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National Fire Protection Association
INTERNATIONAL

Fire Protection Regulations

for

MOTOR CRAFT

Pleasure and Commercial

(Part D, Regulations
Governing Marine Fire Hazards)

1937

Prepared and Revised by Marine Section,
National Fire Protection Association

NOTE

This pamphlet is a complete revision of Appendix D, Regulations Governing Marine Fire Hazards, Edition of 1930.

Fire Protection Regulations for
MOTOR CRAFT
PLEASURE AND COMMERCIAL

The provisions of this pamphlet supplement and supersede the provisions of the Main Rules in their application to motor driven vessels. Where no specific ruling is provided herein, the provisions of the Main Rules shall apply.

GASOLINE POWERED BOATS.

10. Location, Material and Construction of Fuel Tanks.

11. (a) It is recommended that fuel tanks be located in water-tight compartments separate from but adjacent to the engine room, accessible for exterior examination and mounted in a pan or on a metal lined water-tight flat, above the load line, with overboard drains. Such pan or flat is not recommended where bottom of tank is below the load line. Where this arrangement is not practicable, fuel tanks may be located to suit the design of the vessel, but preferably outside of the engine compartment and so that excessive lengths of fuel piping will be avoided. All tanks shall be substantially secured in position to prevent movement and installed to afford as ready external examination and access as possible.

(b) Portable tanks below decks shall not be permitted.

12. Fuel tanks shall be constructed of copper of thickness not less than No. 18 gauge (U. S. Std.), or of iron or steel of thickness not less than No. 14 gauge (U. S. Std.), except that on light runabouts where cylindrical iron or steel tanks are used, those not exceeding 35 gallons capacity shall be of not less than 18 gauge (U. S. Std.), and those of 35 to 70 gallons capacity of not less than 16 gauge (U. S. Std.). Copper is preferable for all gasoline tanks. Ferrous metal should be used only for cylindrical tanks. Non-corrosive alloys may be used subject to approval. Steel or iron tanks should be galvanized both inside and outside, preferably by the hot dipped process, after completion. Those not galvanized shall be kept well coated on the outside to prevent corrosion.

Where possible, tanks should be lifted for examination annually and installation should be designed with this end in view.

13. (a) Seams of copper tanks shall be rolled, riveted and soldered or rolled and brazed. All outside rivet points and heads shall be soldered or brazed.

Seams of ferrous metal tanks shall be welded, or riveted and welded.

All outside rivet points and heads shall be welded.

(b) If fuel tanks have flat heads or are not cylindrical, they shall be fitted with diaphragms, of same character of material as tanks, to break the wash of contents; and shall be properly braced on flat surfaces by diaphragms or other stays to prevent bulging and panting. Diaphragms in tanks shall be well fastened by angles or flanges. Flanges shall be bent to an inside radius of not more than twice the thickness of the flanged sheet, and the riveting, welding or brazing shall be as close to the throat of the flange as practicable.

For pressure fuel tanks, the cylindrical type is recommended.

(c) Tanks shall be designed with a factor of safety not less than 4. Gravity tanks shall be tested by static head above tank top of 10 feet of water, without showing leakage or permanent deformation. Pressure tanks shall be tested to twice the designed working pressure or that required for gravity tanks, whichever is the greater, without leakage or permanent deformation.

14. (a) Outlets on gas fuel line for drawing loose gasoline for any purpose whatever are prohibited in the engine compartment. Drains in the bottom of fuel tanks are not recommended, but where fitted shall be closed by plugs or plugged pipes threaded into spuds, riveted and soldered, welded or brazed to the tank.

(b) It is recommended that all outlets pass through the top of the tanks. In cases where outlets pass through side or bottom, connections shall be threaded into spuds riveted and soldered, brazed or welded to the tank; and where the tank is large enough to permit inside access, an internal gate valve shut-off with extension rod packed at tank top shall be fitted.

(c) Filling pipes and sounding holes shall be so arranged that vapors, or possible overflow when filling, can not escape to the inside of the boat and will run overboard. A pipe made tight to tank and to filling plate on deck outside of cockpit and coamings meets this requirement.

Filling pipes should extend nearly to the bottom of the tank, and a strainer of non-corrodible wire mesh fitted in the throat of the fill is recommended.

In cases where, on account of offsets, sounding hole has to be located otherwise than as above, it shall be not larger than ½ in. I. P. S. and such hole shall be kept closed at all times except during the act of sounding.

(d) Vents or reliefs leading outboard shall be provided on all gasoline tanks; sizes to be as follows:

0 to 100 gals.—⅜ in. I. P. S.
101 to 150 gals.—½ in. I. P. S.
151 to 300 gals.—¾ in. I. P. S.
301 to 500 gals.— 1 in. I. P. S

Two vents or reliefs having a combined area equivalent to that specified above may be used in place of a single vent or relief. On boats liable to heel, vents on port side should be led to starboard and vice versa.

(e) Gauge glasses and try cocks shall not be used. Other methods of indicating the level of the liquid may be used, provided, however, that they are so arranged as not to expose the liquid or vapor in cabin, cockpit or under deck, or to permit vapor to drift below.

(f) It is recommended that auxiliary feeds draw from the main fuel line, but where auxiliary gasoline tanks are necessary, they shall be of a type permitting the same fill pipe and vent arrangement as required on main tanks in order to avoid handling of loose gasoline under deck. Open fills on tanks integral with auxiliaries located below decks are dangerous and are not recommended; but on existing installations where it is impracticable to alter in compliance with the above, gasoline supply for such tanks shall be kept only in approved safety cans filled at a station, and particular care against spilling shall be exercised in the operation of filling the auxiliary tanks therefrom.

20. Fuel Lines.

21. A shut-off valve shall be installed as close to each tank as practicable and one as close to each carburetor as practicable. The handles of all shut-offs at the tanks, whether external or internal, shall be readily accessible. Arrangements shall be provided for operating them from outside the compartments in which the tanks are located, preferably from on deck.

A heat actuated device to automatically shut off the fuel supply near the tank in event of fire is recommended.

Valves for gasoline fuel lines shall be of non-ferrous metal with ground seats and installed to close against the flow. The tinning of cast bodies and bonnets and the use of a type which does not depend solely on packing to prevent leakage at the stem while in fully open position are recommended.

Cocks of any type are not approved for use in gasoline fuel lines.

22. Fuel lines shall be of seamless drawn annealed copper tubing or iron pipe size copper pipe. They shall be run in sight whenever practicable, protected from mechanical injury and effectively secured against vibration by neat fitting soft metal lined or soft non-ferrous metal clips with no sharp edges in contact with tubing. Where passing through steel decks or bulkheads, lines shall be protected by close fitting ferrules of non-abrasive material. When an engine is mounted floating or on soft packing pieces, a short length of approved non-ferrous metallic flexible tubing with approved fittings shall be installed in the line at or near the carburetor to prevent damage by vibration. Such flexible section or a copper loop is recommended for connection between fuel line and engine on all types of mounting.

23. Tubing wall thickness shall be not less than the following:

Outside Diameter of Tubing	Thickness Stubbs Gauge (B W G)	Thickness Inches
$\frac{1}{8}$", $\frac{3}{16}$", $\frac{1}{4}$"	No. 21	.032
$\frac{5}{16}$", $\frac{3}{8}$"	No. 20	.035
$\frac{7}{16}$", $\frac{1}{2}$"	No. 19	.042

Tube fittings shall be of non-ferrous drawn or forged metal and of the flared type at least equal to those of S. A. E.

Standard Practice Code for Refrigeration and Marine.* It is important that tubing be cut square and truly flared by tools designed for those purposes. Annealing of tube ends before flaring is recommended.

Pipe fittings shall be of non-ferrous metal, standard pipe threaded and joints soldered after being made up. The tinning of cast fittings is recommended.

24. A strainer of approved type with bolted or dogged bonnet shall be fitted in the fuel suction line within the engine compartment and supported to take its weight off the line. A shut-off shall be fitted on each side of strainer to permit opening and cleaning. Strainers shall be of type opening on top for cleaning screens.

25. Of various feed systems, such as mechanical, tank pressure, vacuum, gravity and electric diaphragm, the direct connected mechanical is preferred.

30. Carburetor.

31. All carburetors shall have integral therewith or properly secured thereto an approved drip collector. This shall be drained by a device for effectively returning drip to engine intake or discharging it overboard.

32. Air intakes shall be so directed that backfire can not blow down into the bilge and shall be fitted with an approved backfire flame arrester.

40. Motor Exhaust.

41. The exhaust manifold should be water jacketed and cooled by discharge from a pump which operates whenever the engine is running; if not, woodwork within nine inches shall be protected by 1/8-inch asbestos board covered with sheet metal. A dead air space of 1/4 inch shall be left between the protecting asbestos and the wood, and a clearance of not less than 2 inches maintained between the manifold and the surface of such protection.

*Published in the handbook of the Society of Automotive Engineers.

42. (a) It is recommended that all of the engine cooling water be discharged through the exhaust pipe and enter at a point as near to the manifold as practicable. Where the exhaust pipe is overhead or where a low level exhaust is not cooled by the entire discharge of circulating water, it is recommended that a length of not less than twelve diameters of such exhaust pipe adjacent to the manifold be water jacketed and cooled in same manner as manifold, and remainder of pipe shall be kept clear of internal woodwork at least 1½-inch and properly supported by non-combustible hangers or blocks.

(b) Where the first twelve diameters of exhaust is neither jacketed nor cooled by entire discharge of circulating water, woodwork within 6 inches of any part of the exhaust shall be protected by ⅛-inch asbestos board covered with sheet metal. A dead air space of ¼ inch shall be left between the protecting asbestos and the wood, and a clearance of not less than one-half its diameter shall be maintained between the pipe and the surface of such protection.

(c) Where exhaust lines pass through water-tight bulkheads, non-combustible packings should be installed.

43. Exhaust piping shall be led to the point of escape without traps and with a minimum number of bends or elbows. Ninety degree elbows or bends of less than five diameters radius are not recommended.

44. (a) Cast or wrought iron pipe is recommended for exhausts. Where lighter weight is essential, copper tubing may be used provided that, if not jacketed as recommended in paragraph 42(a), the full discharge of circulating water shall pass through the tube. For cruisers and commercial craft, gauge of copper exhaust tubing should not be lighter than:

2 in. O. D.—No. 14 B. W. G.
4 in. O. D.—No. 12 B. W. G.
6 in. O. D.—No. 10 B. W. G.

(b) In runabouts, where extreme lightness is essential, exhaust tubing thickness of No. 16 B. W. G. may be used up to 3 in. O. D.

(c) When flexibility is necessary in the exhaust line, the following is recommended: A section consisting of an extra heavy rubber hose sleeve to be clamped over a gap not ex-

ceeding 12 in. in length in the exhaust line. This sleeve shall be protected on the inside with a piece of the exhaust pipe not less in length than 1 in. shorter than the gap. The length of the rubber sleeve shall be sufficient to allow a length of one diameter on each end for clamping purposes. The flexible connection shall be placed where it is accessible at all times and internally in contact with all circulating water.

50. Bilge.

Frequent flushing and cleaning of bilges is recommended. Drain outlets should be fitted in the bottom of the hull and particular attention paid to securing complete drainage thereto and to the bilge pump suctions in order to facilitate this operation, either hauled out or afloat.

60. Ventilation.

61. Any compartment or space in which a motor is located, particularly the lower portion and bilges, shall be provided with ventilation effective to remove possible accumulation of flammable or explosive vapor. Tank compartments should be similarly ventilated when practicable.

62. To meet this requirement, the following is recommended:—Where motors and/or tanks are in closed compartments; permanently open and adequate inlet and outlet ventilating ducts extending to the bilges should be installed; two inlets leading to the wings at one end of the compartment and two outlets from the wings at the opposite end.

63. Where motors and/or tanks are not in closed compartments; at least one such duct should be installed in the fore part of the boat and one in the after part.

64. Inlet ducts should be provided with cowls or equivalent fittings.

65. Where feasible, it is also recommended that outlet ducts be fitted with wind-actuated self-trimming or rotary exhauster heads or that power operated exhausters be installed in each outlet duct. If exhausters are used, motors shall be installed outside of the ducts and as high above the accommodation flooring as practicable. They shall be run for at

least five minutes before starting any engine. Size of vents should be approximately proportional to the beam of the boat with 2 sq. in. of aggregate vent area per foot of beam as a minimum.

70. Operation.

71. Attention is called to the hazard involved in the handling of gasoline. An atmospheric concentration as low as 1¼ per cent is practically odorless, but is sufficient to create a mixture which may be exploded by a slight spark. Such explosive vapor may travel a considerable distance from the point of leakage.

72. Gasoline vapors are heavier than air and will not escape from low lying pockets, such as bilges or tank bottoms, unless drawn or forced out. A recently emptied gasoline tank is in its most dangerous condition. The following precautions are recommended therefore in order to reduce the fire and/or explosion hazard:

(a) All gasoline connections shall be tight.

(b) Care shall be taken not to expose gasoline in closed spaces through spilling, drawing off, storage or use in any kind of cleaning, no matter how small the quantity.

(c) Ventilation as adequate as possible shall be insured by attention to all arrangements therefor, both before starting and while running.

(d) Naked lights, however small, shall not be carried into compartments where gasoline vapor may be present.

(e) The entire boat and especially the engine compartment shall be kept clean and free from flammable rubbish, loose oil and grease, and dirty waste or rags. Clean waste and rags shall be kept in metal lined lockers or containers. Similar receptacles shall be provided for waste and rags coated with oil, paint, remover or polish; but such accumulation shall be kept to a minimum by frequent disposal ashore.

(f) In fueling:—before tank fills are opened or gasoline brought on board, all engines, motors and fans shall be shut down, galley fires put out, and all doors, ports, windows and hatches closed. On completion, after hose or cans have been

removed, any spillage shall be wiped up and the boat opened. If practicable, it shall remain open for at least five minutes before starting any engine or motor or lighting a fire. No smoking shall be permitted during a fueling operation.

(g) In order to guard against a possible spark during fueling operation, nozzle of the hose or can shall be put in contact with the fill pipe or funnel *before* starting to run in gasoline and this contact shall be kept until the flow has stopped.

NOTE:—There is a serious hazard from static discharge unless this rule is observed.

(h) Lockers in which oiled clothing is carried shall be cool and well ventilated on account of the danger of spontaneous combustion.

(i) Paint and varnish removers are generally highly flammable and particular caution should be exercised during use of such to see that there is ample ventilation and no open lights, fires or smoking.

80. Hull Arrangement.

From standpoint of fire hazard, it is highly desirable that bilges of machinery and fuel tank spaces should be separated from bilges of accommodation spaces by bulkheads as tight as practicable, i.e., of double diagonal wood, steel plate or equivalent construction.

90. Galley Arrangement. (Applies also to sailing and steam craft.)

91. For the reason that galley stoves are liable to promiscuous, unskilled or ignorant operation more than any other piece of boats' gear involving fire risk, it is important that such equipment should be selected and installed with a view to minimizing both the personal and physical hazards.

92. Cooking or heating stoves should not be located in the same compartment with machinery or gasoline tanks; but when such arrangement is unavoidable, stoves shall be placed as remote as possible from carburetors and tank connections.

93. Woodwork within 12 inches of bottom and sides and 24 inches over top of stoves shall be protected with ⅛-inch asbestos board covered with sheet metal and a dead air space of ¼-inch left between the protecting asbestos and the woodwork.

94. Fixed stoves shall be permanently secured in place. Portable stoves are not recommended, but if carried shall be rigidly secured in place well clear of woodwork when in use.

95. On stoves burning liquid fuel, oven should not be under the open burners on account of the danger from overflow if the burners are extinguished.

100. Galley Stoves. (Applies also to sailing and steam craft.)

101. COAL, CHARCOAL OR WOOD:—Such stove installations are covered in Regulations on Marine Fire Hazards, but a clearance of at least 3 in. between bottom of stove and deck is recommended unless installed on a hollow tile base.

102. ALCOHOL, SOLID AND FLUID:—Containers of solidified alcohol shall be properly secured on a fixed base to prevent sliding or overturning in a sudden roll of the vessel.

(a) For fluid burners where wet priming is used, a catch pan not less than ¾-inch deep shall be secured inside the frame of the stove or metal protection thereunder flanged up ¾-inch to form a pan.

(b) Gasoline shall not be used for priming.

(c) Fuel tanks for fixed stoves shall be separate therefrom, mounted either outside, or inside with outside fill and vent.

(d) Either pressure or gravity feed is permissible, but where gravity or siphon is used an easily accessible shut-off valve shall be fitted in fuel line at tank, and if tank is outside, also at the stove.

103. FUEL OIL OR KEROSENE:—Where wet priming is used, a catch pan not less than ¾-inch deep shall be secured inside the frame of the stove, or metal protection thereunder flanged up ¾-inch to form a pan.

(a) Gasoline shall not be used for priming.

(b) Fuel tanks for fixed stoves shall be separate therefrom, mounted either outside, or inside with outside fill and vent.

(c) Either pressure or gravity jet feed is permissible. Bubble feed or any system which may be affected by list or roll of the vessel shall not be used. On gravity or siphon tanks, an easily accessible shut-off valve shall be fitted in fuel line at tank, and if tank is outside, also at the stove.

(d) Burners shall not be primed when hot and burner tips shall be kept clean to avoid choke, extinguishment and consequent flooding.

104. GASOLINE:—Gasoline stoves shall not be used on boats.

105. LIQUEFIED OR COMPRESSED GAS SYSTEMS:—Systems, including regulating and safety equipment, shall be listed by Underwriters' Laboratories, Inc., for marine use.

106. Vapors from petroleum gases are heavier than air, regardless of their varying rates of evaporation. Such vapors will tend to sink to the bottom of an enclosed compartment into which they are released and are not readily dispelled by overhead ventilation. Acetylene, methane and coal gas are lighter than air.

107. All of these vapors when mixed with air in certain proportions are explosive. Safety requires absolute prevention of vapor escape.

108. Cylinders and drums and their pressure relief devices shall be I. C. C. standard for the contained product and shall be filled according to I. C. C. regulations.

109. Systems introducing fuel below decks in gaseous form are regarded as the less hazardous of the liquefied or compressed gas systems. Each cylinder in such systems shall have a stop valve directly on the cylinder outlet and the system shall be provided with a regulating device limiting the pressure at the burners to not over one pound per square inch (28 in. water column).

110. Systems introducing fuel below decks in liquid form are regarded as the more hazardous of the liquefied or compressed gas systems. Each drum in such systems shall have a stop valve, or a check valve in combination with a stop valve, directly on the drum outlet; and where gas may attain a vapor pressure of over 20 lbs. per square inch gauge at 100° F., the system shall be provided with a regulating device limiting the pressure at the burners to not over 20 lbs. per square inch.

111. (a) In both systems the low pressure side of the regulator or the L.P. line shall be provided with a pressure relief device and the chamber above the diaphragm with a vent, both of which may discharge through a common outlet. (See par. 112-119, incl.)

(b) In multi-cylinder or multi-drum systems, a stop valve shall be provided in each line from the container to the regulator or manifold in addition to the valves required at the containers.

(c) Continuous burning or pilot lights are not permitted.

(d) Only dry primed burners shall be used.

(e) An automatic device to shut off gas supply in case flame is extinguished shall be fitted to oven burners and is recommended for other burners on the stove when practicable.

(f) To facilitate detection of possible leaks, an odorant shall be added to fuel gases which do not emit a natural distinctive odor.

INSTALLATION OF LIQUEFIED OR COMPRESSED GAS SYSTEMS.

112. Comprehensive printed instructions and a labeled diagram shall be furnished with each system, covering details of proper installation.

113. Only the kind and specification of gas for which the system is designed and listed shall be used.

114. Cylinders or drums, and regulating and safety equipment shall be substantially secured and located so that vapor escaping from any cause cannot reach the bilges, machinery space, accommodations or other enclosed spaces.

(a) Such locations are confined to open deck or cabin top or in a dummy stack, provided the deck in way is vapor tight to the compartment below. Locations under deck, in a cockpit and on portions of the deck enclosed at the sides by bridge or cabin structures, are not approved.

(b) Cylinders or drums and their regulating and relief equipment shall be protected from climatic extremes by a box or housing (as dummy stack) vented to the open air by holes near the bottom for heavy gases and near the top for light gases.

115. The discharge from the low pressure reliefs shall be led preferably to the stern or, if not feasible, to a point at least two feet distant (and if possible farther) from any part of an opening to the interior of the boat or from a motor exhaust which is below the level of such discharge. Outlet ends shall be turned down to prevent choking the line with water.

116. For low pressure (gaseous phase) systems, line and branches from the regulator to the burners shall be seamless soft copper of the same gauge thickness as required for gasoline feed lines (see Section 23); except that for acetylene, soft brass or composition tubing shall be used. (Unalloyed copper is not suitable for use with acetylene.)

117. For high pressure systems (liquid phase) and lines from cylinders to regulator in low pressure systems, the tubing shall be seamless soft copper $\frac{3}{16}$ in. O. D. with wall thickness 3/64 in. or No. 18 Stubs gauge (BWG).

118. Fittings for standard gauge tubing shall be of approved flared marine type (see Section 23); and for heavy gauge tubing, either of the same type, but with tube end thoroughly annealed before flaring, or of S. A. E. soldered

type, but of drawn or forged non-ferrous metal and using only high temperature solder or brazing.

119. Lines shall be exposed to sight but protected from mechanical injury as far as possible and substantially secured against vibration by neat fitting soft metal lined or soft non-ferrous metal clips with no sharp edges in contact with tubing. Where passing through steel decks or bulkheads, lines shall be protected by close fitting ferrules of non-abrasive material.

OPERATION OF LIQUEFIED OR COMPRESSED GAS SYSTEMS.

120. Brief printed instructions and labeled diagram for operation and maintenance shall be posted where visible for ready reference.

121. Changing of cylinders or drums shall be supervised by one of the licensed personnel when such officers are carried, or by other responsible person when no such officers are carried.

122. In single container systems:—when container is to be changed, close the stop valve on the container and burn out the gas content of the line by lighting all burners, then *shut off the burners.* Disconnect the empty container, leaving the *stop* valve on the container and keep closed, then connect the fresh container.

(a) In types necessitating transfer of an attached fitting containing the stop valve, make this transfer on deck in the open, remote from openings leading below and from sources of ignition.

123. In multi-container systems:—when the container in use becomes exhausted, shut off all burners before turning on the reserve container. When container is to be changed, shut both container stop valve and stop valve in the line to the regulator. It is then unnecessary to burn out the gas content of the low pressure lines, and change of containers may be executed as in a single container system.

124. In either a single or multi-container system:—after turning on a fresh container, it is recommended that all

burners be lighted for sufficient time to insure that there is no air in the lines to interrupt a continuous flow of gas; then shut off burners and container stop valve, and test for leaks and faulty or improperly adjusted regulator.

125. Unconnected reserve containers shall be subject to the same stowage restrictions as those in service. Empty containers shall be kept closed by the means provided (stop valves or plugs) whether or not connected, and unconnected empties put ashore as soon as practicable.

126. Particular care shall be taken against snuffing a flame from boil-over, gust of air or any other cause, and frequent attention shall be given to joints and glands to insure constant tightness.

127. Systems shall be provided with a pressure gauge. At installation they shall be tested with air or water and proven tight at not less than twice the service pressure.

Thereafter, frequent tests at service pressure shall be made (bi-weekly recommended) by closing the cylinder valves and observing the gauge. If tight, there should be no noticeable drop in ten minutes. Trial for location of leaks shall be done with soapsuds or other non-combustible substance and *not with flame.*

130. Cabin Heaters and Hot Water Boilers.

131. Gasoline shall not be used for fuel, and bubble feed burners are not permitted for any kind of fuel. Portable kerosene heaters are not approved.

132. The requirements for installation and operation of galley stoves (pars. 90-127) shall be observed where applicable.

133. All gas burning heaters shall be equipped with an automatic device to shut off gas supply to the heater in case the flame is extinguished.

134. Continuous burning or pilot lights are not permitted.

140. Ice Machines.

Machines operated by flame are not permitted. Electric machines should have motors preferably located on top of the cabinets, or if separate from cabinets, well above the bilges. For wiring, see Section 150.

150. Electrical Equipment.

151. Electrical installations operating at potential of 32 volts and over shall be in accordance with Recommended Practice for Electrical Installations on Shipboard of the American Institute of Electrical Engineers (Publication No. 45, October, 1930). Those operating at potentials under 32 volts shall conform to the following:

NOTE: Low voltage installations do not warrant admission of sub-standard material and workmanship in motor craft where the possible presence of flammable or explosive vapors renders a spark or incandescence from a physical failure liable to entail serious consequences. Where explosion-proof apparatus is specified, it shall conform to requirements for such apparatus contained in the National Electrical Code with respect to Class I hazardous locations.

152. Generators and motors shall be placed in dry, accessible and adequately ventilated locations. Independent generators and motors should be mounted on foundations as high as practicable above the floor to avoid damage by splash from the bilges or by coming in contact with low-lying vapors, and shall not be located in low or pocketed positions unless they are of explosion-proof type. Generators and motors which are an integral part of the propelling unit shall be installed above the center line of the crank shaft. Generators, up to and including 1500 watts capacity, driven by the propelling unit shall be fused at the generators.

153. Switchboards shall be placed in dry, accessible and adequately ventilated locations, preferably outside of the engine compartment. The backs shall be metal encased and provision shall be made for access thereto. All uninsulated current carrying parts shall be mounted on non-absorbent, non-combustible, high dielectric composition.

A master switch shall be installed on the main panel, and where the starting motor is on an independent circuit, an additional switch shall be installed.

Switches other than those mounted on the switchboard shall be of the enclosed type. Each circuit shall be fused to not more than the current carrying capacity allowed for the conductor (see paragraph 155).

154. Batteries should be so located that gas generated in charging can be easily dissipated by natural or induced ventilation. Acid batteries should be set in lead pans. Alkaline batteries should be insulated from possible metal contact and consequent short circuit.

Batteries should be secured against shifting with the roll of the boat and should be easily accessible for observation of terminals, testing and replenishment. Preferably, batteries should not be located in the same compartment with a gasoline tank or engine; but where location elsewhere is impracticable, they shall be effectively screened off by a cage or similar structure in order to minimize the danger of accidental spark through dropping a metal object across terminals.

Battery terminals shall be of the soldered lug type.

155. Ignition wiring as supplied or recommended by engine makers is generally acceptable.

Light and power wiring sizes shall be according to Section 612 of the National Electrical Code* for current to be carried; except that as a precaution against rupture by vibration, all conductors shall be of the stranded type and no conductor smaller than No. 12 A. W. G. shall be used.

Capacities in Section 612 are for standard voltages, but the fact that sub-standard voltages, to be effective, permit only a minimum voltage drop is the consideration in determining wiring sizes. The resistance of copper being 10.75 ohms per circular mil foot, the proper size of wire to be used may be determined from the following formula:

> 10.75 x Length in ft. of single wire x Ampere load divided by Effective voltage drop equals Circular mil area.
>
> The permissible drop in a 6-volt circuit fully loaded shall not exceed 1.5 volts; for a 12-volt circuit, it shall not exceed 2 volts.

156. Light and power conductors for interior wiring shall be rubber insulated in accordance with Section 602 of the National Electrical Code.

*See footnote next page.

Conductors passing to the exterior shall be run in metal kick-pipes or stuffing tubes to water-tight receptacles. From such receptacles to exterior fixtures, conductors shall be type "S" flexible cord in accordance with Section 609 of the National Electrical Code.*

For intercommunication wiring, rubber covered single braid IC cable, type RF-32 stranded and not smaller than No. 16 A. W. G. or equivalent, shall be used. Commercial bell wire shall not be used.

157. All wiring shall be run as high as practicable above the accommodation flooring. Surface wiring shall be protected in accordance with the National Electrical Code*: Section 514 for wooden raceways, Section 504 for metal raceways, Section 503 for conduit, and Section 508 for metallic tubing. However, the extended use of conduit and metallic tubing is not recommended because of the liability of moisture accumulating therein.

Concealed wiring may be unprotected, but shall be secured by neat fitting non-ferrous cleats with rounded edges spaced not over 14 in. apart.

Lead sheathed unarmored conductors and conductors armored with spiral wound flat metal stripping are not approved. Conductors armored with metallic basket weave or helical wire, with or without inside lead sheathing, in accordance with the A. I. E. E. Recommended Practice for Electrical Installations on Shipboard, may be used.

*The references in these Regulations are to the 1935 Edition of the National Electrical Code, current at the time of publication of this pamphlet. The 1937 Edition of the National Electrical Code will have a different arrangement and numbering. The following list shows the identifying numbers in the 1937 Code of the 1935 Code paragraphs referred to herein.

1935 N. E. Code	1937 N. E. Code
Section 503	Article 346
Section 504	Article 352
Section 508	Article 348
Section 514	Article 326
Section 602	Chapter 10, Sections 10301 and 10302
Section 609	Chapter 9, Table 19
Section 612	Chapter 9, Table 1

158. (a) Wiring joints and splices shall be mechanically secure. Unless a splice is made by a solderless wire connector, listed by Underwriters' Laboratories, Inc., it shall be thoroughly soldered. Where ends of stranded conductors are to be clamped under terminal screws, they shall be formed and soldered unless fitted with solderless lugs listed by Underwriters' Laboratories, Inc.

(b) Splices, unless provided with insulated wire connectors listed by Underwriters' Laboratories, Inc., shall be first taped with rubber and then with friction tape to afford insulation equivalent to that of the conductors joined.

159. Accessories, such as switches, fuses, and sockets, shall be standard National Electrical Code types for the loads to be carried and shall be of types listed by Underwriters' Laboratories, Inc.

Lighting and power switches and light fixtures in the engine room, forepeak, lazarette and galley (if gas is used for the range) shall be of the explosion proof type. The use of explosion proof switches throughout under deck is recommended.

Junction boxes (instead of junction blocks) and Edison base lamps and sockets (instead of bayonet lock type) are recommended.

Magnetic starting switches, approved for use in hazardous locations, mounted close to the starting motors and explosion-proof starting motors and generators are also recommended.

160. Lightning Protection.

On wooden boats it is recommended that attention be given to protection against lightning damage by grounding vertical projections in general compliance with land practice as recommended by the N.F.P.A. Code for the Protection of Life and Property Against Lightning, pending specific recommendations for marine installations to be promulgated.

170. Lamps and Lanterns.

Gasoline burning lamps and lanterns are not permitted. Oil lamps shall have metal bodies and, except hand lanterns, shall be kept in brackets well secured or suspended and stayed. They shall be secured in the brackets by an efficient device for holding them in place and shall have metal shields over the chimneys. Hand lanterns when suspended shall be

secured by clips or lashings. Kerosene should be carried in an approved receptacle with a tight cover, and this receptacle, and oil burning lamps and lanterns not in service brackets, should be kept in a metal lined locker which is vented to the outside air.

180. Fire Extinguishing Equipment.

181. All hand extinguishers and extinguishing systems shall be on the "List of Inspected Fire Protection Appliances" issued by Underwriters' Laboratories, Inc., and on the approved list of the U. S. Bureau of Marine Inspection and Navigation.

182. CLASSIFICATION:—For purposes of extinguisher application, fires are classed by Underwriters' Laboratories, Inc., as follows:—

CLASS OF FIRE	CLASS OF EXTINGUISHER
A—In ordinary combustible material.	Quenching and cooling.
B—In flammable liquids.	Blanketing, direct smothering.
C—In electrical equipment.	Non-conducting.

The application of various types and sizes of extinguishers is designated by numbers in conjunction with above classification letters which indicate the extinguishing rating relative to an assumed unit; the number 1 indicating that the particular extinguisher is adequate for a whole unit; the number 2, that two extinguishers so rated are required for one unit; and similarly for 3; 4, etc.

The rating of various types and sizes of hand extinguishers may be found in the Regulations of the National Board of Fire Underwriters on First Aid Fire Appliances as recommended by the National Fire Protection Association or Table 1 in the Regulations for Fire Detection, Alarm and Extinguishing Apparatus (N.F.P.A. Proceedings 1935, page 485) and is marked on the label of extinguishers listed by Underwriters' Laboratories, Inc.

183. PROPERTIES:—A description of properties of various extinguishing elements formerly listed by the U. S. Steamboat Inspection Service is reprinted as follows for reference purposes.

FIRE EXTINGUISHERS.

Soda-Acid (*Class A*)

Effect: Primarily quenching and cooling.
Freezing: Requires protection below 32° F.
Dielectric: Low.
Uses: For wood, paper, and fabric fires.
Limitations: Least effective on flammable liquid fires. Dangerous in electrical apparatus.
By-effects: Acid detrimental to fabrics, etc.

Antifreeze (*Class A*)

Chemicals treated to resist freezing.
Otherwise generally same as soda-acid.
Under this classification are calcium-chloride and "loaded stream" types.

Carbon-Tetrachloride (*Class B and C*)

Effect: Becomes fire-smothering gas at 140° F.
Freezing: Nonfreezing above —50° F.
Dielectric: High. Safe at 5,000 volts.
Uses: For fires in electrical apparatus and in confined fires in flammable liquids where burning surface is accessible to stream.
Limitations: Ineffective unless vaporized by heat, and smothering gas quickly dissipates in atmosphere.
By-effects: Gas strangulating, but not toxic. Harmless to fabrics, etc.

Foam (or Froth) (*Class A and B*)

Effect: Smothering by inert gas in foam blanket.
Freezing: Solutions require protection below 32° F. Dry powders unaffected by atmospheric temperatures.
Dielectric: Low.
Uses: For fires in combustible materials and flammable liquids where burning surface is accessible to stream or flow.
Limitations: Dangerous on fires in electrical apparatus.
By-effects: Harmless.

Carbon-Dioxide (Direct) (*Class B and C*)

Effect: Smothering and cooling by inert gas applied direct on flames or into burning compartment.
Freezing: Unaffected by atmospheric temperatures.
Dielectric: High. Equal to air.
Uses: For fires in combustible materials, flammable liquids, and electrical apparatus.
Limitations: Except in confined spaces, smothering gas quickly dissipates in atmosphere.
By-effects: Smothering, but not toxic or strangulating.

Dry Chemical (Expelled by Pressure) (*Class B and C*)

Effect: Smothering.
Freezing: Non-freezing.
Dielectric: High.
Uses: For fires in flammable liquids and electric apparatus.
Limitations: Easily dissipated by drafts.
By-effects: Harmless.

184. INSTALLATION AND UPKEEP:—Portable hand fire extinguishing equipment shall be provided, and fixed extinguishing systems for protection of machinery spaces, bilges and galleys are recommended.

Hand extinguishers and manual controls for systems shall be placed so that they may be readily reached from outside the compartment which they are intended to serve.

Dual manual controls, well separated, are recommended for systems.

Neither free carbon dioxide nor carbon tetrachloride should be discharged into closed compartments occupied by persons, particularly sleeping quarters, as their effects may prove dangerous to life.

Soda-acid and foam extinguishers shall be discharged, cleaned and recharged annually. Carbon tetrachloride type shall be tested at least annually and preferably oftener by partially discharging into a container and replacing the discharge plus any quantity necessary to completely fill. Carbon dioxide type shall be weighed annually and if found lighter than the weight stamped on the cylinder, shall be made tight and recharged.

185. RECOMMENDED HAND EXTINGUISHER EQUIPMENT:—All power boats shall carry not less than two hand extinguishers mounted in accessible but separate locations. On boats having a galley stove, one extinguisher shall be mounted convenient thereto. A table of minimum recommended hand fire equipment and typical locations is given below:

Type of Boat	*Extinguishers*	*Typical Assignments*
Runabouts	2-B2	Driver's and/or passenger pits
Cruisers under 35 ft.	2-B2	Bridge and cabin
Cruisers 36 ft.-45 ft.	3-B2*	Motor compt., bridge and galley
Cruisers 46 ft.-55 ft.	4-B2*	Motor compt., bridge and galley
Cruisers 56 ft.-75 ft.	5-B2*	Motor compt., bridge C.Q. and galley
Cruisers 76 ft.-100 ft.	6-B2*	Motor compt., bridge C.Q. and galley
Sail Auxiliary	2-B2	Motor compt. and galley
Sail only	1-B2	Cabin
Commercial under 30 ft.	2-B2	Motor compt. and pilot house
Commercial 30 ft. and over	4-B2*	Motor compt., pilot house and galley

*Where more than two B-2 units are recommended, the specified extinguishing capacity may be made up of a smaller number of larger units; e.g. three B-1 units may be used instead of six B-2 units.

186. SMOTHERING SYSTEMS:—A fixed carbon dioxide fire smothering system, listed for motor craft by Underwriters' Laboratories, Inc., and installed in accordance with the Regulations of the National Board of Fire Underwriters for Carbon Dioxide Fire Extinguishing Systems as recommended by the National Fire Protection Association insofar as they apply, is recommended for motor and gasoline tank compartments, bilges and galleys. The quantity of gas required for such smothering systems by Underwriters' Laboratories, Inc., is:

Volume of Space (cu. ft. net)	Carbon Dioxide in lbs.
100	7.5
140	10.
220	15.
300	20.
375	25.
500	35.
800	50.
1100	70.
1600	100.

and up to 4500 cu. ft. at the rate of 1 lb. of gas per 18 cu. ft. of space and above 4500 at 1 lb. per 20 cu. ft.

Where bilges are open or communicating to more than one space, such spaces together with bilge shall be considered as one in determining the capacity of the system.

Systems may be manually or automatically operated.

Spaces to be protected by smothering systems should be enclosed and contain only the usual number of ports, companionways and door openings.

Plan of application of smothering systems may be (A) independent systems installed to cover the various spaces required; (B) single system of sufficient capacity for all required spaces simultaneously; (C) single system of sufficient capacity for the largest required space, distributed by direction valves at the controls to other required spaces. (A) and (B) are preferred.