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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.

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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.

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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.

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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.

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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

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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

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the U.S. Coast Guard channel 22 (157.100 MHz FM) and the intership channel 6 (156.300 MHz FM).

A.17.1.1 Navigational publications should include the following:

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

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

A.17.2.2 The term *radar* (radio detecting and ranging) refers to a method of detecting distant objects and determining their distance, velocity, or other information by analysis of very high frequency radio waves.

A.18.2 Anodes should be arranged to minimize hull drag and positioned to avoid contact with lifting slings or dry-dock blocks. Consideration should be given to anode materials, depending on various environments.

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

A.19.3.14.1 Equipment locations should be inspected for efficient operations and positioning.

A.19.3.22.9 The test itself ensures function and stability of the rudder and props.

A.19.3.31.1 Representatives of the pump manufacturer and pump driver manufacturer should be present for the acceptance test. An independent third-party certification organization can conduct or witness the pump tests and certify the pump test results.

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

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

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

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

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

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

A.20.1.1 Local maintenance and repair facilities should be researched prior to final vessel design.

A.20.1.2 A maintenance schedule should be developed to determine and record those systems and equipment requiring periodic maintenance and inspection during haul-out.

A.20.3.1 The facility to be used for the vessel should meet the operational directives for the vessel. Where the vessel is to be used at any time, there should be 24-hour access to the vessel. Items that should be of concern are the tides, bridges that have to be opened, and area construction.

Where the vessel is to be used for EMS responses, the dock area, as well as access to and from the dock, has to be able to accommodate a stretcher and patient movement. No ladders should be used for the handling of EMS patients. Where the dock cannot accommodate patient off-loading, an alternate location for patient transfer should be designated.

A.20.4.1 Trailers should conform to local and state requirements, as appropriate.

A.20.5.1 Where the marine fire-fighting vessel is involved in an incident (accident) producing any damage that could result in unsafe operation or unreliable service, the marine fire-fighting vessel should be placed out of service until repairs can be accomplished.

A.20.5.3 In areas of extreme cold, waterflow tests should be run only when the weather conditions allow and using the manufacturer's recommendation for cold weather operations.

Annex B Marine Fire-Fighting Vessel Design Considerations

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

B.1 Determination of Needs Study. Prior to the construction of a new marine fire-fighting vessel or the major conversion of a vessel for fire-fighting purposes, a study should be undertaken to clearly identify the mission and capability requirements of the vessel. Some of the issues that the study should cover are as follows:

(1) General
  (a) The geographical size of the area to be protected by the vessel
  (b) The nature of the waterfront facilities and vessels to be protected
  (c) The maximum desirable response times
  (d) The maximum wake permissible
  (e) The 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
(2) Crew — The expected number of personnel in the vessel's crew
(3) Fire-fighting mission requirements
  (a) Requirements for supplying shoreside water systems
  (b) Number of major pier fires in the jurisdiction to which marine fire-fighting vessels have responded or would have responded within the past 10 years

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(c) Number of major vessel fires in the jurisdiction to which marine fire-fighting vessels have responded or would have responded within the past 10 years
(d) Number of major land fires in the jurisdiction to which marine fire-fighting vessels have responded or would have responded within the past 10 years
(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) Hose and equipment used or required at previous fires by marine fire-fighting vessels
(i) Requirements to remain on station during previous fires in the jurisdiction

(4) Rescue requirements
(a) Number of rescue incidents in the jurisdiction within the last 10 years 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
(a) Building inspection requirements
(b) Subpier inspection requirements
(c) Hazardous cargo inspection requirements
(d) Prefire inspection requirements

(6) Effect of standards and requirements
(a) NFPA standards
(b) USCG requirements
(c) Insurance Rating Association requirements

B.2 Vessel Requirements Specification. From this study, the purchaser should specify the details of the vessel. This standard should form the basis of the specifications. However, special consideration should be given to detailing requirements for the following:

(1) Crew requirements
(a) Personnel required to perform the mission
(b) Maximum number in crew
(c) Training requirements
(d) Crew facilities
(e) Chemical, biological, radiological, and nuclear (CBRN) protection systems

(2) Pumping capacity
(a) Maximum volume required
(b) Maximum pressure required
(c) Discharge characteristics

(3) Equipment requirements
(a) Hose complement required
(b) Minimum portable equipment inventory
(c) Weight restriction of equipment

(4) Foam requirements
(a) Quantity required
(b) Weight restrictions

(5) Open deck requirements
(a) Shore-based fire-fighting operations
(b) Offshore fire-fighting operations
(c) Marine rescue operations
(d) EMS requirements
(e) Accessibility to the water

(6) Speed requirements
(a) Maximum desirable response times
i. Public assembly occupancies
ii. High-hazard occupancies
iii. Most distant point in the district
(b) Patrol speed requirements
(c) Wake considerations

(7) Station-keeping requirements
(a) Length of time required to maintain station
(b) Fuel requirement
(c) Fuel weight restriction
(d) Freshwater requirements

(8) Foul weather capability
(a) Fog and night operations
(b) Maximum sea state

In addition, the purchaser should specify the amount, quality, and duration of training in operation, care, and maintenance required to be provided by a technically qualified representative for the vessel's equipment.

B.3 Mission of the Marine Fire-Fighting Vessel. The mission of the vessel should be determined prior to its design and construction. Where the vessel is used for the sole purpose of fire fighting, it should meet all the stated objectives of this section. Where the vessel is assigned other duties, it should meet all the objectives of the needs assessment study as well as those for each of the following special operations categories.

B.3.1 Search and Rescue. The equipment requirements for the vessel in search and rescue operations vary by location. Lighting is needed for night operations, both surface and subsurface. Ropes, sleds, and EMS kits should be available. Rescue suits can be carried, but they should be used only by trained personnel.

B.3.2 Pollution and Hazardous Materials Response. The use of marine fire-fighting vessels in hazardous materials incidents can be a vital asset. Precautions should be taken to avoid allowing the material involved in the incident to come in contact with the vessel if it will contaminate or damage the vessel. The crew of the vessel is required to be trained in hazardous materials to the operations level.

B.3.3 EMS. A marine fire-fighting vessel in EMS operations could be used to transport injured persons to medical care and to act as the first responder. In areas where the vessel is used extensively for EMS operations, it can be considered as a water ambulance and should, therefore, be equipped as an ambulance.

The radio capabilities of the vessel should include the hospitals and ambulances that are to be involved with victim care and transport.

B.3.4 Port Security Patrols. A marine fire-fighting vessel being used to also perform security patrols should patrol for fires and other hazards.

B.3.5 Emergency Towing. A marine fire-fighting vessel could engage in emergency towing of other vessels, provided it has been effectively equipped to do so. The crew should be trained in the rules, procedures, and safety requirements of towing.

B.3.6 Diving. Diving operations can be used with a number of the special operations listed in this section. All personnel engaged in the actual diving operations should be certified

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divers. For each area of special operation that a diver is to be used, additional training should be provided in advance, especially fire fighting, search and rescue, and hazardous materials. (Being a diver does not qualify a person to operate beyond his or her realm of basic training.)

Where a marine fire-fighting vessel is to be used as a diving platform, it should be equipped with the diving equipment, including a dive flag, spare breathing air cylinders, special hose and nozzle floats, diver personal protection equipment, and ropes. Each department decides whether wet or dry suits are to be used. In dives involving contaminated waters, only dry suits should be used. Additional areas on the vessel should be designed for the safe storage of the diving equipment, especially the breathing air cylinders.

A second helm should be installed in the rear of the vessel for safety reasons, to be used during diving operations.

B.3.7 On-Scene Command Post. The use of a vessel as a command post requires that the vessel have the radio capabilities to communicate with all companies involved at the incident and with a land-based communications unit.

B.3.8 Maintenance of Aids to Navigation. In addition to the assignment of the marine fire-fighting vessel, the vessel might also be used in the maintenance of navigation aids. In such cases, the crew and vessel's primary assignment is that of a marine fire-fighting vessel. Vessels that are designed and assigned as tenders that also have fire-fighting capabilities should not be covered by this section; they are not considered as marine fire-fighting vessels.

Annex C Informational References

C.1 Referenced Publications. The documents or portions thereof listed in this annex are referenced within the informational sections of this standard and are not part of the requirements of this document unless also listed in Chapter 2 for other reasons.

C.1.1 NFPA Publications. National Fire Protection Association, 1 Batterymarch Part, Quincy, MA 02169-7471.

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

C.1.2 Other Publications. (Reserved)

C.2 Informational References.

C.2.1 ABYC Publications. American Boat and Yacht Council, 613 Third Street, Suite 10, Annapolis, MD 21403.

ABYC H-28, *Inflatable Boats*, July 2010.

ABYC H-41, *Ladders, Handholds and Rails*, 2009.

C.2.2 U.S. Government Publications. U.S. Government Printing Office, Washington, DC 20402.

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

C.3 References for Extracts in Informational Sections.

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

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

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