

NFPA® 1925

Standard on Marine Fire-Fighting Vessels

2013 Edition



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

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NFPA® 1925

Standard on

Marine Fire-Fighting Vessels

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.



Documents

Document Sharing Hub

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

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



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

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_{su}). 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 ft³).

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 [$\geq 3\frac{1}{2}$ 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 [$\geq 3\frac{1}{2}$ 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 suction 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.