology for defining the capabilities for marine fire-fighting vessels that support resource sharing in mutual aid applications.

Also for the 2008 edition, the committee reorganized and updated the information in the document to make it consistent with current industry design and specification practices. The committee updated the equipment specification listings for each class of marine fire-fighting vessel.

For the 2013 edition, the committee has completely reorganized Chapter 6, Fire-Fighting System Capabilities, to remove redundant requirements and assist the user with applying the standard. In addition to updating the definition of *fire-fighting vessel*, the committee also added new definitions for *Category A machinery space* and *net positive suction head*. Extinguishing systems, optical warning devices, installation of navigation equipment, and testing of communication and signaling equipment are some of the other requirements that have been updated in this edition of the standard.

Dedication

The Marine Fire Fighting Vessels Committee dedicated the 2004 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

Jeffery P. McBride, *Chair*
EBL Engineers, LLC, MD [SE]

V. Frank Bateman, UTC/Kidde Fire Fighting, CA [M]
Bob D. Beck, Zodiac of North America, Inc., MD [M]
Anthony R. Carli, Everett Fire Department, MA [U]
Richard E. Chester, Jr., Seattle Fire Department, WA [U]
Patrick J. Conroy, Aon Fire Protection Engineering, WA [I]
Peter J. Duclos, Gladding-Hearn, Duclos Corporation, MA [M]
Paul V. Fleury, Marine Services, VA [IM]
Stephen A. Fredlund, Tampa Fire Rescue Department, FL [U]
Gary Handwerk, Hale Products Inc., FL [M]
Muhammad S. Mahtab, Latitude Marine Consultants, Canada [SE]
John J. McDevitt, Drexel Hill, PA [C]
Bill McDonough, The Wexford Group International, PA [SE]
Robert M. Neelon, SeaArk Marine, Inc., SC [M]
Derek J. Noon, Robert Allan Ltd., Canada [SE]
Jonathan G. Parrott, Jensen Maritime Consultants, Inc., WA [SE]
William B. Robbins, New England Marine Survey, LLC, CT [SE]
Donald H. Seaman, CSC Advanced Marine, DC [SE]
Nathan Stabile, John Deere Power Systems, IA [M]
Donald H. J. Turno, Savannah River Nuclear Solutions, LLC, SC [U]
Timothy VonSeggern, Portland Fire & Rescue, OR [U]
Kris Walker, Oceanid, WA [M]

Alternates

Robert G. Allan, Robert Allan Ltd., Canada [SE]
(Alt. to D. J. Noon)
Melissa L. Hertel, Jensen Maritime Consultants, Inc., WA [SE]
(Alt. to J. G. Parrott)
Karl D. Houser, EBL Engineers, LLC, MD [SE]
(Alt. to J. P. McBride)
Carl J. Micu, John Deere Power Systems, IA [M]
(Alt. to N. Stabile)
Richard Tull, Hale Products Inc., PA [M]
(Alt. to G. Handwerk)

Nonvoting

Walter A. Damon, Buffalo Grove, IL [I]
(Member Emeritus)

Laurence J. Stewart, 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.

Contents

NFPA 1925

Standard on

Marine Fire-Fighting Vessels

2013 Edition

IMPORTANT NOTE: This NFPA document is made available for use subject to important notices and legal disclaimers. These notices and disclaimers appear in all publications containing this document and may be found under the heading "Important Notices and Disclaimers Concerning NFPA Documents." They can also be obtained on request from NFPA or viewed at www.nfpa.org/disclaimers.

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

Changes other than editorial are indicated by a vertical rule beside the paragraph, table, or figure in which the change occurred. These rules are included as an aid to the user in identifying changes from the previous edition. Where one or more complete paragraphs have been deleted, the deletion is indicated by a bullet (•) between the paragraphs that remain.

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, the complete title and edition of the source documents for extracts in mandatory sections of the document are given in Chapter 2 and those for extracts in informational sections are given in Annex C. Extracted text may be edited for consistency and style and may include the revision of internal paragraph references and other references as appropriate. Requests for interpretations or revisions of extracted text shall be sent to the technical committee responsible for the source document.

Information on referenced publications 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 for marine fire-fighting vessels.

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.

1.2.3 This standard is not intended to serve as a staffing document for marine fire-fighting vessels.

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 in this standard is intended to prevent the use of systems, methods, or devices of equivalent or superior quality, strength, fire resistance, effectiveness, durability, and safety over those prescribed by this standard.

1.5.3 The technical documentation shall be submitted to the authority having jurisdiction to demonstrate equivalency.

1.5.4 The system, method, or device shall be approved for the intended purpose by the authority having jurisdiction.

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 10, *Standard for Portable Fire Extinguishers,* 2013 edition.

NFPA 11, *Standard for Low-, Medium-, and High-Expansion Foam,* 2010 edition.

NFPA 12, *Standard on Carbon Dioxide Extinguishing Systems,* 2011 edition.

NFPA 72®, *National Fire Alarm and Signaling Code,* 2013 edition.

NFPA 302, *Fire Protection Standard for Pleasure and Commercial Motor Craft,* 2010 edition.

NFPA 303, *Fire Protection Standard for Marinas and Boatyards,* 2011 edition.

NFPA 720, *Standard for the Installation of Carbon Monoxide (CO) Detection and Warning Equipment,* 2012 edition.

NFPA 1005, *Standard for Professional Qualifications for Marine Fire Fighting for Land-Based Fire Fighters,* 2007 edition.

NFPA 1500, *Standard on Fire Department Occupational Safety and Health Program,* 2013 edition.

NFPA 1931, *Standard for Manufacturer's Design of Fire Department Ground Ladders,* 2010 edition.

NFPA 1961, *Standard on Fire Hose,* 2013 edition.

NFPA 1963, *Standard for Fire Hose Connections,* 2009 edition.

NFPA 1964, *Standard for Spray Nozzles,* 2013 edition.

NFPA 1981, *Standard on Open-Circuit Self-Contained Breathing Apparatus (SCBA) for Emergency Services,* 2013 edition.

NFPA 1983, *Standard on Life Safety Rope and Equipment for Emergency Services,* 2012 edition.

NFPA 2001, *Standard on Clean Agent Fire Extinguishing Systems,* 2012 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, 2006.

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, 2006.

ABS Guidance Notes on Fire-Fighting Systems, 2005.

2.3.2 ABYC Publications. American Boat and Yacht Council, 613 Third Street, Suite 10, Annapolis, MD 21403.

ABYC A-4, *Fire Fighting Equipment*, July 2008.

ABYC A-24, *Carbon Monoxide Detection Systems*, July 2007.

ABYC A-27, *Alternating Current (AC) Generator Sets*, July 2004.

ABYC A-28, *Galvanic Isolators*, July 2008.

ABYC A-31, *Battery Chargers and Inverters*, 2010.

ABYC E-2, *Cathodic Protection*, July 2008.

ABYC E-10, *Storage Batteries*, July 2011.

ABYC E-11, *Alternating Current (AC) and Direct Current (DC) Electrical Systems on Boats*, July 2009.

ABYC H-2, *Ventilation of Boats Using Gasoline*, 2008.

ABYC H-3, *Windows, Windshields, Exterior Hatches, Doors, Port Lights and Glazing Materials*, July 2008.

ABYC H-24, *Gasoline Fuel Systems*, July 2010.

ABYC H-25, *Portable Gasoline Fuel Systems*, July 2010.

ABYC H-26, *Powering of Boats*, July 2011.

ABYC H-32, *Ventilation of Boats Using Diesel Fuel*, 2008.

ABYC H-33, *Diesel Fuel Systems*, July 2010.

ABYC H-40, *Anchoring, Mooring, and Lifting*, July 2008.

ABYC P-1, *Installation of Exhaust Systems for Propulsion and Auxiliary Engines*, 2010.

ABYC P-4, *Marine Inboard Engines and Transmissions*, May 2004.

ABYC P-6, *Propeller Shafting Systems*, July 2010.

ABYC P-14, *Mechanical Propulsion Control Systems*, December 2010.

ABYC P-17, *Steering Systems for Outboard, Inboard, Sterndrive, and Water Jet Drive Boats*, July 2008.

ABYC P-18, *Cable over Pulley Steering Systems for Outboard Engines*, July 2008.

ABYC P-21, *Manual Hydraulic Steering Systems*, July 2003.

ABYC P-22, *Steering Wheels*, July 2008.

ABYC P-23, *Steering and Propulsion Controls for Jet Boats*, July 2001.

ABYC P-24, *Electric/Electronic Propulsion Control Systems*, July 2010.

ABYC S-12, *Outboard Motor Transom and Motor Well Dimensions*, July 2010.

ABYC S-30, *Outboard Engine and Related Equipment Weights*, July 2006.

ABYC Standards and Technical Information Reports for Small Craft, July 2012.

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)*, 2001.

ANSI/CGA G-7.1, *Commodity Specification for Air*, 2004.

2.3.4 ASTM Publications. ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428–2959.

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

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*, 2005.

2.3.6 IMO Publications. International Maritime Organization, 4 Albert Embankment, London, SE1 7SR, United Kingdom.

IMO A 18, Resolution 749, *Code on Intact Stability for All Types of Ships Covered by IMO Instruments*, 1993 edition.

2.3.7 ISO Publications. International Organization for Standardization, 1, ch. de la Voie-Creuse, Case postale 56, CH-1211 Geneva 20, Switzerland.

ISO 12217-1, *Small Craft — Stability and Buoyancy Assessment and Categorization — Part 1: Non-Sailing Boats of Hull Length Greater Than or Equal to 6 m*, 2002.

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

Title 33, Code of Federal Regulations, Parts 1–124, "Navigation Rules," July 2000.

Title 33, Code of Federal Regulations, Part 88, "Pilot Rules," 2012.

Title 33, Code of Federal Regulations, Parts 1251–1387, "Federal Water Pollution Control Act," 2002.

Title 46, Code of Federal Regulations, Part 25.30, "Fire-Extinguishing Equipment," 2007.

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 181, "Fire Protection Equipment," 2004.

Title 46, Code of Federal Regulations, Part 183.550, "General Alarm Systems," 2012.

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 175–187 (Subchapter T), "Small Passenger Vessels (Under 100 Gross Tons)," Oct. 2001.

USCG, NVIC (Navigation and Vessel Inspection Circular) 9-97, *Guide to Structural Fire Protection*, 1997.

2.3.9 Other Publications.

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

2.4 References for Extracts in Mandatory Sections.

NFPA 11, *Standard for Low-, Medium-, and High-Expansion Foam,* 2010 edition.

NFPA 20, *Standard for the Installation of Stationary Pumps for Fire Protection,* 2013 edition.

NFPA 58, *Liquefied Petroleum Gas Code,* 2011 edition.

NFPA 70®, National Electrical Code®, 2011 edition.

NFPA 302, *Fire Protection Standard for Pleasure and Commercial Motor Craft,* 2010 edition.

NFPA 1405, *Guide for Land-Based Fire Departments That Respond to Marine Vessel Fires,* 2011 edition.

NFPA 1901, *Standard for Automotive Fire Apparatus,* 2009 edition.

NFPA 1906, *Standard for Wildland Fire Apparatus,* 2012 edition.

NFPA 1983, *Standard on Life Safety Rope and Equipment for Emergency Services,* 2012 edition.

Chapter 3 Definitions

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

3.2 NFPA Official Definitions.

3.2.1* 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 are not to be considered a part of the requirements of a standard and shall be located in an appendix, annex, footnote, informational note, or other means as permitted in the *Manual of Style for NFPA Technical Committee Documents.*

3.3 General Definitions.

3.3.1 Acceptance. An agreement between the purchasing authority and the contractor that the terms and conditions of the contract have been met. [**1906**, 2012]

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, and so forth. [**70:**100]

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. See 3.3.16.1.

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 the one to which it is coupled. *(See also 3.3.15, Cathode.)*

3.3.9 Bilge. The lowest inner part of a ship's hull. [**1405**, 2011]

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.

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.

3.3.14 Category A Machinery Space. Spaces and trunks to such spaces that contain either internal combustion machinery used for main propulsion, internal combustion machinery used for purposes other than main propulsion where such machinery has in the aggregate a total power output of not less than 375 kW, or any oil-fired boiler, oil fuel unit, or oil-fired equipment other than boilers, such as inert gas generators, incinerators, and so forth.

3.3.15* Cathode. A metal that in an electrolyte assumes a more electropositive charge than the one to which it is coupled. *(See also 3.3.8, Anode.)*

3.3.16 Chocks. Usually found on the rail or deck of a vessel, fittings having jaws that serve as fair leads for anchor rode and other lines.

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

3.3.17 Class A or Class B Foams. See 3.3.31, Foam.

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

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

3.3.20 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.

3.3.21 Crew. Anyone associated with the onboard operation of the vessel.

3.3.22 dBA. Decibel, "A" scale.

3.3.23 Deck Rail. See 3.3.52, Life Rail, Deck Rail, or Lifeline.

3.3.24 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).

3.3.25* Eductor. A device that uses the Venturi principle to siphon a liquid in a water stream.

3.3.26* Electrolyte. A liquid in which an electric current is easily conducted.

3.3.27 EMS. Emergency medical services.

3.3.28 Fire Hazard Area.

3.3.28.1* ***Major Fire Hazard Area.*** Any compartment, space, or duct 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.*** Includes accommodation, service, and public spaces where the proximity of combustible materials, flammable liquids, and potential sources of ignitions doesn't promote a fire.

3.3.29 Fire Monitor. See 3.3.58, Monitor.

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

3.3.31* Foam. A stable aggregation of bubbles of lower density than oil or water. [**11**, 2010]

3.3.32 Freeboard. The vertical distance between the sheer and the waterline.

3.3.33 Gallon U.S. Standard. 1 U.S. gal = 0.833 Imperial gal = 231 $in.^3$ = 3.785 L. [**58**, 2011]

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

3.3.35 Galvanic Isolator. A device installed in series with the ac grounding (green, or green with yellow stripe) 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, or green with yellow stripe) conductor. [**302,** 2010]

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

3.3.37 GM. Abbreviation of metacentric height. *(See also 3.3.57, Metacentric Height.)*

3.3.38 gpm. Gallons per minute.

3.3.39 Grab Rail. See 3.3.44, Handhold Device or Grab Rail.

3.3.40 Ground. The electrical potential of the earth's surface. The boat's ground is established by a conducting connection (intentional or accidental) with the earth, including any conductive part of the wetted surface of a hull. [**302**, 2010]

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

3.3.42 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.

3.3.43 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.

3.3.44* 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.

3.3.45 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.

3.3.46* Helm. The position from which direction and water speed of the vessel are controlled.

3.3.47 Hull Potential Monitor. A dc meter that measures the potential of a metallic hull or metallic hull fittings as compared to a reference electrode.

3.3.48* 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.

3.3.49 Inclining Experiment. See 3.3.73, Stability Test (Inclining Experiment).

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

3.3.50.1 ***Rigid Hull Inflatable Boat (RHIB).*** Solid-shaped hull mated with a flexible multicompartment buoyancy tube(s) at the gunwale.

3.3.51* Jet Drive. A propulsion unit that generates thrust in reaction to a water stream.

3.3.52 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 prevent falls overboard.

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

3.3.54 Line. Rope, when in use. [**1983**, 2012]

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

3.3.56 Manufacturer. The person or persons, company, firm, corporation, partnership, or other organization responsible for turning raw materials or components into a finished product. [**1901**, 2009]

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

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

3.3.59 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.

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

3.3.61 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.*

3.3.62 Net Positive Suction Head (NPSH) (h_{sv}). The total suction head in meters (feet) of liquid absolute, determined at the suction nozzle, and referred to datum, less the vapor pressure of the liquid in meters (feet) absolute. [**20,** 2013]

3.3.63* Net Pump Pressure. The sum of the discharge pressure and the suction lift converted to psi or kPa when pumping at draft, or the difference between the discharge pressure and the intake pressure when pumping from a hydrant or other source of water under positive pressure. [**1901**, 2009]

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

3.3.65 psi. Pounds per square inch. [**1901**, 2009]

3.3.66 Pump Operator's Position. The location from which the pump operator operates the pump. [**1901,** 2009]

3.3.67 Rigid Hull Inflatable Boat (RHIB). See 3.3.50.1.

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 that 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 Stability Test (Inclining Experiment). A test to determine the vessel displacement (light ship survey) and the position of the center of gravity both vertical and longitudinal.

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 of enclosed volume of a vessel inside of structural frames (1 ton = 100 ft^3).

3.3.78* Ventilation. The changing of air within a compartment by natural or mechanical means. [**302**, 2010]

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 Design Considerations

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

4.2 Vessel Performance.

4.2.1 General.

4.2.1.1 The overall performance of a marine fire-fighting vessel shall be permitted to be determined after a careful evaluation of all perceived operational requirements.

4.2.1.2 Elements of performance requiring definition shall include, but are not limited to, speed, range, capacity, endurance, and seakeeping capability, as well as the capability of the fire-fighting system(s).

4.2.1.3 The performance criteria shall be permitted to be defined after the completion of a Determination of Needs Study as described in 4.2.2, or equivalent assessment as determined by the AHJ.

4.2.2 Determination of Needs Study. See also Annex B.

4.2.2.1 Prior to the construction of a new marine fire-fighting vessel or the major conversion of a vessel for fire-fighting purposes, a study shall be undertaken to clearly identify the mission and capability requirements of the vessel.

4.2.2.2 Some of the issues that the study shall be permitted to cover are as follows:

(1) General specifications as follows:
   (a) Geographical size of the area to be protected by the vessel
   (b) Nature of the waterfront facilities and vessels to be protected
   (c) Maximum desirable response times
   (d) Maximum wake permissible
   (e) Nature of the marine environment in which the vessel will operate, including mutual aid operations
   (f) Anticipated future growth in the service area and the service needs from the marine fire-fighting vessel
   (g) Projected or anticipated years of service
(2) Crew — The expected number of personnel in the vessel's crew
(3) Fire-fighting mission requirements as follows:
   (a) Requirements for supplying shoreside water systems
   (b) Number of pier fires in the jurisdiction to which marine fire-fighting vessels have responded or would have responded
   (c) Number of vessel fires in the jurisdiction to which marine fire-fighting vessels have responded or would have responded
   (d) Number of land fires in the jurisdiction to which marine fire-fighting vessels have responded or would have responded
   (e) Maximum expected duration of a mission
   (f) Pumping capacity used or required during previous major fires
   (g) Maximum pumping capacity to be reasonably expected of a marine fire-fighting vessel
   (h) *Minimum pumping capacity for expected handline use
   (i) Hose and equipment used or required at previous fires by marine fire-fighting vessels
   (j) Requirements to remain on station during previous fires in the jurisdiction
   (k) Self protection such as, but not limited to, heat protection, spray, and CBRN
(4) Rescue and emergency medical services (EMS) requirements as follows:
   (a) Number of rescue incidents in the jurisdiction in which marine fire-fighting vessels have been involved
   (b) Type of rescue missions that the marine fire-fighting vessel could become involved with during service life
(5) Fire prevention requirements as follows:
   (a) Building inspection requirements
   (b) Subpier inspection requirements
   (c) Hazardous cargo inspection requirements
   (d) Prefire inspection requirements
(6) Effect of standards and requirements as follows:
   (a) NFPA standards
   (b) U.S. Coast Guard (USCG) requirements
   (c) American Boat and Yacht Council (ABYC) standards
   (d) Local insurance considerations

4.2.3 Mission of the Vessel.

4.2.3.1 The mission of the vessel shall be defined as a result of the Determination of Needs Study as determined in accordance with 4.2.2.

4.2.3.2 Where the vessel is used for the sole purpose of fire fighting, it shall meet all the stated objectives of this standard.

4.2.3.3 Where the vessel is assigned additional duties, it shall meet all the objectives of this standard, as well as those for each of the designated special operations.

4.2.4 Vessel Requirements Specification.

4.2.4.1 Based upon the outcome of the Determination of Needs Study, the details of the vessel shall be specified.

4.2.4.2 The services of an experienced professional shall be considered to prepare this document and properly define the vessel.

4.3 Command and Control Spaces.

4.3.1 Helm Control Station.

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

4.3.1.2 Polarized or tinted windows that would interfere with safe navigation shall be prohibited.

4.3.1.3 Machinery, alarm, and monitoring equipment shall be provided at the primary helm or master control station and be adequate for the safe and proper operation of the vessel.

4.3.2 Machinery Control Stations. 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."

4.3.3 Fire-Fighting Control Centers.

4.3.3.1 Fire-fighting control centers shall provide control of the fire pump and associated remote control equipment.

4.3.3.2 Fire-fighting control centers shall be located in close proximity to the navigation control center.

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

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

4.3.3.5 Fire-fighting control stations on Type I through Type IV vessels shall be insulated from heat and protected from spray in accordance with the Determination of Needs Study.

4.4 Construction.

4.4.1 General. Placement of equipment shall allow for its removal from the vessel with minimal disruption of permanently installed structural members, or equipment shall be situated to allow for maintenance and repair.

4.4.2 Materials.

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

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

4.4.3 Fuel Tanks.

4.4.3.1 Diesel fuel systems shall comply with *ABS Rules for Building and Classing Steel Vessels*, for Types I and II and ABYC H-33, *Diesel Fuel Systems*, for Types III, IV, and V.

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

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

4.4.3.4 The use of liquid hydrocarbon alternative fuels shall be permitted in accordance with accepted industry practices.

4.4.4 Void Spaces.

4.4.4.1 Access and lightening holes shall be arranged clear of concentrated loads or areas of high stresses.

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

4.4.5 Open Decks.

4.4.5.1 Openings in weather decks shall comply with *ABS Rules for Building and Classing High Speed Craft* or ABYC H-3, *Windows, Windshields, Exterior Hatches, Doors, Port Lights and Glazing Materials*.

4.4.5.2 All vessels shall be equipped with freeing ports or drains to provide rapid drainage of water, including fire flow, from the weather deck under all operating conditions.

4.4.6 Machinery Spaces.

4.4.6.1 Within practical limits, machinery spaces shall be designed so that all equipment that requires inspection, adjustment, or maintenance is readily accessible.

4.4.6.2 Within practical limits, all equipment shall be arranged so that it is not damaged by bilge water.

4.4.6.3 Compartments in which flammable gases, acid fumes, and oil vapors can accumulate shall be ventilated to reduce the possibility of explosion.

4.4.6.4 Openings and ventilators shall be arranged to minimize risk of water ingress onto equipment.

4.5 Human Factors Engineering.

4.5.1 The vessel shall comply with the requirements in NFPA 302, *Fire Protection Standard for Pleasure and Commercial Motor Craft*; *ABYC Standards and Technical Information Reports for Small Craft*; *ABS Rules for Building and Classing Steel Vessels Under 90 Meters (295 ft) in Length*; 46 CFR 24–28, Subchapter C, "Uninspected Vessels," or 46 CFR 175–187, Subchapter T, "Small Passenger Vessels (Under 100 Gross Tons)," as appropriate.

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

4.5.3 Escape plans, operating instructions, diagrams, safety checklists, and other pertinent data shall be available to those onboard.

Chapter 5 Classifications

5.1* Classifications. Marine fire-fighting vessels shall be classified and equipped in accordance with Table 5.1 for classification of emergency response vessel resources.

5.2 Requirements for Vessel Classification.

5.2.1 Marine fire-fighting vessels designated as Type I shall meet the following minimum requirements:

(1) Minimum number of pumps: 2
(2) Minimum water pumping capacity: 20,000 gpm (80,000 L/min) @ 150 psi (10 bar)
(3) Foam production in accordance with Chapter 9 of NFPA 11, *Standard for Low-, Medium-, and High-Expansion Foam*
(4) Minimum number of generators: 2
(5) On-station fuel capacity: 48 hours
(6) Minimum number of monitors: 4
(7) Minimum number of discharge outlets: 24; 6 [1½ in. (38 mm)]; 10 [2½ in. (65 mm) or larger]; 4 [≥3½ in. (89 mm)]; 4 [5 in. (127 mm)]

5.2.2 Marine fire-fighting vessels designated as Type II shall meet the following minimum requirements:

(1) Minimum number of pumps: 2
(2) Minimum pumping capacity: 10,000 gpm (40,000 L/min) @ 150 psi (10 bar)
(3) Foam production in accordance with Chapter 9 of NFPA 11, *Standard for Low-, Medium-, and High-Expansion Foam*
(4) Minimum number of generators: 2
(5) On-station fuel capacity: 24 hours
(6) Minimum number of monitors: 4
(7) Minimum number of discharge outlets: 8; 3 [≥3½ in. (89 mm)]; 5 [5 in. (127 mm)]

Table 5.1 Minimum Capabilities of Vessel Classification

Component	Type I	Type II	Type III	Type IV	Type V
Pumps	2	2	2	1	1
Pumping water capacity (gpm)	20,000	10,000	4500	1500	500
Foam production	Per Chapter 9 of NFPA 11	Per Chapter 9 of NFPA 11	Per Chapter 9 of NFPA 11	Per Chapter 9 of NFPA 11	None
Generators	2	2	1 with direct power source	0	0
On-station fuel capacity (hours)	48	24	8	6	4
Monitors	4	4	4	2	1
Discharge outlets	Per 5.2	Per 5.2	Per 5.2	Per 5.2	N/A

N/A: Not applicable.
Note: Additional fire-fighting equipment requirements for all types of vessels are found in Chapter 10.

5.2.3 Marine fire-fighting vessels and special purpose fire-fighting vessels designated as Type III shall meet the following minimum requirements:

(1) Minimum number of pumps: 2
(2) Minimum pumping capacity: 4500 gpm (18,000 L/min) @ 150 psi (10 bar)
(3) Foam production in accordance with Chapter 9 of NFPA 11, *Standard for Low-, Medium-, and High-Expansion Foam*
(4) Minimum number of generators: 1 with direct power source
(5) On-station fuel capacity: 8 hours
(6) Minimum number of monitors: 4
(7) Minimum number of discharge outlets: 4; 2 [≥3½ in. (89 mm)]; 2 [5 in. (127 mm)]

5.2.4 Marine fire-fighting vessels and special purpose fire-fighting vessels designated as Type IV shall meet the following minimum requirements:

(1) Minimum number of pumps: 1
(2) Minimum pumping capacity: 1500 gpm (6000 L/min) @ 150 psi (10 bar)
(3) Foam production in accordance with Chapter 9 of NFPA 11, *Standard for Low-, Medium-, and High-Expansion Foam*
(4) On-station fuel capacity: 6 hours
(5) Minimum number of monitors: 2
(6) Minimum number of discharge outlets: 2 [≥3½ in. (89 mm)]

5.2.5 Marine fire-fighting vessels and special purpose fire-fighting vessels designated as Type V shall meet the following minimum requirements:

(1) Minimum number of pumps: 1
(2) Minimum pumping capacity: 500 gpm (2000 L/min) @ 150 psi (10 bar)
(3) On-station fuel capacity: 4 hours
(4) Minimum number of monitors: 1

Chapter 6 Fire-Fighting System Capabilities

6.1 General.

6.1.1 The selection of pumps and design of distribution piping shall be done in consideration of the Determination of Needs Study per 4.2.2 and the following:

(1) Number, sizes, and types of distribution devices expected to be used singularly or simultaneously
(2) Pressure required at the inlets of the discharge devices
(3) Required full-range fire flow

6.1.1.1 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.

6.1.1.2 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.

6.2 System Design.

6.2.1* Fire-fighting piping systems shall be designed for not less than the maximum potential flow rate, cut-off pressure of the pump(s), or relief valve setting of the pump.

6.2.2 The pump suction velocity shall generally not exceed 6.5 ft/sec (2 m/sec), and discharge piping shall generally not exceed 13 ft/sec (4 m/sec) at the design flow rate for each section of pipe.

6.2.3 Recommended flow rates shall be permitted to be exceeded where other aspects of the design could be compromised by fitting larger or heavier pipes and fittings, provided the impact of the higher rates on erosion in piping and fittings is identified and accepted by the owner/operator, and the higher flow resistance does not impair the performance of the system.

6.2.4 Where a common suction or discharge header is connected to more than one pump, the design flow rate in the header shall reflect the combined capacity of all connected pumps operating simultaneously.

6.2.5 Means shall be provided to prevent the pump from overheating with distribution devices closed, such as an overboard discharge.

6.2.6 Where multiple pumps are installed, the failure of any single pump shall not reduce fire flow by more than 50 percent.

6.2.7 Where piping serves multiple pumps, the failure of any piping shall not reduce fire flow by more than 50 percent.

6.2.8 Pump discharge piping shall include a check valve and isolation valve for each pump in a multiple pump system.

6.2.9 Isolation valves shall be installed where necessary for each device or outlet and where necessary for continued operation of the system in case of piping or component failure.

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

6.2.11 Suction Arrangement.

6.2.11.1* The suction arrangements for each pump shall include at least one dedicated sea chest with screened inlet, a valve at the sea chest outlet, and a valved vent to atmosphere.

6.2.11.2 Where pump suctions are arranged in a manifold (sea main), an isolation valve shall be provided at or near the suction inlet of each pump.

6.2.11.3* The open area of the screen shall be at least two times the cross-sectional area of the suction pipe, and the individual openings shall not be larger than the pump manufacturer's maximum particle size.

6.2.11.4 The intakes to all fire pumps shall be fitted with a means of clearing while the vessel is afloat.

6.2.12 System Pressure Ratings and Control.

6.2.12.1 Fire-fighting pump discharge piping shall be designed for a working pressure not less than the maximum cut-off pressure of the pump(s) fitted, except as noted in 6.2.12.3 and 6.2.12.4.

6.2.12.2 Piping systems shall be designed to avoid water hammer and similar hydraulic shocks within the system during operation by fitting valve operators with controlled opening/closing rates in accordance with 6.3.6.3 and by providing the means to purge air from the piping system at low flow velocities.

6.2.12.3 The use of automatic pressure relief valves in systems shall be permitted where the piping system cannot satisfy 6.2.12.1.

6.2.12.4* Where pressure relief valves are fitted, the discharge(s) shall be to the pump suction or, if discharged outside the marine fire-fighting vessel, the discharge shall be above the waterline and in a position least likely to affect vessel operations or the safety of other vessels or personnel in the vicinity.

6.2.13 Drains.

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

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

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

6.3 Components and Materials.

6.3.1 General.

6.3.1.1 All components shall have design pressure ratings equal to or greater than the maximum pump pressure or relief valve setting.

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

6.3.1.3 Any components and materials to be used with fire-fighting foams shall be compatible with the type of foam concentrate to be used.

6.3.2 Piping.

6.3.2.1 Where steel pipe is joined by threaded fittings referenced in 6.3.3, the minimum wall thickness shall be in accordance with Schedule 40 for pressures up to 300 psi (20.7 bar).

6.3.2.2 Bending of pipe and tube shall be in accordance with *ABS Rules for Building and Classing Steel Vessels Under 90 Meters (295 ft) in Length.*

6.3.3 Fittings.

6.3.3.1 Threaded fittings shall not be used on pipe larger than 2 in. (50 mm).

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

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

6.3.3.4 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.

6.3.4 Welded Pipe and Fittings. Welding to join pipes and fittings shall be permitted provided that the welding methods comply with AWS B2.1, *Specification for Welding Procedure and Performance Qualification.*

6.3.5 Brazed Joints.

6.3.5.1 Joints for the connection of copper tube shall be brazed or welded in accordance with Subchapter F of 46 CFR 56.70, "Welding."

6.3.5.2 Excess flux shall be removed after brazing.

6.3.6 Valves.

6.3.6.1 All valves used in the pump piping system shall be equipped with an operating mechanism that visually indicates the position of the valve at all operating locations.

6.3.6.2 All valves shall be arranged so that the open or closed position is clearly indicated directly on the valve.

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

6.3.6.3.1 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.

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

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

6.3.6.4 Suction valves shall be capable of being opened and closed smoothly and readily at flow velocities up to 15 ft/sec (4.6 m/sec).

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

6.3.7* Pumps.

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

6.3.7.2 Pumps shall be installed below the waterline where possible, and in all cases the net positive suction head (NPSH) shall be verified for the proposed installation and pump performance.

6.3.7.3 Pumps installed above the waterline shall be designed to operate at rated capacity with a total suction lift not to exceed 10 ft (3 m).

6.3.7.4 Net pump pressure at rated capacity shall be 150 psi (10.34 bar) or greater for all vessels.

6.3.7.5 The pump manufacturer shall hydrostatically test the pump at twice the rated discharge pressure of the pump.

6.3.7.6 Certification.

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

6.3.7.6.2 The certification for each pump shall be provided to the owner.

6.3.8 Discharge Devices.

6.3.8.1* General.

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

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

6.3.8.2 Monitors.

6.3.8.2.1* For all marine fire-fighting vessels, a single monitor or combination of monitors shall provide 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.

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

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

6.3.8.2.4 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.

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

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

6.3.8.2.7 Each monitor operator position shall have an effective means of communication with the vessel's operator position.

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

6.3.8.3 Discharge Outlets.

6.3.8.3.1 For Type III through Type V vessels, hose connections shall be provided to discharge 100 percent of the rated pump capacity. For Type I and Type II vessels, hose connections shall be determined with special consideration of the Determination of Needs Study, per 4.2.2.

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

6.3.9 Installation.

6.3.9.1 All components and equipment shall be installed in accordance with manufacturers' requirements.

6.3.9.2 Piping shall be supported from the vessel structure to carry the load of a completely filled piping system, allowing for the anticipated vertical design accelerations, which can reasonably be expected in the service.

6.3.9.3 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.

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

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

6.3.10 Controls, Indicators, and Instruments.

6.3.10.1 When mechanical indicators are used, all master fire pump pressure indicators shall have a dial not less than 3½ in. (90 mm) in diameter.

6.3.10.1.1 When mechanical indicators are used, indicator connections shall be accessible to permit back flushing of pressure tubing from remote indicator locations.

6.3.10.2 The suction indicator indicator, when provided, shall be a compound type ranging from 30 in. Hg (760 mm Hg) to 15 psi (1 bar).

6.3.10.2.1 Suction indicators shall not be required on Type V vessels.

6.3.10.3 The discharge pressure indicator range shall be from 0 psi (0 bar) to twice the maximum pressure that the pump produces.

6.3.10.4 A pump pressure indicator shall be provided to monitor fire main pressure and shall be visible to the fire system operator.

6.3.11 Testing.

6.3.11.1 The installed discharge piping shall be hydrostatically tested for not less than 1 hour at not less than 200 psi (13.8 bar), or at 50 percent greater pressure than the rated cut-off pressure of the pump(s), whichever is greater.

6.3.11.2 Pressure test instrument connections shall be provided at each pump and monitor.

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

6.3.11.4 A valved test connection shall be located for accessibility above deck plates as close to the gauge tap on the pump flange as possible.

Chapter 7 Foam Systems

7.1 General.

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

7.1.2* 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.

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

(1) Minimum and maximum foam solution flow rates
(2) Foam solution proportioning rate or range
(3) Minimum operating time required
(4) Minimum performance requirements of system discharge devices including at least flow, pressure, reach, whether aspirated or nonaspirated

7.2 Design and Performance Requirements.

7.2.1 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.

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

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

7.2.4 For Type I through Type III vessels, the foam-proportioning system shall be an integral part of the water delivery system.

7.2.4.1 Type IV and Type V marine fire-fighting vessels shall be permitted to utilize portable foam delivery systems in accordance with Chapter 9 of NFPA 11, *Standard for Low-, Medium-, and High-Expansion Foam*.

7.2.5 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) Minimum and maximum rate of foam solution discharge available at each individual outlet equipped with a foam-proportioning device

7.2.6 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.

7.2.7 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 (4.6 m/sec) at the maximum design flow.

7.2.8 The operating characteristics of the selected individual foam system components shall be reviewed to ensure that the installed system meets or exceeds the design performance requirements.

7.2.9 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.

7.2.9.1 The components in 7.2.9, including, but not limited to, gaskets, seals, and binding of moving parts, shall also be constructed of materials resistant to deterioration by foam concentrates.

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

7.2.11 A check valve or similar means of isolation shall be installed in the concentrate delivery piping as close to the proportioners as possible to prevent the mixing/contamination of the concentrate with backflow of fire main water.

7.3 Controls.

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

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

7.3.3 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.

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

7.3.5 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.

7.4 Gauges, Flowmeters, and Indicators.

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

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

7.4.3 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.

7.5 Nameplates and Instruction Plates.

7.5.1 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.

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

7.5.3 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.

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

7.5.4 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.

7.6 Atmospheric Foam Concentrate Tank.

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

7.6.2 The foam concentrate tank and associated piping shall be constructed of materials in accordance with 7.2.3.

7.6.3 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 (20 L) foam concentrate containers.

7.6.3.1 Foam concentrate tanks larger than 200 gal (800 L) shall incorporate a fill opening with an area of at least 36 in.^{2} (2320 mm^2).

7.6.3.2 Where a fill opening is less than 36 in.^{2} (2320 mm^2), a fill funnel with strainer shall be provided with a neck to fit the fill opening and a minimum 36 in.^{2} (2320 mm^2) fill cup.

7.6.3.3 Foam concentrate tanks of 200 gal (800 L) or less shall incorporate a fill opening with an area not less than 4 in.^{2} (260 mm^2).

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

7.6.4.1* The cover shall be attached to the tank fill by mechanical means to prevent air from entering or escaping during normal service.

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

7.6.5.1 The volume of the expansion compartment in 7.6.5 shall be not less than 2 percent of the total foam concentrate tank volume.

7.6.6 Pressure/Vacuum Vent.

7.6.6.1 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.

7.6.6.2 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.

7.6.6.3 The alternative to a pressure/vacuum vent shall be permitted to be a small vented header tank, fitted with a sight glass or similar level indicator, that would present a small contact surface area of foam to the atmosphere, and ensure that the main storage tanks are void of air.

7.6.7 Foam Isolation.

7.6.7.1 The foam concentrate shall be isolated from direct contact with the atmosphere to prevent drying out and to reduce risk of internal corrosion in the tank.

7.6.7.2 The foam concentrate tank shall be fitted with a pressure vacuum vent or alternative device that allows the tank to react safely to changes in pressure when filling or removing foam concentrate from the tank.

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

7.6.7.4 An acceptable alternative to a pressure vacuum vent shall be permitted to be a small vented header tank, fitted with a sight glass or similar level indicator, which presents only a small contact surface area of foam to the atmosphere and ensures that the main storage tanks are void of air.

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

7.6.8.1 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. (510 mm).

7.6.8.2 Tanks equipped with a personnel access hatch shall also be equipped with a 20 in. (510 mm) minimum inside diameter opening through any internal baffles to allow personnel access to the entire tank interior.

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

7.6.9 Swash Partitions.

7.6.9.1 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. (1220 mm) and shall be not less than 23 in. (584 mm).

7.6.9.2 The swash partitions shall have 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.

7.6.10 Discharge.

7.6.10.1 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.

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

7.6.10.3 The foam concentrate tank inlet connection shall terminate within 2 in. (51 mm) of the tank bottom to prevent aerating the foam concentrate.

7.6.11 Valved Drain.

7.6.11.1 A minimum 1 in. (25 mm) valved drain shall be provided in the sump of any foam concentrate tank of 20 gal (80 L) or more.

7.6.11.2 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).

7.7 Foam Concentrate Pump.

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

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

7.7.3 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.

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

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

7.7.6* 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 passes through the strainer.

Chapter 8 Manufacturer/Purchaser Responsibilities

8.1* Personnel Training. After delivery of the marine fire-fighting vessel, the owner shall be responsible for ongoing training of its personnel to proficiency regarding the proper and safe use of the marine fire-fighting vessel and associated equipment as defined in NFPA 1005, *Standard for Professional Qualifications for Marine Fire Fighting for Land-Based Fire Fighters*,

and NFPA 1500, *Standard on Fire Department Occupational Safety and Health Program*.

8.2* Compliance with Regulations. The owner shall comply with all applicable regulations for operation of vessels in their location.

8.3 Training and Instruction. The fire-fighting vessel manufacturer/builder of the fire-fighting vessel shall supply a qualified person to provide operational training to fire department personnel that includes the following:

(1) A complete system component familiarization/walkaround
(2) A complete review of the system and its safety features
(3) A review of all operation, service, and maintenance documentation
(4) Hands-on familiarization of the safe operation of the vessel

Chapter 9 Fire Protection Equipment for the Vessel

9.1 General.

9.1.1 The requirements in *ABS Guidance Notes on Fire Fighting Systems* shall apply to Type I through Type III marine fire-fighting vessels.

9.1.2 The requirements of 46 CFR 175–187, Subchapter T, "Small Passenger Vessels (under 100 Gross Tons)"; ABYC A-4, *Fire Fighting Equipment*; and NFPA 302, *Fire Protection Standard for Pleasure and Commercial Motor Craft*, shall apply to Type IV and Type V marine fire-fighting vessels.

9.1.3 Type I and Type II marine fire-fighting vessels shall be equipped with a water curtain or equivalent system to protect the vessel and its equipment during fire-fighting operations.

9.1.4 The melting point of the exposed water curtain or equivalent system piping materials shall be equal to or greater than that of the hull structure material.

9.2 Fire Detection and Alarm Systems.

9.2.1 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.

9.2.2 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.

9.2.3 Smoke, heat, or flame detectors shall be of an approved or listed type.

9.2.4 Carbon monoxide detection shall be provided in accordance with ABYC A-24, *Carbon Monoxide Detection Systems*, and NFPA 302, *Fire Protection Standard for Pleasure and Commercial Motor Craft*, for vessels fitted with inboard spark ignition engines.

9.2.5 Detector Location.

9.2.5.1 Detectors shall be located in accordance with *NFPA 72, National Fire Alarm and Signaling Code*; NFPA 720, *Standard for the Installation of Carbon Monoxide (CO) Detection and Warning Equipment*; and NFPA 302, *Fire Protection Standard for Pleasure and Commercial Motor Craft*.

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

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

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

9.2.5.5 Detectors shall be installed and maintained according to the device manufacturer's instructions.

9.2.6 Control Panels for Type I Through Type III Marine Fire-Fighting Vessels.

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

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

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

9.2.8 Type I through Type III marine fire-fighting vessels with enclosed engine spaces 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.

9.2.9 All electrical components shall meet the requirements found in Section 14.1.

9.3 Fire Protection Water Piping and Pumps.

9.3.1 All Type I through Type III vessels shall have at least one fire protection pump.

9.3.2 The fire protection pump system shall have at least the capacity and at least be powered as shown in Table 9.3.2 in accordance with 46 CFR 181, "Fire Protection Equipment."

9.3.3 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 9.3.2 for fire protection.

9.3.4 All Type I through Type III vessels shall be fitted with a fire protection main.

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

9.3.6 All piping shall be tested in accordance with Chapter 19.

9.4 Hose Stations.

9.4.1 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.

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

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

9.4.2 Hose station fire hose shall have a minimum diameter of 1 in. (25 mm) and a maximum length of 75 ft (23 m).

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

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

Table 9.3.2 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	—	—

9.5 Fixed Inert Gas Extinguishing Systems.

9.5.1* A manually activated fixed inert gas or equivalent extinguishing system shall be installed for all Category A machinery spaces in Type I through Type III vessels.

9.5.2 Pre-engineered systems located in a Category A machinery space shall be located as high as possible and away from mechanical and natural ventilation.

9.5.3 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.

9.5.4 For occupiable, protected spaces, 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.

9.5.5 Doors to the protected space shall open outward.

9.5.6 The system shall have two control stations.

9.5.6.1 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.

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

9.5.6.3 Operating instructions shall be posted at all control stations.

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

9.5.8 Necessary controls shall operate from outside the space.

9.5.9 Carbon dioxide (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.

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

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

9.5.12 Piping, valves, and fittings shall meet the requirements of Subchapter F of 46 CFR 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.

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

9.5.14 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.

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

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

9.5.17 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.

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

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

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

9.6 Hand Portable/Semiportable Fire Extinguishers.

9.6.1* Portable fire extinguishers shall be provided, located, and maintained in accordance with NFPA 10, *Standard for Portable Fire Extinguishers*; Chapter 12 of NFPA 302, *Fire Protection Standard for Pleasure and Commercial Motor Craft*; ABYC A-4, *Fire Fighting Equipment*; and 46 CFR 25.30, "Fire-Extinguishing Equipment."

9.6.2 Whenever propulsion or pumping engines and generator sets are enclosed in housings, a portable extinguisher sized for the volume of the enclosed housing shall be provided so that the extinguishing agent can be discharged into the enclosure without opening it.

Chapter 10 Fire-Fighting and Emergency Equipment for the Vessel

10.1 General.

10.1.1 Fire-fighting equipment that is specified in this chapter and required for a given class of vessel shall be supplied and mounted or stowed as per the AHJ prior to the vessel being placed in operation in accordance with Table 10.1.1(a) and Table 10.1.1(b).

Table 10.1.1(a) Fire-Fighting Equipment (U.S. Units)

	Type I		Type II		Type III		Type IV		Type V	
Equipment	**Qty**	**Size**	**Qty**	**Size**	**Qty**	**Size**	**Qty**	**Size**	**Qty**	**Size**
Line gun	1		1		1			Optional per AHJ		Optional per AHJ
Pry bar	2	6 ft	2	6 ft	2	6 ft	1	Optional/ Length per AHJ	1	Optional/ Length per AHJ
Bolt cutter	1	24 in.	1	24 in.	1	24 in.	1	24 in.	1	24 in.
Pike pole	2	15 ft	2	15 ft	2	15 ft	1	10 ft or 6 ft	1	6 ft or longer
	2	6 ft	2	6 ft	2	6 ft				
Scoop shovel	2		2		2		1			Optional per AHJ
Adjustable hydrant wrench	2		2		2		1		1	
Sprinkler shutoff/wedge	4		4		4		2		1	
Utility rope	2	100 ft	2	100 ft	2	100 ft	1	100 ft	1	100 ft
Floating stretcher with harness	2		2		2		1			Optional per AHJ
Portable extinguisher	4	2-A:20-B:C	4	2-A:20-B:C	4	2-A:20-B:C	1	2-A:20-B:C	1	2-A:10-B:C
Dry chemical extinguisher	2	80-B:C	2	80-B:C	2	80-B:C	1	80-B:C	1	80-B:C
Electrical extension cords	2	100 ft	2	100 ft	2	100 ft	1	50 ft		Optional per AHJ
Flathead axe	1	6 lb	1	6 lb	1	6 lb	1	6 lb	1	6 lb
Pickhead axe	1	6 lb	1	6 lb	1	6 lb		Optional per AHJ		Optional per AHJ
Halligan tools or equivalent	2	6 lb	2	6 lb	2	6 lb	1	6 lb		Optional per AHJ
Spanner wrench	8		8		8		4		4	
Sledge hammer	1	10 lb	1	10 lb	1	10 lb	1	10 lb		Optional per AHJ
Grappling hook	2		2		2		1			Optional per AHJ
Ropes in throw bag	2	75 ft	2	75 ft	2	75 ft	1	75 ft	1	75 ft
Heaving line	2	75 ft	2	75 ft	2	75 ft	1	75 ft		Optional per AHJ
NFPA 1983 life safety rope	1	100 ft	1	100 ft	1	100 ft		Optional per AHJ		Optional per AHJ
Jet siphons	2	2½ in. to 3½ in. or larger	2	2½ in. to 3½ in. or larger	2	2½ in. to 3½ in. or larger		Optional per AHJ		Optional per AHJ
	2	1½ in. to 2½ in.	2	1½ in. to 2½ in.	2	1½ in. to 2½ in.	1	1½ in. to 2½ in.		Optional per AHJ
Positive pressure fan (portable)	2	Size per AHJ	2	Size per AHJ	2	Size per AHJ		N/A		N/A
Gasoline-powered chain saw	1		1		1			Optional per AHJ		N/A
Portable oxygen gas cutting set or equal	1		1		1			N/A		N/A
Hydraulic rescue tool	1	Gas powered or manually operated	1	Gas powered or manually operated	1	Gas powered or manually operated		Optional per AHJ		N/A

N/A = Not applicable.

Table 10.1.1(b) Fire-Fighting Equipment (SI Units)

	Type I		Type II		Type III		Type IV		Type V	
Equipment	**Qty**	**Size**	**Qty**	**Size**	**Qty**	**Size**	**Qty**	**Size**	**Qty**	**Size**
Line gun	1		1		1			Optional per AHJ		Optional per AHJ
Pry bar	2	1.8 m	2	1.8 m	2	1.8 m	1	Optional/ Length per AHJ	1	Optional/ Length per AHJ
Bolt cutter	1	610 mm	1	610 mm	1	610 mm	1	610 mm	1	610 mm
Pike pole	2	4.5 m	2	4.5 m	2	4.5 m	1	3 m or		
	2	1.8 m	2	1.8 m	2	1.8 m		1.8 m	1	1.8 m or longer
Scoop shovel	2		2		2		1			Optional per AHJ
Adjustable hydrant wrench	2		2		2		1		1	
Sprinkler shutoff/wedge	4		4		4		2		1	
Utility rope	2	30 m	2	30 m	2	30 m	1	30 m	1	30 m
Floating stretcher with harness	2		2		2		1			Optional per AHJ
Portable extinguisher	4	2-A:20-B:C	4	2-A:20-B:C	4	2-A:20-B:C	1	2-A:20-B:C	1	2-A:10-B:C
Dry chemical extinguisher	2	80-B:C	2	80-B:C	2	80-B:C	1	80-B:C	1	80-B:C
Electrical extension cords	2	30 m	2	30 m	2	30 m	1	15 m		Optional per AHJ
Flathead axe	1	2.7 kg	1	2.7 kg	1	2.7 kg	1	2.7 kg	1	2.7 kg
Pickhead axe	1	2.7 kg	1	2.7 kg	1	2.7 kg		Optional per AHJ		Optional per AHJ
Halligan tools or equivalent	2	2.7 kg	2	2.7 kg	2	2.7 kg	1	2.7 kg		Optional per AHJ
Spanner wrench	8		8		8		4		2	
Sledge hammer	1	4.5 kg	1	4.5 kg	1	4.5 kg	1	4.5 kg		Optional per AHJ
Grappling hook	2		2		2		1			Optional per AHJ
Ropes in throw bag	2	23 m	2	23 m	2	23 m	1	23 m	1	23 m
Heaving line	2	23 m	2	23 m	2	23 m	1	23 m		Optional per AHJ
NFPA 1983 life safety rope	1	30 m	1	30 m	1	30 m		Optional per AHJ		Optional per AHJ
Jet siphons	2	65 mm to 90 mm or larger	2	65 mm to 90 mm or larger	2	65 mm to 90 mm or larger	1	65 mm to 90 mm or larger *or*		Optional per AHJ
	2	38 mm to 65 mm	2	38 mm to 65 mm	2	38 mm to 65 mm	1	38 mm to 65 mm		Optional per AHJ
Positive pressure fan (portable)	2	Size per AHJ	2	Size per AHJ	2	Size per AHJ		N/A		N/A
Gasoline-powered chain saw	1		1		1			Optional per AHJ		N/A
Portable oxygen gas cutting set or equal	1		1		1			N/A		N/A
Hydraulic rescue tool	1	Gas powered or manually operated	1	Gas powered or manually operated	1	Gas powered or manually operated		Optional per AHJ		N/A

N/A = Not applicable.

10.1.2 Fire-fighting equipment specified in this chapter are minimum requirements for the given type of vessel and shall be mounted or stowed securely utilizing the manufacturer's recommendations along with standard marine practices.

10.1.2.1 Portable gasoline equipment and containers shall be stored in a well-ventilated storage compartment so that vapors are vented overboard and away from air intakes in accordance with ABYC H-25, *Portable Gasoline Fuel Systems.*

10.1.2.2 Any electrical equipment installed within the storage compartment shall be ignition protected as defined by ABYC E-11, *Alternating Current (AC) and Direct Current (DC) Electrical Systems on Boats.*

10.1.3 All fire service equipment required by this chapter and Table 5.1 shall meet the requirements of NFPA standards for the particular type of equipment as identified as follows:

(1) NFPA 10, *Standard for Portable Fire Extinguishers*
(2) NFPA 1931, *Standard for Manufacturer's Design of Fire Department Ground Ladders*
(3) NFPA 1961, *Standard on Fire Hose*
(4) NFPA 1963, *Standard for Fire Hose Connections*
(5) NFPA 1964, *Standard for Spray Nozzles*
(6) NFPA 1981, *Standard on Open-Circuit Self-Contained Breathing Apparatus (SCBA) for Emergency Services*
(7) NFPA 1983, *Standard on Life Safety Rope and Equipment for Emergency Services*

10.1.4 Type I through Type III vessels shall be outfitted with a minimum complement of the equipment identified in Table 10.1.1(a) and Table 10.1.1(b).

10.2 Self-Contained Breathing Apparatus (SCBA).

10.2.1* All SCBA shall be in accordance with this section and Table 10.2.1 and shall meet the requirements of NFPA 1981, *Standard on Open-Circuit Self-Contained Breathing Apparatus (SCBA) for Emergency Services.*

10.2.2 Stowage of SCBA in compartments shall be secure and shall use racks to allow rapid donning.

10.2.3 Stowage space shall be provided for spare breathing air cylinders in racks.

10.3 Fire Hose and Appliances.

10.3.1 Fire Hose. All fire hose shall be in accordance with Table 10.3.1(a) or Table 10.3.1(b) and shall meet the requirements of NFPA 1961, *Standard on Fire Hose.*

Table 10.2.1 Self-Contained Breathing Apparatus (SCBA)

Equipment	Type I Qty	Type II Qty	Type III Qty	Type IV Qty	Type V Qty
SCBA (at least)	1 per crew 1 spare set	1 per crew 1 spare set	1 per crew 1 spare set	1 per crew 1 spare set	1 per crew 1 spare set
Spare SCBA Cylinder	2 spare cylinder per crew SCBA carried	Same as Type I	Same as Type I	1 spare cylinder per crew SCBA carried	1 spare cylinder per crew SCBA carried

10.3.2 Fire Hose Storage. Weather-protected stowage compartments shall be provided for fire-fighting equipment and appliances.

10.3.3 Couplings. All couplings on fire hose shall meet the requirements of NFPA 1963, *Standard for Fire Hose Connections.*

10.3.4 Nozzles.

10.3.4.1 All nozzles shall be in accordance with Table 10.3.1(a) or Table 10.3.1(b) and meet the requirements of NFPA 1964, *Standard for Spray Nozzles.*

10.3.4.2 All nozzles and accessories shall be of corrosion-resistant construction.

10.3.5 Couplings and Appliances. All connections on appliances shall comply with the requirements of NFPA 1963, *Standard for Fire Hose Connections.*

10.4 Rescue/Work Boat. Type I and Type II vessels shall be outfitted with a motorized rescue/work vessel capable of safely carrying a minimum of two fire fighters in full protective clothing and SCBA and a minimum weight-bearing capacity of 1500 lb (680 kg).

10.5 Required Safety Equipment. All vessels shall carry the appropriate U.S. Coast Guard safety equipment required for the size and operational territory of the vessel.

Table 10.3.1(a) Fire Hoses, Fittings and Appliances (U.S. Units)

	Type I		Type II		Type III		Type IV		Type V	
Equipment	**Qty**	**Size**	**Qty**	**Size**	**Qty**	**Size**	**Qty**	**Size**	**Qty**	**Size**
Large-diameter hose	600 ft	3½ in. or larger	600 ft	3½ in. or larger	400 ft	3½ in. or larger	200 ft	3½ in. or larger		N/A
Attack hose (large)	600 ft	2½ in. or 3 in.	600 ft	2½ in. or 3 in.	400 ft	2½ in. or 3 in.	200 ft	2½ in. or 3 in.		N/A
Attack hose (small)	600 ft	1½ in., 1¾ in., or 2 in.	600 ft	1½ in., 1¾ in., or 2 in.	400 ft	1½ in., 1¾ in., or 2 in.	200 ft	1½ in., 1¾ in., or 2 in.	200 ft	1½ in., 1¾ in., or 2 in.
Combination nozzle with shutoff	4	2½ in.	4	2½ in.	4	2½ in.	2	2½ in.	2	1½ in. or 2½ in.
	4	1½ in.	4	1½ in.	4	1½ in.	2	1½ in.		N/A
Cellar or distributor nozzle	2	2½ in.	2	2½ in.	2	2½ in.	1	2½ in.		N/A
Foam eductor with matching nozzle		Opt. per AHJ		Opt. per AHJ		Opt. per AHJ		Opt. per AHJ		N/A
(portable)		Opt. per AHJ		Opt. per AHJ		Opt. per AHJ		Opt. per AHJ		N/A
Couplings:										
Double male	2	Consistent with large-diameter hose used	2	Same as Type I	2	Same as Type I	2	Same as Type I		N/A
Double female	2	Consistent with large-diameter hose used	2	Same as Type I	2	Same as Type I	2	Same as Type I		N/A
Double males	2	2½ in.	2	2½ in.	2	2½ in.	2	2½ in.		Consistent with hose used
Double females	2	2½ in.	2	2½ in.	2	2½ in.	2	2½ in.		Consistent with hose used
Reducers:										
Large-diameter to 2½ in.	2		2		2		1			N/A
2½ in. to 1½ in.	2		2		2		1			N/A
Increasers:										
2½ in. to large-diameter	2		2		2		1			N/A
Wyes:										
2½ in. × 1½ in. × 1½ in. gated	2		2		2		1			N/A
2½ in. gated	2		2		2		1			N/A
Large-diameter to 2–2½ in. gated	1		1		1			N/A		N/A
2½ in. plug (male thread)	2		2		2		1			N/A
2½ in. cap (female thread)	2		2		2		1			N/A
2½ in. Siamese	2		2		1			N/A		N/A
International shore connection	2		2		2		1			N/A

N/A = Not applicable.

Table 10.3.1(b) Fire Hoses, Fittings and Appliances (SI Units)

	Type I		Type II		Type III		Type IV		Type V	
Equipment	**Qty**	**Size (mm)**	**Qty**	**Size (mm)**	**Qty**	**Size (mm)**	**Qty**	**Size (mm)**	**Qty**	**Size (mm)**
Large-diameter hose	180 m	90 or larger	180 m	90 or larger	120 m	90 or larger	60 m	90 or larger		N/A
Attack hose (large)	180 m	65 or 76	180 m	65 or 76	120 m	65 or 76	60 m	65 or 76		N/A
Attack hose (small)	180 m	38, 45, or 50	180 m	38, 45, or 50	120 m	38, 45, or 50	60 m	38, 45, 50	60 m	38, 45, 50
Combination nozzle with shutoff	4	65	4	65	4	65	2	65	2	38 or 65
	4	38	4	38	4	38	2	38		N/A
Cellar or distributor nozzle	2	65	2	65	2	65	1	65		N/A
Foam eductor with matching nozzle (portable)		Opt. per AHJ		Opt. per AHJ		Opt. per AHJ		Opt. per AHJ		N/A
		Opt. per AHJ		Opt. per AHJ		Opt. per AHJ		Opt. per AHJ		N/A
Couplings:										
Double male	2	Consistent with large-diameter hose used	2	Same as Type I	2	Same as Type I	2	Same as Type I		N/A
Double female	2	Consistent with large-diameter hose used	2	Same as Type I	2	Same as Type I	2	Same as Type I		N/A
Double males	2	65	2	65	2	65	2	65		Consistent with hose used
Double females	2	65	2	65	2	65	2	65		Consistent with hose used
Reducers:										
Large-diameter to 65 mm	2		2		2		1			N/A
65 mm to 38 mm	2		2		2		1			N/A
Increasers:										
65 mm to large-diameter	2		2		2		1			N/A
Wyes:										
65 mm × 38 mm × 38 mm gated	2		2		2		1			N/A
65 mm gated	2		2		2		1			N/A
Large-diameter to 50–65 mm gated	1		1		1			N/A		N/A
65 mm plug (male thread)	2		2		2		1			N/A
65 mm cap (female thread)	2		2		2		1			N/A
65 mm Siamese	2		2		1			N/A		N/A
International shore connection	2		2		2		1			N/A

N/A = Not applicable.

Chapter 11 Marine Fire-Fighting Vessel Stability and Subdivision

11.1 Subdivision.

11.1.1 Standard of Subdivision.

11.1.1.1 Marine fire-fighting vessels shall meet the standard of subdivision required for the individual type, as described in Table 11.1.1.1.

Table 11.1.1.1 Vessel Subdivision Standards

Type of Marine Fire-Fighting Vessel	Types I, II, and III	Type IV	Type V
Requirements for compartment	One compartment	Collision bulkhead, and able to survive largest compartment flooding, or positive flotation	Positive flotation

11.1.1.2 The marine fire-fighting vessel shall be presumed to be in a maximum design load condition when damage occurs.

11.1.1.3 Where watertight doors are fitted in subdivision bulkheads, they shall be permitted to be fitted with indicators of open/closed status at the main control station.

11.1.2 Collision Bulkheads.

11.1.2.1 A collision bulkhead shall be fitted to all marine fire-fighting vessels of Types I through III, in accordance with the requirements of *ABS Rules for Building and Classing Steel Vessels.*

11.1.2.2 A collision bulkhead shall be fitted to all marine fire-fighting vessels of Type IV, in accordance with the requirements of ABYC fire protection standards.

11.1.2.3 A collision bulkhead shall be fitted to all fireboats, 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.

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

11.1.3 Positive Flotation.

11.1.3.1 Vessels of Type IV and V shall be fitted with positive flotation or an equivalent level of subdivision or compartmentalization.

11.1.3.2 The amount of flotation shall be sufficient to support the weight of the fully laden boat in fresh water, plus 10 percent of that weight.

11.1.3.3 Flotation shall be in the form of either buoyancy tanks, foam blocks, or hull structure.

11.1.3.4 Flotation shall be secured in place and shall retain its effectiveness after submergence in fresh water after 24 hours.

11.2 Intact Stability.

11.2.1 Design Objectives.

11.2.1.1 Every marine fire-fighting vessel shall have stability characteristics commensurate with its intended service and its intended area of operation.

11.2.1.2 Every marine fire-fighting vessel shall have, when new, an allowance/margin built into the design for appreciable growth in weight of systems and equipment throughout its life.

11.2.1.3 Every marine fire-fighting vessel shall be designed to provide a platform that is safe and stable for the operating crews, recognizing that the crews are in most cases not likely to be seasoned seafarers.

11.2.1.4 All possible operations of the marine fire-fighting vessel shall be addressed in the stability analysis of the vessel, including deployment and operation of all monitors, lateral thrusters, cranes, ladders, workboats, and so forth.

11.2.1.5 The stability of planing and semi-planing craft shall be carefully assessed, including operation at full speed.

11.2.2 Stability Criteria.

11.2.2.1 Marine fire-fighting vessels, according to their type, shall comply fully with the latest published relevant standard for marine fire-fighting vessel stability as described in Table 11.2.2.1.

11.2.2.2 Every new marine fire-fighting vessel shall have intact stability characteristics that, when new, are not less than 20 percent in excess of the minimum criteria stipulated in Table 11.2.2.1.

11.2.2.3 In no case shall the stability characteristics of a Type I, II, or III marine fire-fighting vessel be less than those permitted by IMO A 18, Resolution 749, *Code on Intact Stability for All Types of Ships Covered by IMO Instruments.*

11.2.3 Stability Calculations.

11.2.3.1 Detailed calculations shall be submitted to the pertinent regulatory authority for approval where applicable, and/or to the AHJ for acceptance, describing the following:

(1) The adequacy of the marine fire-fighting vessel's stability during all fire-fighting operations
(2) The adequacy of propulsion power and steering capability required for the marine fire-fighting vessel to maintain station and hold position during fire-fighting operations

11.2.3.2 The stability information shall be placed onboard the marine fire-fighting vessel for the information and guidance of the master and shall become part of the vessel operating booklet.

11.2.3.3 The master of the marine fire-fighting vessel shall receive training in the use of formal stability documentation.

11.2.4 Specific Stability Concerns.

11.2.4.1 Monitor Heel.

11.2.4.1.1 Each marine fire-fighting vessel shall have adequate stability for the full range of fire-fighting operation conditions, with all fire-fighting monitors operating at maximum output, in the direction most unfavorable to the stability of the marine fire-fighting vessel.

Table 11.2.2.1 Intact Stability Criteria for Marine Fire-Fighting Vessels

	Type I	Type II	Type III	Type IV	Type V
Applicable Stability Criteria	*ABS Rules for Building and Classing Steel Vessels Under 90 Meters (295 ft) in Length*	*ABS Rules for Building and Classing Steel Vessels Under 90 Meters (295 ft) in Length*	*ABS Rules for Building and Classing Steel Vessels Under 90 Meters (295 ft) in Length*	ISO 12217-1, Category C vessel[1]	ISO 12217-1, Category C or D vessel[1]
Maximum Heel Angle — Monitor Reactions	7 degrees maximum 5 degrees recommended	7 degrees maximum 5 degrees recommended	7 degrees maximum 5 degrees recommended	An angle that would immerse a maximum of ½ the full load freeboard, or 7 degrees maximum	An angle that would immerse a maximum of ½ the full load freeboard, or 7 degrees maximum
Maximum Heel Angle — Crane Operations	5 degrees, or manufacturer's maximum allowable heel or trim or combination thereof	5 degrees, or manufacturer's maximum allowable heel or trim or combination thereof	5 degrees, or manufacturer's maximum allowable heel or trim or combination thereof	5 degrees, or manufacturer's maximum allowable heel or trim or combination thereof	Not applicable (Assumes no crane fitted; if a crane is fitted, apply same criteria as Type IV)
Passenger Heel	Full	Full	Full	Simple	Simple
Wind Heel	Full	Full	Full	Simple	Simple
Towing Criteria	Only if fitted with a towing winch	Only if fitted with a towing winch	No	No	No
Icing Criteria	As applicable to area of operation	As applicable to area of operation	As applicable to area of operation	As applicable to area of operation	As applicable to area of operation
Test Required	Inclining experiment	Inclining experiment	Inclining experiment	Physical weighing or lightship/ deadweight survey[2, 3]	Physical weighing or lightship/ deadweight survey[2, 3]

[1]ISO 12217-1, *Small Craft — Stability and Buoyancy Assessment and Categorization — Part I: Non-Sailing Boats of Hull Length Greater Than or Equal to 6 m.*

[2]If the lightship weight determined by this test varies by more than 3 percent from that calculated or defined at the time of contract signing, then an inclining experiment shall be performed to accurately establish the position of the vertical center of gravity (VCG).

[3]Acceptance of a lightship survey assumes that the position of the vessel center of gravity (CG) is defined by detailed calculation, and thus results in acceptable heel, trim, and stability characteristics. If such a calculation cannot be provided, then a full inclining experiment shall be performed.

11.2.4.1.2 The maximum heel induced by the worst combination of thrust produced by monitor reaction and by the counteracting thrust from lateral thrusters, rudders, and so forth, shall not exceed the limits described in Table 11.2.2.1.

11.2.4.1.3 Where compliance with the specific criteria for maximum heel angle stipulated in Table 11.2.2.1 would compromise other critical aspects of the effectiveness or safe operation of the marine fire-fighting vessel, stability calculations shall be developed that confirm compliance with *ABS Rules for Building and Classing Steel Vessels under 90 meters (295 ft) in Length*, Part 5, Chapter 9, Appendix 1, Section 5.3, and that produce a maximum heel angle that the owner is prepared to accept as safe for the operation of the vessel and its crew.

11.2.4.2 Crane Operations.

11.2.4.2.1 The stability of the marine fire-fighting vessel shall be evaluated under the influence of the maximum heeling moment imposed by operation of any crane or similar lifting device installed aboard the marine fire-fighting vessel.

11.2.4.2.2 The maximum heel induced by crane operations shall not exceed the limits defined in Table 11.2.2.1.

11.2.4.2.3 The manufacturer's certificate for the crane shall clearly identify that the crane is certified for operation at the defined maximum angle of heel or trim or combination thereof.

11.2.5 Wind and Weather Influences.

11.2.5.1 The effects of prevailing wind and weather conditions in the area of operation shall be taken into account by application of wind heel criteria.

11.2.5.2 Stability criteria shall be met after application of applicable wind-heel criteria.

11.2.6 Icing.

11.2.6.1 The effects of icing and freezing spray on the marine fire-fighting vessel's stability shall be considered for marine fire-fighting vessels operating in areas where such conditions exist.

11.2.6.2 International Standards Organization (ISO) criteria for icing of fishing vessels shall be used as a standard to determine the effects of icing.

11.2.6.3 Where the potential exists for icing of the marine fire-fighting vessel, effective means of reducing or eliminating the presence of ice accumulation on the marine fire-fighting vessel shall be provided.

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

11.2.6.5 The use of watertight doors in subdivision bulkheads shall be avoided.

11.3 Flotation.

11.3.1 Type V vessels shall be fitted with positive flotation in lieu of having subdivision.

11.3.2 The amount of flotation shall be equivalent to the weight of the fully loaded vessel in fresh water plus 10 percent.

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

11.3.4 Flotation shall be permitted to be in the form of buoyancy tanks, foam blocks, or hull structure.

11.3.5 Flotation shall be secured in place and shall retain its effectiveness after submergence in fresh water for 24 hours.

11.4 Loading Conditions.

11.4.1 The loading conditions to be evaluated for the intact stability calculations for normal vessel loads shall include those listed as follows:

(1) Full load consists of the following:
   (a) 95 percent fuel
   (b) 100 percent foam concentrate
   (c) 100 percent potable water
   (d) 100 percent stores
   (e) Normal crew and their effects
(2) 50 percent load consists of the following:
   (a) 50 percent fuel
   (b) 100 percent foam concentrate
   (c) 50 percent potable water
   (d) 50 percent stores
   (e) Normal crew and their effects
(3) 10 percent consumables consists of the following:
   (a) 10 percent fuel
   (b) 100 percent foam concentrate
   (c) 10 percent potable water
   (d) 10 percent stores
   (e) Normal crew and their effects

11.4.2 The loading conditions to be evaluated for the intact stability calculations for fire-fighting loads shall include those listed as follows:

(1) Maximum load consists of the same as full load in 11.4.1, plus the following:
   (a) Water in fire main
   (b) Elevating tower or platform at maximum extension
   (c) Extra crew and their effects
(2) Minimum load consists of the same as 10 percent consumables in 11.4.1 plus the following:
   (a) 10 percent foam concentrate
   (b) Water in fire main
   (c) Elevating tower or platform at maximum extension
   (d) Extra crew and their effects

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

11.4.4 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.

Chapter 12 Main Propulsion and Auxiliary Engines

12.1 General.

12.1.1 Installation requirements for marine propulsion systems that include engines, reduction gears, power takeoffs, and final drives shall be incorporated by reference to Chapter 5 of NFPA 302, *Fire Protection Standard for Pleasure and Commercial Motor Craft*; ABYC H-2, *Ventilation of Boats Using Gasoline*; ABYC H-24, *Gasoline Fuel Systems*; ABYC H-26, *Powering of Boats*; ABYC H-32, *Ventilation of Boats Using Diesel Fuel*; ABYC H-33, *Diesel Fuel Systems*; ABYC P-1, *Installation of Exhaust Systems for Propulsion and Auxiliary Engines*; ABYC P-4, *Marine Inboard Engines and Transmissions;* ABYC P-6, *Propeller Shafting Systems*; ABYC P-14, *Mechanical Propulsion Control Systems*; ABYC P-24, *Electric/Electronic Propulsion Control Systems*, as applicable, and other standards for the type of vessel and intended use.

12.1.2 Installation requirements for marine auxiliary engine systems that include engines, power takeoffs, and auxiliary machinery shall be incorporated by reference to Chapters 5 and 10 of NFPA 302, *Fire Protection Standard for Pleasure and Commercial Motor Craft*; ABYC H-2, *Ventilation of Boats Using Gasoline*; ABYC H-24, *Gasoline Fuel Systems*; ABYC H-32, *Ventilation of Boats Using Diesel Fuel*; ABYC H-33, *Diesel Fuel Systems*; ABYC P-1, *Installation of Exhaust Systems for Propulsion and Auxiliary Engines*; ABYC P-4, *Marine Inboard Engines and Transmissions*; ABYC P-6, *Propeller Shafting Systems*; ABYC P-14, *Mechanical Propulsion Control Systems*, as applicable, and other standards for the type of vessel and its intended use.

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

12.1.4 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.

12.1.5 As constrained by Sections 12.2 and 12.3, auxiliary engines on Type I through Type III vessels shall be of the diesel fuel type.

12.2 Outboard Engines.

12.2.1 Outboard engines shall be permitted to be gasoline fueled and shall comply with ABYC H-26, *Powering of Boats*; ABYC S-12, *Outboard Motor Transom and Motor Well Dimensions*; and ABYC S-30, *Outboard Engine and Related Equipment Weights.*

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

12.2.3 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.*

12.2.4 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.*

12.3 Inboard Engines.

12.3.1 Vessel Types.

12.3.1.1 For Type I through Type IV vessels, inboard propulsion and auxiliary engines shall be of the diesel fuel type.

12.3.1.2 Type I and Type II vessels shall comply with *ABS Rules for Building and Classing Steel Vessels for Service on Rivers and Intracoastal Waterways.*

12.3.1.3 Type III through Type V vessels shall comply with ABYC P-4, *Marine Inboard Engines and Transmissions.*

12.3.2 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.

12.3.3* Propulsion Engine Horsepower.

12.3.3.1 Where a fire pump is driven by a propulsion engine, the pump drive system shall be rated to at least the rated capacity of the pump.

12.3.3.2 Horsepower requirements for propulsion engines, designed for simultaneously powering one or more fire pumps and a propulsion/steering device, shall not exceed 80 percent of the engine's rated horsepower while at maximum pumping capacity, leaving a minimum 20 percent of the engine's power for maneuvering.

12.3.4 Engine Shutdown.

12.3.4.1* With the exception of outboard motors, automatic engine shutdown and power reduction shall not be permitted.

12.3.4.2 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.

12.4 Power Trains Using Inboard Engines.

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

12.4.2 The requirement in 12.4.1 shall also comply with *ABS Rules for Building and Classing High Speed Craft* for Type I and Type II vessels.

12.4.3 Driveline systems shall have horsepower and speed ratings compatible with the supplied propulsion engine.

12.4.4 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* for Type I and Type II vessels and ABYC P-4, *Marine Inboard Engines and Transmissions*; ABYC P-6, *Propeller Shafting Systems*; ABYC P-14, *Mechanical Propulsion Control Systems*; ABYC P-23, *Steering and Propulsion Controls for Jet Boats*; and ABYC P-24, *Electric/Electronic Propulsion Control Systems*, as appropriate for Type III through Type V and to the manufacturers' installation and proposed operating requirements.

12.4.5 Shafting Requirements. Shafting requirements shall conform to one of the following documents:

(1) *ABS Rules for Building and Classing Steel Vessels for Service on Rivers and Intracoastal Waterways*
(2) *ABS Rules for Building and Classing High Speed Craft*
(3) ABYC P-6, *Propeller Shafting Systems*

12.4.6 Propellers.

12.4.6.1 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* for Type I and Type II vessels and ABYC P-6, *Propeller Shafting Systems*, for Type III through Type V vessels.

12.4.6.2 Propellers shall be sized and pitched to allow the engine to operate within the engine manufacturers' specifications under the vessel's most severe load conditions.

12.4.7 Steering systems shall comply with ABYC P-17, *Steering Systems for Outboard, Inboard, Sterndrive, and Water Jet Drive Boats*; ABYC P-18, *Cable over Pulley Steering Systems for Outboard Engines*; ABYC P-21, *Manual Hydraulic Steering Systems*; and ABYC P-22, *Steering Wheels*, for Type III through Type V vessels and *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*, for Type I and Type II vessels.

12.4.8 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.

12.4.9 Jet pump inlet grille(s) shall have provisions for clearing the intake area.

12.5 Engine Systems.

12.5.1 General.

12.5.1.1 Required engine fuel, exhaust, cooling, starting, ventilation, control, and instrument systems shall be in accordance with Chapters 5, 6, 7, and 10 of NFPA 302, *Fire Protection Standard for Pleasure and Commercial Motor Craft*; ABYC H-2, *Ventilation of Boats Using Gasoline*; ABYC H-24, *Gasoline Fuel Systems*; ABYC H-32, *Ventilation of Boats Using Diesel Fuel*; ABYC H-33, *Diesel Fuel Systems*; and ABYC P-1, *Installation of Exhaust Systems for Propulsion and Auxiliary Engines*, as applicable.

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

12.5.1.3 Each inboard propulsion and auxiliary diesel engine shall be equipped with a manufacturer-approved emergency engine shutdown system.

12.5.1.4 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.

12.5.2 Fuel System.

12.5.2.1 Fuel systems shall comply with Chapter 7 of NFPA 302, *Fire Protection Standard for Pleasure and Commercial Motor Craft*; ABYC H-24, *Gasoline Fuel Systems*; and ABYC H-33, *Diesel Fuel Systems*.

12.5.2.2 Fuel Capacity.

12.5.2.2.1 The fuel capacity shall be sufficient to provide for the transit fuel consumption to and from the scene plus the time listed in Table 5.1 of operation mode for each type of vessel.

12.5.2.2.2 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) On station 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.

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

12.5.2.4 Safety considerations shall limit gasoline refueling at the scene to nonhazardous areas.

12.5.3 Exhaust Systems.

12.5.3.1 Exhaust systems shall comply with Chapter 6 of NFPA 302, *Fire Protection Standard for Pleasure and Commercial Motor Craft*; and ABYC P-1, *Installation of Exhaust Systems for Propulsion and Auxiliary Engines*.

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

12.5.3.3 Where installed, 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*.

12.5.4 Cooling Systems.

12.5.4.1 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* for Type I and Type II vessels and ABYC P-4, *Marine Inboard Engines and Transmissions,* for Type III through Type V vessels.

12.5.4.2 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.

12.5.5 Starting Systems.

12.5.5.1 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*, for Type I and Type II vessels; and NFPA 302; ABYC E-10, *Storage Batteries*; and ABYC E-11, *Alternating Current (AC) and Direct Current (DC) Electrical Systems on Boats*, for Type III through Type V vessels.

12.5.5.1.1 Starting systems shall have sufficient capacity without recharging for starting each main engine for Type III through Type V vessels.

12.5.5.1.2 At least six consecutive starts shall be required for main and auxiliary engines on Type III through Type V vessels.

12.5.5.2 For vessels fitted with multiple main engines, the capacity of the starting system shall be two-thirds the number of main engines times the number of starts required for each engine.

12.5.6 Ventilation Systems.

12.5.6.1 All machinery spaces should be adequately ventilated and comply with Chapters 4, 5, 6, and 7 of NFPA 302, *Fire Protection Standard for Pleasure and Commercial Motor Craft*; ABYC H-2, *Ventilation of Boats Using Gasoline*; and ABYC H-32, *Ventilation of Boats Using Diesel Fuel*.

12.5.6.2 Ventilation systems relative to gasoline-powered vessels shall be in accordance with Chapters 4, 5, 6, and 7 of NFPA 302, *Fire Protection Standard for Pleasure and Commercial Motor Craft*.

12.5.6.3 Machinery space ventilation openings shall be fitted with louvers or baffles to minimize the intake of spray.

12.5.6.4 Machinery space ventilation shall comply with engine manufacturer's recommendations.

12.5.7 Controls and Instruments.

12.5.7.1 Controls and instruments shall conform to *ABS Rules for Building and Classing Steel Vessels for Service on Rivers and Intracoastal Waterways* and *ABS Rules for Building and Classing High Speed Craft* for Type I and Type II vessels and ABYC P-14, *Mechanical Propulsion Control Systems*; ABYC P-23, *Steering and Propulsion Controls for Jet Boats*; and ABYC P-24, *Electric/Electronic Propulsion Control Systems*, as appropriate for Type III through Type V vessels.

12.5.7.1.1 Minimum helm-mounted instruments for each inboard propulsion and auxiliary engine provided shall consist of indicators for coolant temperature, oil pressure, tachometer, engine hours, and dc voltmeter.

12.5.7.1.2 Minimum helm-mounted instruments for each outboard propulsion provided shall consist of indicators for engine temperature, tachometer, and engine hours.

12.5.7.2 A helm-mounted ac voltmeter shall be provided for auxiliary ac systems, if furnished, and a dc voltmeter or ammeter shall be provided for dc systems.

12.5.7.3 Minimum helm-mounted instruments for each reduction gear provided shall consist of a temperature and pressure indicator.

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

12.5.7.5 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.

12.6 Auxiliary Engine Systems.

12.6.1 Auxiliary AC generator system(s) shall be designed for marine use and shall have 10 percent overload capability.

12.6.2 AC generator systems shall conform to Chapters 5, 6, 9, and 10 of NFPA 302, *Fire Protection Standard for Pleasure and Commercial Motor Craft*.

12.6.3 Auxiliary engine(s) for powering fire pumps shall be rated at the power required by the pump with a 10 percent overload capability.

12.6.4 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.

12.6.5 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* for Type I and Type II vessels and 46 CFR 175–187, Subchapter T, "Small Passenger Vessels (Under 100 Gross Tons)," for Type III through Type V vessels.

Chapter 13 Auxiliary Machinery and Systems

13.1 General.

13.1.1* Auxiliary machinery and systems on Type I and Type II vessels shall comply with 46 CFR 175–187, 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*; ABYC A-27, *Alternating Current (AC) Generator Sets*; or 46 CFR 197, "Marine Occupational Safety and Health Standards."

13.1.2* Type III through Type V vessels shall comply with NFPA 302, *Fire Protection Standard for Pleasure and Commercial Motor Craft*, and the appropriate ABYC standards for small craft.

13.2 Alarm and Monitoring Systems.

13.2.1 All vessels with enclosed bilges or engine and machinery compartments shall be equipped with bilge alarms that are installed to indicate high levels of liquids in the vessel's bilges in accordance with 46 CFR 182.530, Subchapter T, "Small Passenger Vessels (Under 100 Gross Tons)."

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

13.2.1.2 Bilge alarm sending units shall be buffered to compensate for vessel motions.

13.2.1.3 Exterior visual and audible annunciation of fire, bilge, and loss of shore power shall be provided.

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

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

13.2.3 Type I and Type II vessels shall be equipped with a general alarm in accordance with 46 CFR 175–187, Subchapter T, "Small Passenger Vessels (Under 100 Gross Tons)."

13.3 Compressed Air Systems.

13.3.1 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.

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

13.4 Steering Systems.

13.4.1 All vessels shall have a primary and emergency steering system as required by 46 CFR 182, Subchapter T, "Small Passenger Vessels (Under 100 Gross Tons)."

13.4.2 Steering control and rudder angle indicator shall be provided.

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

13.5 Bilge and Ballast Systems. Bilge pumps and bilge piping and ballast systems shall be installed in accordance with 46 CFR 182.500–183.540, Subchapter T, "Small Passenger Vessels (Under 100 Gross Tons)," and 46 CFR 56.50–55, "Bilge Pumps."

13.6 Sanitary Systems. Design and construction of marine sanitation devices shall meet the requirements of 33 CFR 1251–1387, "Federal Water Pollution Control Act" (Clean Water Act, Amended 1972), 2000, and other local and federal government requirements.

13.7 Hydraulic Systems. All pressure piping materials and components used in power-driven pressure systems shall comply with 46 CFR 50–64, Subchapter F, "Marine Engineering."

13.8 Wiper Systems.

13.8.1 Hand or mechanical wiper systems shall be provided on all forward-facing windows.

13.8.2 Windows equipped with a wiper system shall be provided with a means of defrosting and washing.

13.8.3* For vessels operating where freezing conditions are possible, a means of de-icing forward-facing windows shall be provided.

13.8.4* Wipers shall ensure maximum practical clear window area for each window on which they are utilized.

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

13.9 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 Rules for Building and Classing Steel Vessels Under 90 Meters (295 ft) in Length*; ABYC E-11, *Alternating Current (AC) and Direct Current (DC) Electrical Systems on Boats*; and Chapter 9 of NFPA 302, *Fire Protection Standard for Pleasure and Commercial Motor Craft*, as appropriate.

13.10 Piping and Systems Insulation.

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

13.10.2 Piping systems that contain high temperature gases or liquids shall be insulated in any areas where there is risk of human contact.

13.10.3 Piping that contains cold liquids, when passing through warm spaces, shall be insulated to prevent condensation where condensation could cause damage.

13.10.4 All piping and appliances that are designed to remain "filled" during periods of freezing temperatures shall be insulated and protected to prevent freezing of the liquid.

Chapter 14 Electrical Systems

14.1 General.

14.1.1 Electrical systems for vessels shall comply with Chapters 9 and 10 of NFPA 302, *Fire Protection Standard for Pleasure and Commercial Motor Craft*; ABYC E-11, *Alternating Current (AC) and Direct Current (DC) Electrical Systems on Boats*; *ABS Rules for Building and Classing Steel Vessels Under 90 Meters (295 ft) in Length*; 46 CFR 111, "Electric Systems — General Requirements"; or 46 CFR 112, "Emergency Lighting and Power Systems," as appropriate and ABYC A-31, *Battery Chargers and Inverters*.

14.1.2 All wire and cable shall be clearly marked or color-coded and verified against the electrical drawings of the vessel.

14.1.3 Emergency Lighting. All marine fire-fighting vessels shall be provided with emergency lighting in the engine room or machinery compartment.

14.1.3.1 All Type I through Type III marine fire-fighting vessels shall also be provided with emergency lighting in accommodation spaces, in first aid stations, and at all means of egress.

14.1.3.2 Emergency lighting shall have a power source independent of the main power system.

14.1.3.2.1 The duration of the emergency lighting for Type I through Type III marine fire-fighting vessels shall be at least 3 hours.

14.1.3.2.2 Where provided, the duration of the emergency lighting for Type IV and Type V marine fire-fighting vessels shall be at least 90 minutes.

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

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

14.2 Battery Systems.

14.2.1 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.

14.2.2 Battery Banks.

14.2.2.1 Type I through Type IV vessels with battery-starting systems shall have a minimum of two battery banks, either of which shall be capable of starting the engine(s).

14.2.2.2 A master switch shall allow selection of either bank.

14.3 Navigation Lights. Navigation lights shall comply with USCG Navigation Rules—International and Inland (33 CFR, Parts 1–124).

14.4 Searchlights.

14.4.1 Type I through Type III marine fire-fighting vessels shall be equipped with at least two mounted searchlights, each with a minimum of 3 million candlepower (3,000,000 candlepower).

14.4.2 Type IV marine fire-fighting vessels shall be equipped with at least one mounted searchlight with a minimum of 3 million candlepower (3,000,000 candlepower).

14.4.3 Type V marine fire-fighting vessels shall be equipped with at least one 1 million candlepower (1,000,000 candlepower) portable searchlight.

14.4.4* The combined arc of rotation of all mounted searchlights shall be not less than 360 degrees, and lights shall be mounted to permit the illumination of the water as close to the marine fire-fighting vessel as possible.

Chapter 15 Outfitting

15.1 General.

15.1.1 Installation of accommodations and access and egress shall comply with NFPA 302, *Fire Protection Standard for Pleasure and Commercial Motor Craft*; *ABYC Standards and Technical Information Reports for Small Craft*, *ABS Rules for Building and Classing Steel Vessels Under 90 Meters (295 ft) in Length*; or 46 CFR 177, "Construction and Arrangement," as appropriate.

15.1.2 All accommodation spaces below the weather deck shall be provided with mechanical ventilation.

15.1.3 Facilities shall be provided for the additional fire fighters or other emergency response personnel who are likely to be aboard the vessel.

15.1.4 Considerations shall be given for access and egress of personnel wearing full personal protection equipment (PPE).

15.1.5 For vessels equipped with medical treatment areas, considerations shall be given to the selection of materials for ease of cleaning and disinfection.

15.2* Toilet Facilities. Type I through Type IV marine fire-fighting vessels shall have approved marine sanitation device(s) and sink(s) commensurate with the number of the crew.

15.3 Storage Compartments.

15.3.1 General.

15.3.1.1 Compartments for marine equipment shall provide secure stowage and quick access to ensure safe vessel operations.

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

15.4 Insulation.

15.4.1 Thermal and Fire Insulation. Type I and Type II vessels shall be fitted with structural fire protection meeting the requirements of USCG, NVIC 9-97, *Guide to Structural Fire Protection*.

15.4.2 Acoustical Insulation.

15.4.2.1 Type I through Type IV vessels shall be insulated acoustically to provide a maximum of 85 dBA in interior spaces other than machinery spaces, and 90 dBA on exterior decks, at both full speed and full pumping capacity.

15.4.2.2 Persons in areas that measure greater than 90 dBA shall be required to wear hearing protection according to Occupational Safety and Health Administration (OSHA) standards.

15.5 Deck Surfaces. Non-skid 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 in machinery spaces

15.6 Ground Tackle.

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

15.6.2* All Type I through Type III 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*.

15.6.3* All Type IV and Type V 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*.

15.6.4 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.

15.6.5* The anchor rode for Type I through Type III vessels shall be a minimum of 300 ft (91 m) in length and for Type IV vessels, a minimum of 200 ft (61 m) in length.

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

15.7 Anchor Storage.

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

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

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

15.7.3.1 Fiber rodes shall also incorporate thimbles.

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

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

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

15.8 Mooring Lines.

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

15.8.2 All Type I through Type IV vessels shall be provided with a minimum of five dock lines.

15.8.3 Each dock line shall be at least as long as the vessel, and one shall be at least 1½ times the vessel's length.

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

15.8.4.1 The working surfaces and edges shall be smooth and rounded to minimize chafing.

15.8.4.2 The mooring bitt or cleats shall be secured to a foundation that is of adequate strength to carry the mooring loads.

15.8.5 All vessels shall carry at least two boat hooks with a minimum length of 12 ft (3.8 m).

15.9* Emergency Towing. All marine fire-fighting vessels shall be equipped with a means of safely towing a vessel of comparable size and displacement in an emergency situation.

15.10 Lifesaving and Rescue Equipment.

15.10.1 Capacity Number.

15.10.1.1 All vessels shall have a posted capacity number.

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

15.10.2* Whenever the freeboard of the vessel exceeds 24 in. (610 mm), the vessel shall be equipped with means to facilitate boarding from smaller vessels and from the water.

15.11* Personal Flotation Devices.

15.11.1* Where the vessel operates in cold water, the vessel shall carry an immersion suit for each crew member.

15.11.2* A person overboard recovery system shall be provided.

15.11.3 Type I and Type II vessels shall have at least four Type IV throwable flotation devices provided on the vessel, Type III and Type IV vessels shall have at least two, and Type V vessels shall have at least one.

15.11.4 Buoyant Apparatus and Life Rafts.

15.11.4.1 Where provided, buoyant apparatus, life rafts, or equivalent to be used only in emergencies shall be provided with secure storage on the vessel in a manner that allows quick removal and placement in the water.

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

15.11.4.3 Life rafts shall be inspected periodically according to USCG and manufacturer's recommendations.

15.12 Emergency Signaling Devices.

15.12.1 Each vessel shall carry an emergency position indicator radio beacon (EPIRB), and it shall be stowed to prevent accidental activation.

15.12.2* Each vessel type shall be required to carry a USCG-approved pyrotechnic emergency signaling kit, including, but not limited to, flares and explosive devices.

15.12.3 The USCG-required pyrotechnic emergency signaling kits shall be stored in containers designed to prevent their accidental discharge and to protect the devices from moisture.

15.13 Medical Equipment.

15.13.1* All Type I through Type IV vessels shall be equipped with basic life support (BLS) equipment and be provided with an automated external defibrillator (AED).

15.13.2 Type V vessels shall be equipped with a USCG-approved first aid kit.

15.14 Recovery of Persons from the Water.

15.14.1 Means shall be provided for water rescue or body recovery, such as dive platform, transom gate, or davit.

15.14.2 Where a davit or mechanized crane is fitted, it shall have a minimum safe working load of 500 lb (227 kg), at full horizontal extension.

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 All Type I through Type IV vessels shall be equipped with two fixed-mount, 25 watt, VHF-FM radios.

16.1.2.2 All Type V vessels shall be equipped with one VHF-FM radio.

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

16.1.4 All Type I through Type III 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.

16.1.5 Hailer.

16.1.5.1 All Type IV and Type V vessels shall be equipped with a hailer for giving audible signals to persons on the vessel and for short-range direct voice communications.

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

16.1.6 Intercom System.

16.1.6.1 All Type I through Type III vessels shall be equipped with an intercom system for communication between all operating stations and the engine room.

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

16.1.7 Type I through Type III vessels shall be equipped with a general alarm in accordance with 46 CFR 183.550, "General Alarm Systems."

16.2 Communications.

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

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

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

16.4 Installation. All communication equipment shall be installed according to manufacturer instructions.

16.5 Optical Warning Devices. All marine fire-fighting vessels shall be equipped with optical warning devices in accordance with 33 CFR 88, "Pilot Rules."

Chapter 17 Navigation Equipment and Systems

17.1 General.

17.1.1* All vessels shall carry up-to-date navigational publications for the intended operational area.

17.1.2 All vessels shall be fitted with an illuminated compass.

17.2 Vessel Type–Specific Requirements.

17.2.1 All Type I through Type IV 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.

17.2.2* All Type I and Type II vessels shall be fitted with a minimum of two radar units, one global positioning system (GPS), and a chart plotter.

17.2.3 All Type III and Type IV vessels shall be fitted with a minimum of one radar unit, one GPS, and a chart plotter.

17.2.4 All Type V vessels shall have a minimum of one GPS and a chart plotter.

17.3 Depth Sounding Apparatus. All vessels shall be fitted with an electronic depth sounding apparatus.

17.4 Installation. All navigation equipment shall be installed according to the manufacturer's instructions.

Chapter 18 Protective Coatings and Corrosion Protection

18.1 General.

18.1.1 Protective coatings and corrosion protection shall comply with *ABS Rules for Building and Classing Steel Vessels*; NFPA 302, *Fire Protection Standard for Pleasure and Commercial Motor Craft*; ABYC A-28, *Galvanic Isolators*; or ABYC E-2, *Cathodic Protection.*

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

18.1.3 All metal hulls for vessels normally docked afloat shall be protected below the water line with a corrosion-resistant coating system.

18.1.3.1 Vessels normally docked afloat that are located in an environment where marine growth fouling can be expected shall be provided with anti-fouling or foul release coating, as appropriate.

18.1.4 All steel surfaces and ferrous machinery and equipment shall be protected with a corrosion-resistant coating.

18.1.5 All vessels normally docked afloat shall be fitted with sacrificial anodes or impressed current systems.

18.1.6 Vessels equipped with shore power connections shall be galvanically isolated in accordance with ABYC A-28, *Galvanic Isolators*; ABYC E-2, *Cathodic Protection*; ABYC E-11, *Alternating Current (AC) and Direct Current (DC) Electrical Systems on Boats*; or Chapters 9 and 10 of NFPA 302, *Fire Protection Standard for Pleasure and Commercial Motor Craft*.

18.2* Sacrificial Anodes. Sacrificial anodes shall be sized and located to provide cathodic protection for the time periods between recommended dry dockings and shall be installed in accordance with ABYC E-2, *Cathodic Protection*.

18.3 Impressed Current System.

18.3.1 Installation.

18.3.1.1 If installed, an impressed current system shall be installed in accordance with ABYC E-2, *Cathodic Protection*, and the manufacturer's recommendations.

18.3.1.2 The type, size, and quantity of anodes and reference electrodes shall be determined by National Association of Corrosion Engineers (NACE) corrosion-certified personnel.

18.3.2 Hull Potential Meters. All metallic vessels and vessels with outdrives and jet drives shall be equipped with a hull potential meter appropriate to the reference cell, which is either silver/silver-chloride or zinc.

18.4 Coating System.

18.4.1* All surfaces that receive coating shall be cleaned and prepared in accordance with the coating manufacturer's instructions and with special attention to removal of salts.

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

18.5 Bonding. All machinery and underwater metals shall be bonded to minimize stray electric currents.

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, as appropriate for the complexity of the vessel.

19.1.2 Trials shall be conducted to determine that the vessel and its equipment conform to 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.

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

19.1.6 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.

19.3 Builder's Trials.

19.3.1 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.

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

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

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

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

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

19.3.7 Tightness Test.

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

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

19.3.7.2.1 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).

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

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

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

19.3.8 Main Propulsion System Test.

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

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

19.3.9 Engine Starting System Test.

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

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

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

19.3.9.3.1 The starting time shall be recorded and cranking time limited to 15 seconds.

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

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

19.3.9.4 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.

19.3.10 Wire and Cable Inspection. All wire and cable shall be tested and inspected for safe installation, grounding, chafe points, flexibility between fixed and moving equipment, and entry into junction boxes and equipment and through watertight decks and bulkheads.

19.3.11 Engine-Driven DC Generator/Alternator Test.

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

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

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

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

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

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

19.3.12 AC Generator Test.

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

19.3.12.2 The ac load shall be disconnected at the vessel's breaker panel, and the engine shall be started.

19.3.12.3 The engine shall be run until all oil and water temperatures have stabilized.

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

19.3.12.5 The rpm, voltage, current, frequency, oil pressure, and temperature at 0, 25 percent, 50 percent, 75 percent, and full rated loads shall be measured, compared with the manufacturer's specifications, and recorded, noting the presence of unusual noise and vibration.

19.3.13 Electrical Power Distribution Test.

19.3.13.1 An electrical power distribution test shall be performed to verify safe installation, voltage, and phase and polarity of each ac/dc circuit and correct distribution through switchboards or power panels.

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

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

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

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

19.3.13.6 The shore power feeder shall be connected, and the power transfer switch/circuit breaker shall be operated to verify safe transfer from generator to shore power.

19.3.13.6.1 The voltage at the control panel shall be measured.

19.3.13.6.2 The phasing shall be verified.

19.3.14 Lighting System Test.

19.3.14.1* All lighting switches, circuit breakers, and cables shall be inspected for safe installation, functioning, and labeling.

19.3.14.2 Each lamp shall be inspected for safe size and type.

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

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

19.3.14.5 The arcs of coverage of the navigation lights shall be observed to ensure compliance with 33 CFR Parts 1–124, "Navigation Rules," with respect to obstruction by the vessel's structure or other equipment.

19.3.14.6 All lighting shall be tested in the hours of darkness, including interior lighting in the pilothouse for identification of gauges, switches, and controls.

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

19.3.14.6.2 Deficiencies for nighttime navigation and operations shall be corrected to the owner's satisfaction.

19.3.15 Navigation Equipment Test.

19.3.15.1 All navigation equipment shall be tested to verify safe installation, operation, alignment, and calibration in accordance with the manufacturer's instructions.

19.3.15.2 All navigational equipment shall be located for maximum efficiency, safe operation, and ease of maintenance and approved by the equipment manufacturer as to full and proper installation.

19.3.16 Communications and Signaling System Test.

19.3.16.1 All communication and signaling equipment shall be tested to verify safe installation, operation, alignment, and calibration in accordance with the manufacturer's instructions.

19.3.16.2 The location of the communication and signaling equipment shall be inspected for efficient operation and positioning.

19.3.17 Fire Flow Test.

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

19.3.17.2 Where indicators are installed, pump suction and discharge pressures shall be observed and recorded.

19.3.17.3 Each system monitor and nozzle shall be operated and the pressure recorded to verify its performance in accordance with manufacturer's specifications.

19.3.18 Instruments and Indicators Test.

19.3.18.1 Instruments and indicators shall be tested to determine that they are installed and functioning effectively.

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

19.3.18.3 If fitted, the fuel level indicator's accuracy shall be verified.

19.3.19 Piping System Tests.

19.3.19.1 All piping systems shall be pressurized or operated and observed for leaks.

19.3.19.2 Fire pump piping and distribution piping to discharge devices shall be hydrostatically tested in accordance with 6.3.11.1.

19.3.19.3 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.

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

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

19.3.20 Heating, Ventilation, and Air-Conditioning Tests.

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

19.3.20.2 HVAC units shall be operated until the specified temperature is reached.

19.3.21 Fire-Extinguishing System Test.

19.3.21.1 The fire-extinguishing system shall be inspected, tested, and certified in accordance with manufacturers' requirements and design performance standards.

19.3.21.2 All placards shall be inspected to verify that they are installed in effective locations.

19.3.22 Steering Gear Test.

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

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

19.3.22.3 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.

19.3.22.4 The steering system shall be tested to demonstrate compliance with Section 13.4.

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

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

19.3.22.7 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.

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

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

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

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

19.3.22.10 Where fitted, auto pilot systems shall be calibrated and tested to manufacturers' specifications.

19.3.23 Deck Machinery Tests. Where provided, deck machinery, such as a crane, davit, or winches, shall be tested at maximum rated load capacity to verify that it meets specified requirements and operates without damage or distortion to the structure or vessel.

19.3.24 Anchor Stowage and Handling Test.

19.3.24.1 Anchor stowage and handling and associated equipment shall be tested to ensure efficient deployment, recovery, and securing of the anchor and associated equipment.

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

19.3.25 Towing Fitting Test.

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

19.3.25.2 The fitting(s) shall be inspected for cracking, distortions, or any other damage due to the load.

19.3.26 Window Wiper Test.

19.3.26.1 The window wipers, washers, and defog systems shall be tested to determine that the equipment is operating effectively.

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

19.3.27 Galley Equipment Test. Where provided, the galley equipment shall be tested to determine that the equipment is operating safely.

19.3.28 Noise Evaluation Test.

19.3.28.1 The mean sound levels shall be measured in all applicable areas as required by 15.4.2.

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

19.3.29 Propulsion System Test.

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

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

19.3.29.3 During the operation as specified in 19.3.29.2, the engine oil pressure, rpm, water temperature, and gear oil pressure shall be recorded at 15-minute intervals.

19.3.30 Propeller or Jet Pump Speed Trials.

19.3.30.1 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.

19.3.30.2 The following information shall be recorded before beginning trial:

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

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

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

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

19.3.31 Fire Pump Test.

19.3.31.1* The fire pump shall be tested to demonstrate installation and operation of the fire pump system, including controls and safety devices in accordance with the specifications.

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

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

19.3.31.4 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.

19.3.31.5 The pump pressures shall be recorded, and flow capacities calculated and recorded.

19.3.31.6 A vessel's capability to maneuver and keep stationary while pumping shall be demonstrated.

19.3.32 Testing of Fire Protection Equipment for the Vessel. All fire protection systems shall be tested to verify satisfactory installation and operation in accordance with the specifications.

19.3.33 Foam Systems (if Applicable).

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

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

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

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

19.3.34 Other Devices.

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

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

19.4 Delivery Documentation. The builder shall supply no fewer than two copies of the following documentation at the time of delivery:

(1) Copy of test and trials report
(2) Full set of original equipment manufacturer's manuals
(3) The edition of NFPA 1925 to which the vessel was constructed
(4) The original classification of the vessel in accordance with the types of marine fire-fighting vessels listed in Chapter 5
(5) A list of basic equipment and related items required by the classification as found in Table 10.1.1(a) [or Table 10.1.1(b)] and Table 10.3.1(a) [or Table 10.3.1(b)]

Chapter 20 Vessel Maintenance

20.1 Haul-Out for Maintenance and Inspection.

20.1.1* A vessel docking or haul-out plan shall be provided by the builder.

20.1.2* A recommended time interval for haul-out shall be provided by the builder.

20.2 Maintenance Schedules.

20.2.1 The owner/operator shall develop a schedule for care, maintenance, and inspection utilizing information from the builder, equipment/machinery manufacturers, and owner's maintenance personnel.

20.2.2 The schedule shall specify the maintenance, or inspection interval and what must be done to maintain each piece of equipment, including the types and amounts of grease, oil, and other fluids recommended for use.

20.2.3 A daily, weekly, monthly, and annual check-off sheet shall be kept in an accessible location.

20.3 Docking and Access.

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

20.3.2 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.

20.4 Trailers.

20.4.1* Where a trailer is used for storage and launching the vessel, the trailer shall be designed for the intended purpose of the vessel and accommodate the total weight, including a full complement of tools and equipment.

20.4.2 The trailer shall have at a minimum a biannual maintenance schedule to include, but not be limited to, inspection of brakes, bearings, winch and cable, bunks, tire pressure, and lubrication.

20.5 Maintenance Tests.

20.5.1* 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.

20.5.2 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.

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

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

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

20.5.4.2 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.3.3.8 Anode. This metal tends to corrode or dissolve in an electrolyte.

A.3.3.11 Bitter End. An example of a bitter end is the onboard end of the anchor rode, which is usually permanently attached to the vessel.

A.3.3.13 Bridge. The bridge is also called the pilothouse.

A.3.3.15 Cathode. This metal tends not to corrode or dissolve in an electrolyte.

A.3.3.25 Eductor. Typical uses include foam mixing, dewatering, bilge pumping, and so forth. The pressure at the throat is below atmospheric pressure, allowing liquid at atmospheric pressure to flow into the water stream.

A.3.3.26 Electrolyte. Salt or brackish water are examples of electrolytes.

A.3.3.28.1 Major Fire Hazard Area. The area includes machinery spaces, uptakes, ventilation ducts and equivalents, and special category spaces.

A.3.3.31 Foam. 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. Firefighting 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,** 2010]

A.3.3.44 Handhold Device or Grab Rail. It can be of metal, wood, plastic, reinforced fiberglass, or any combination of materials suited for the purpose.

A.3.3.46 Helm. 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.

A.3.3.48 Impressed Current System. Typical power sources are batteries, alternators, and rectified output from alternating current generators.

A.3.3.51 Jet Drive. Water jet is an example of jet drive.

A.3.3.63 Net Pump Pressure. When operating from a hydrant, the net pump pressure typically is less than the discharge pressure. For example, if the discharge pressure gauge reads 150 psi (1034 kPa) and the intake (suction) gauge reads 20 psi (138 kPa), the net pump pressure equals 130 psi (896 kPa). When operating from draft, the net pump pressure will be above the discharge pressure. For example, if the discharge pressure gauge reads 145 psi (1000 kPa) and the intake (suction) gauge reads 10 in. Hg (34 kPa) vacuum, the net pump pressure will be 150 psi (1034 kPa) (1 in. Hg = 0.5 psi = 3.4 kPa). [**1901**, 2009]

A.3.3.78 Ventilation. Ventilation can be achieved by introduction of fresh air to dilute contaminated air or by local exhaust of contaminated air. [**302,** 2010]

A.4.2.2.2(3)(h) Consideration should be given for minimum pumping capacity where minimum flow would require diverting water and for how low flow is accommodated where diverting water is not wanted.

A.5.1 The Insurance Services Office (ISO) maintains a fire suppression rating schedule that is designed to measure a community's structural fire defenses. Marine fire-fighting vessels are not typically considered under ISO's fire suppression rating schedule and have no impact on a community's public fire protection classification. Communities who wish to receive ISO credit for a marine fire-fighting vessel must equip the vessel similarly to an engine company and apply specifically to ISO for marine fire-fighting vessel consideration.

A.6.2.1 Fittings and valves that are designed for low friction losses should be selected. Elbows should be of the long radius pattern.

A.6.2.11.1 Consideration should be given to providing both a high and low sea chest to permit continuous operation in rough water and shallow water. Consideration should be given to providing a means, such as a vent cock, for eliminating air from fire pump casings.

A.6.2.11.3 The committee notes that a larger cross-sectional area for the sea chest inlet should be used if the boat will be working in areas of debris or shallow water.

A.6.2.12.4 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.6.3.7 It is recommended that multiple pumps of equal or very similar capacity be provided to achieve maximize redundancy in operation.

A.6.3.8.1 See Section 5.1 for numbers of discharge outlets required for each vessel classification.

A.6.3.8.2.1 See also stability requirements for all marine fire-fighting vessels in Chapter 11.

A.7.1.2 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.7.2.3 The foam manufacturer should be consulted regarding the need for mixing and/or circulation. Appropriate provisions should be included in the foam system.

A.7.6.4.1 Examples of mechanical means are a threaded cap or a gasketed hinged cover with a mechanical latching device.

A.7.6.8 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.7.7.1 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.7.7.6 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.8.1 It is the responsibility of the purchaser to provide the contractor with sufficient information to enable the contractor to prepare a bid and a complete description of the apparatus the contractor proposes to supply. Completion of the Apparatus Purchasing Specification Form in Annex B of NFPA 1901, *Standard for Automotive Fire Apparatus*, should provide the information required in the various sections of this document.

A.8.2 The U.S. Coast Guard requires that all inspected vessels be operated by a U.S. Coast Guard licensed captain. Although most marine fire-fighting vessels are not inspected vessels, it is the recommendation of the NFPA Marine Fire-Fighting Vessels Committee that operators of Type I through Type IV marine fire-fighting vessels possess an active U.S. Coast Guard license. Type V vessel operators should have attended a recognized safe boating course.

A.9.5.1 A manually activated fixed inert gas or equivalent extinguishing system should be installed in all enclosed engine compartments or spaces in Type IV and Type V marine fire-fighting vessels.

A.9.6.1 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.10.2.1 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. Type I and Type II 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. Type I vessels should be capable of refilling six cylinders every 15 minutes for at least 2 hours.

A.12.3.3 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.12.3.4.1 It is not the intent to have engines shut down automatically under any circumstances. Operators should have complete control over vessel operations.

A.13.1.1 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.13.1.2 See A.13.1.1.

A.13.8.3 Means for de-icing deck and hand rails should be considered where operations in freezing conditions are anticipated.

A.13.8.4 Pantograph wipers are superior to pendulum type for this application.

A.13.8.5 Filtering is essential to prevent clogging of small-diameter spray nozzles.

A.14.4.4 Light position and placement should consider effects of glare on the operator and operator's night vision.

A.15.2 Type V marine fire-fighting vessels should have approved marine sanitation device(s) and sink(s) commensurate with the number of the crew.

A.15.6.2 The owner/operator should consider local operating conditions when specifying the type of anchor and length of rode.

A.15.6.3 The owner/operator should consider local operating conditions when specifying the type of anchor and length of rode.

A.15.6.5 Where it is necessary to anchor in deeper water, additional lengths of anchor rode should be provided to accommodate those depths.

A.15.9 Although designed with the capability for emergency towing, marine fire-fighting vessels are not to be considered as towing vessels.

A.15.10.2 On longer vessels, consideration should be given to providing access from both sides.

A.15.11 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. The limitations on the acceptability of Type Vs are described in the following list. 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 underway.
(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 PFD 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.15.11.1 Immersion suits should be considered as standard equipment on all vessels to aid in water rescue operations.

A.15.11.2 A written plan should be prepared for person overboard operations, and regular training should be conducted in the equipment and procedures.

A.15.12.2 All assigned crew members should be trained in the safe firing of all pyrotechnic devices used on the vessel. All devices should be checked at regular intervals to ensure they are protected and in operational condition.

A.15.13.1 The BLS equipment needs to be determined by the AHJ.

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