

Table 11.2.2.1 Intact Stability Criteria for Marine Fire-Fighting Vessels

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

¹ISO 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.*

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

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

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

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

11.2.4.2 Crane Operations.

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

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

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

11.2.5 Wind and Weather Influences.

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

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

11.2.6 Icing.

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

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

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

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

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

11.3 Flotation.

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

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

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

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

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

11.4 Loading Conditions.

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

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

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

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

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

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

Chapter 12 Main Propulsion and Auxiliary Engines

12.1 General.

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

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

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

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

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



12.2 Outboard Engines.

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

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

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

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

12.3 Inboard Engines.

12.3.1 Vessel Types.

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

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

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

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

12.3.3* Propulsion Engine Horsepower.

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

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

12.3.4 Engine Shutdown.

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

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

12.4 Power Trains Using Inboard Engines.

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

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

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

12.4.4 The reduction gear cooling system, controls, and instruments shall conform to *ABS Rules for Building and Classing Steel Vessels for Service on Rivers and Intracoastal Waterways* for Type I and Type II vessels and ABYC P-4, *Marine Inboard Engines and Transmissions*; ABYC P-6, *Propeller Shafting Systems*; ABYC P-14, *Mechanical Propulsion Control Systems*; ABYC P-23, *Steering and Propulsion Controls for Jet Boats*; and ABYC P-24, *Electric/Electronic Propulsion Control Systems*, as appropriate for Type III through Type V and to the manufacturers' installation and proposed operating requirements.

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

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

12.4.6 Propellers.

12.4.6.1 Propeller systems shall conform to the standards within *ABS Rules for Building and Classing Steel Vessels for Service on Rivers and Intracoastal Waterways* or *ABS Rules for Building and Classing High Speed Craft* for Type I and Type II vessels and ABYC P-6, *Propeller Shafting Systems*, for Type III through Type V vessels.

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

12.4.7 Steering systems shall comply with ABYC P-17, *Steering Systems for Outboard, Inboard, Sterndrive, and Water Jet Drive Boats*; ABYC P-18, *Cable over Pulley Steering Systems for Outboard Engines*; ABYC P-21, *Manual Hydraulic Steering Systems*; and ABYC P-22, *Steering Wheels*, for Type III through Type V vessels and *ABS Rules for Building and Classing Steel Vessels for Service on Rivers and Intracoastal Waterways* or *ABS Rules for Building and Classing High Speed Craft*, for Type I and Type II vessels.

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

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

12.5 Engine Systems.

12.5.1 General.

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

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

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

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

12.5.2 Fuel System.

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

12.5.2.2 Fuel Capacity.

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

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

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

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

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

12.5.3 Exhaust Systems.

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

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

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

12.5.4 Cooling Systems.

12.5.4.1 Cooling system sea suction shall comply with ABS *Rules for Building and Classing Steel Vessels Under 90 Meters (295 ft) in Length*; ABS *Rules for Building and Classing Steel Vessels for Service on Rivers and Intracoastal Waterways*; or ABS *Rules for Building and Classing High Speed Craft* for Type I and Type II vessels and ABYC P-4, *Marine Inboard Engines and Transmissions*, for Type III through Type V vessels.

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

12.5.5 Starting Systems.

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

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

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

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

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

12.5.6 Ventilation Systems.

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

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

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

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

12.5.7 Controls and Instruments.

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

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

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

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

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

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

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



12.6 Auxiliary Engine Systems.

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

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

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

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

12.6.5 Auxiliary air compressor system(s) shall be rated for marine use and shall conform to *ABS Rules for Building and Classing Steel Vessels for Service on Rivers and Intracoastal Waterways* or *ABS Rules for Building and Classing High Speed Craft* for Type I and Type II vessels and 46 CFR 175-187, Subchapter T, "Small Passenger Vessels (Under 100 Gross Tons)," for Type III through Type V vessels.

Chapter 13 Auxiliary Machinery and Systems

13.1 General.

13.1.1* Auxiliary machinery and systems on Type I and Type II vessels shall comply with 46 CFR 175-187, Subchapter T, "Small Passenger Vessels (Under 100 Gross Tons)"; *ABS Rules for Building and Classing Steel Vessels*; NFPA 302, *Fire Protection Standard for Pleasure and Commercial Motor Craft*; ABYC A-27, *Alternating Current (AC) Generator Sets*; or 46 CFR 197, "Marine Occupational Safety and Health Standards."

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

13.2 Alarm and Monitoring Systems.

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

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

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

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

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

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

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

13.3 Compressed Air Systems.

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

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

13.4 Steering Systems.

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

13.4.2 Steering control and rudder angle indicator shall be provided.

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

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

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

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

13.8 Wiper Systems.

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

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

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

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

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

13.9 Thruster Systems Not Involving the Fire Main System. Vessels equipped with thrusters not supplied by the vessel's fire main system that are used for station keeping shall comply with the requirements of Section 2 of *ABS Rules for Building and Classing Steel Vessels Under 90 Meters (295 ft) in Length*; ABYC E-11, *Alternating Current (AC) and Direct Current (DC) Electrical Systems on Boats*; and Chapter 9 of NFPA 302, *Fire Protection Standard for Pleasure and Commercial Motor Craft*, as appropriate.

13.10 Piping and Systems Insulation.

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

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

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

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

Chapter 14 Electrical Systems

14.1 General.

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

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

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

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

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

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

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

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

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

14.2 Battery Systems.

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

14.2.2 Battery Banks.

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

14.2.2.2 A master switch shall allow selection of either bank.

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

14.4 Searchlights.

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

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

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

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

Chapter 15 Outfitting

15.1 General.

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

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

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

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

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

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

15.3 Storage Compartments.

15.3.1 General.

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

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

15.4 Insulation.

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



15.4.2 Acoustical Insulation.

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

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

15.5 Deck Surfaces. Non-skid surfaces shall be used in the following areas:

- (1) Exterior walkways and companionways
- (2) Shower areas
- (3) Weather decks
- (4) Ladder steps and rungs
- (5) Walkways in machinery spaces

15.6 Ground Tackle.

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

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

15.6.3* All Type IV and Type V vessels shall carry at least one set of ground tackle that shall comply with the requirements for storm anchors of *ABYC H-40, Anchoring, Mooring, and Lifting*.

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

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

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

15.7 Anchor Storage.

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

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

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

15.7.3.1 Fiber rodes shall also incorporate thimbles.

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

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

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

15.8 Mooring Lines.

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

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

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

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

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

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

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

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

15.10 Lifesaving and Rescue Equipment.

15.10.1 Capacity Number.

15.10.1.1 All vessels shall have a posted capacity number.

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

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

15.11* Personal Flotation Devices.

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

15.11.2* A person overboard recovery system shall be provided.

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

15.11.4 Buoyant Apparatus and Life Rafts.

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

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

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

15.12 Emergency Signaling Devices.

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

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

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

15.13 Medical Equipment.

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

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

15.14 Recovery of Persons from the Water.

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

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

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

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

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

Chapter 16 Communications Equipment and Systems

16.1 General.

16.1.1* Fire Department Radio Systems.

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

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

16.1.2* Maritime VHF-FM Radio.

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

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

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

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

16.1.5 Hailer.

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

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

16.1.6 Intercom System.

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

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

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

16.2 Communications.

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

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

Chapter 17 Navigation Equipment and Systems

17.1 General.

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

17.1.2 All vessels shall be fitted with an illuminated compass.

17.2 Vessel Type-Specific Requirements.

17.2.1 All Type I through Type IV vessels shall have a work area or chart table for navigational chart work and chart navigation tools and an area of sufficient size to store navigational charts.

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

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

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

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

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

Chapter 18 Protective Coatings and Corrosion Protection

18.1 General.

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

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

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

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

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

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

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

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

18.3 Impressed Current System.

18.3.1 Installation.

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

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

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

18.4 Coating System.

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

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

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

Chapter 19 Tests and Trials

19.1 General.

19.1.1 The vessel shall be thoroughly inspected or tested to demonstrate conformance to this standard and to regulatory body requirements, as appropriate for the complexity of the vessel.

19.1.2 Trials shall be conducted to determine that the vessel and its equipment conform to the contract, the drawings, and the specifications.

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

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

19.1.4 Test Records.

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

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

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

19.1.6 Qualified personnel shall perform all tests.

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

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

19.2 Testing During Construction.

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

19.2.2 The builder shall correct any deficiencies that appear during inspection and testing and reinspect or test until proven satisfactory.

19.3 Builder's Trials.

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

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

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

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

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

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

19.3.7 Tightness Test.

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

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

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

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

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

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