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NATIONAL FIRE PROTECTION ASSOCIATION

60 Batterymarch St., Boston 10, Mass., U.S.A.

# National Fire Protection Association

International

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This is one of a large number of publications on fire safety issued by the Association. All NFPA standards and recommended practices, including this text, are prepared by the technical committees of the NFPA and adopted at an Annual Meeting of the Association. They are intended to prescribe reasonable measures for minimizing losses of life and property by fire.

This text and most other NFPA standards and recommended practices are published in the National Fire Codes, a compilation of NFPA's official technical material, issued in seven clothbound volumes. Full information on the availability of these Codes and other NFPA publications can be secured from the Association.

#### Official NFPA Definitions

Shall is intended to indicate requirements.

Should is intended to indicate recommendations, or that which is advised but not required.

APPROVED refers to approval by the authority having jurisdiction.

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# Marinas and Boatyards

NFPA No. 303 — 1960

The first standard of NFPA on the subject of marinas was adopted by the Association in 1940 on recommendation of the Committee on Boat Basins & Municipal Marinas of the then NFPA Marine Section. That standard, entitled "Recommended Good Practice Requirements for the Location, Construction, and Operation of Marinas," was superseded in 1951 by recommendations, the scope of which had been enlarged to encompass boat service and storage yards. Minor amendments were adopted in 1952 and 1957. This revised edition of the recommendations was prepared by the Committee on Motor Craft and Marinas, endorsed by the Committee on Marine Fire Protection, and adopted by the Association at its 64th annual meeting, May 16-20, 1960.

#### COMMITTEE ON MARINE FIRE PROTECTION

Thomas M. Torrey, Chairman, Insurance Co. of North America, 79 John St., New York 38, N. Y. (Personal)

Charles S. Morgan,† Secretary, National Fire Protection Assn., 60 Batterymarch St., Boston 10, Mass.

- Braxton B. Carr, The American Waterways Operators, Inc.
- Joseph E. Choate, National Assn. of Engine & Boat Mfrs.
- R. Cox, Fire Equipment Manufacturers
- Alan Cumyn, Canada Department of Transport.
- Frank W. Dunham, Jr., American Assn. of Port Authorities.
- F. J. Fee, Jr., National Automatic Sprinkler & Fire Control Assn.
- H. A. Gilbert, American Petroleum Institute.
- Rear Admiral Frank D. Higbee, USCG (ret.) (ex-officio), Chairman, Committee on Harbor Emergency Organization.
- Lewis C. Host (ex-officio), Chairman, Committee on Gas Hazards.
- Rear Admiral H. T. Jewell, U. S. Coast Guard.
- George W. Morgan, Assn. of American Ship Owners.
- Capt. Harry J. Parker, National Cargo Bureau, Inc.
- L. R. Sanford, Shipbuilders' Council of America.

- Rear Admiral H. C. Shepheard, USCG (ret.), Washington 16, D. C. (Personal)
- Earl S. Shulters, U. S. Maritime Administration.
- Vice Adm. Lyndon Spencer, USCG (ret.), Lake Carriers' Assn.
- Spencer T. Stack (ex-officio), Chairman, Committee on Operation of Marine Terminals.
- John M. Techton, Marine Chemists' Assn.
- E. S. Terwilliger (ex-officio), Chairman, Committee on Motor Craft and Mari-
- J. Paul Thompson, U. S. Salvage Assn., Inc.
- J. H. Travers, Pacific American Steamship Assn.

#### Alternates.

- Stanley Beckett, Canada Dept. of Transport. (Alternate to A. Cumyn.)
- James E. Moss, American Petroleum Institute. (Alt. to H. A. Gilbert.)
- Burr Williamson, Fire Equipment Mfrs. Assn. (Alternate to R. Cox.)

<sup>†</sup> Non-voting.

### COMMITTEE ON MOTOR CRAFT AND MARINAS

E. S. Terwilliger, Chairman, Yacht Safety Bureau, 21 West St., New York 6, N. Y.

Jack Bartlow, Internal Combustion Engine Institute.

R. C. Bolling, American Boat & Yacht Council.

Joseph E. Choate, National Assn. of Engine & Boat Manufacturers, Inc.

C. L. Clark,\* Marine Surveyor.

Henry F. Geils,\* Marine Electrical Consultant.

Rodney Gordon, Chubb & Son.

John M. High, U. S. Power Squadrons.

Guy W. Hughes, Outboard Boating Club of America.

Irving D. Jakobson,\* Jakobson Shipyard, Inc.

Wm. Edgar John,\* Wm. Edgar John & Associates.

C. F. Kelley,\* Seaboard Associates, Inc.

George E. Maxwell, American Petroleum Institute.

Wm. E. O'Neil, National Park Service.

Comdr. Wm. R. Sayer, United States Coast Guard.

R. H. Sweeny,\* Marine Office of America.

Wm. F. Watkins, United States Salvage Assn., Inc.

W. N. Zippler,\* Gibbs & Cox, Inc.

### Alternates.

Richard Hanna (Alternate to Jack Bartlow).

Donald I. Reed (Alternate to Guy W. Hughes).

John C. Loeser,\* Marine Surveyor.

<sup>\*</sup> Serving in a personal capacity.

# Fire Protection of Marinas and Boatyards

NFPA No. 303-1960

### INTRODUCTION

The following recommendations are intended to suggest safe practices for areas used for the construction, repair, storage, launching, berthing and fueling of small craft, whether or not operated in conjunction with other facilities, for which other standards are available.

# PART I - FIRE PREVENTION

10. The most effective fight against fire is that carried on to prevent fire. Effective fire prevention requires the consideration of and attention to every potential fire hazard every minute of the day, every day of the year. The magnitude of the fire hazard in any marina or boatyard, irrespective of the physical conditions present or the fire extinguishing equipment provided, depends largely upon operational practices. If managements initiate sound regulations for the conduct of activities, including those of boat owners, and insist on careful adherence to those regulations, the greatest single step will have been taken in the interest of fire safety to life and property.

# 11. GENERAL

- 111. Management and Personnel: It is essential that marina and boatyard owners and managers have a high degree of "fire consciousness." The seriousness with which management plans and follows a fire prevention effort will influence the attitude of all employees and impress the owners of boats using the facilities.
- 112. Access: It is recommended that adequate fencing be provided to prevent access by unauthorized persons to areas not intended for public use. Fencing, when provided, should be arranged suitably to permit access by public fire fighting equipment in an emergency.
- 113. Cleanliness: A systematic procedure for the maintenance of clean premises should be adopted and adhered to.
- (a) Substantial metal waste cans with covers should be provided as receptacles for such materials as oily or soiled waste, rags, and other discarded combustibles. A suitable, non-combustible receptacle of sufficient size may be used in outside areas for discarded rubbish and debris.

- (b) Wood shavings, dust and light wood waste are readily ignited, and should be cleared away daily.
  - (c) Refuse should not be permitted to accumulate.
- (d) High weeds, grass and brush constitute a severe hazard in dry weather and should be destroyed by the application of a suitable weed killer or removed by fire-safe methods. Grass should be moved regularly while green and long cuttings removed.
- (e) Congestion in the storage of combustible equipment and supplies should be avoided.
- (f) A daily inspection of all areas used by the public should be made for the express purpose of eliminating hazardous conditions.
- 114. Smoking: The hazard due to smoking is great, and it must be handled realistically. Complete prohibition of smoking is difficult to enforce. Consequently "NO SMOKING" signs should be posted and rigidly enforced in areas where smoking is dangerous, such as fueling docks or any location where fuel or hazardous liquids are being handled, boat storage sheds, woodworking and paint shops, sail lofts, battery charging rooms, storage and locker rooms.
- 115. Operating Regulations: The enforcement of fire prevention regulations and the maintenance of all fire protection equipment should be a specific responsibility of the marina or yard management. All managements should comply with local laws, regulations and requirements.

### 12. BERTHING FACILITIES

120. Facilities for the berthing or mooring of small craft in commission but not in use are referred to as marinas or boat basins. The following have specific reference to such berthing and mooring facilities.

NOTE: The National Assn. of Engine & Boat Manufacturers has published "Recommendations for Design, Construction and Maintenance of Marinas" and "Boat Handling Equipment in the Modern Marina" which deal with features beyond the scope of these recommendations.

121. Location: The following factors are considered important relative to the area in which marina facilities are located

- (a) The area should be sufficiently extensive to contain the number of piers of proper design and layout to accommodate efficiently the total estimated number of boats to be berthed with enough clear space remaining for turning, entrance and exit operations.
- (b) The area should be under the protection of a municipal fire department with convenient land access by an improved road and good access on the water side to fire boats, workboats, tugs or other craft which might be of assistance in an emergency.
- 122. Design: The berthing facilities should be so designed as to avoid congestion. This requires an entrance and an exit remote from each other, plus enough space between main piers and sufficient width of roadstead for convenient maneuvering. If a separate entrance and exit is not feasible, the single opening should be so located as to be as accessible as possible from all points within the marina and large enough for two lines of boats moving rapidly during emergencies. It is recommended that the space between main piers be not less than twice the over-all length of the largest boat to be berthed. The design should specifically provide:
- (a) Access to all parts for the operation of fire fighting apparatus.
- (b) Access to each boat for emergency removal without the necessity of moving any other boat.
- (c) Adequate means of illumination. This may best be accomplished by a system of electric flood lights providing at least 1/4 foot-candle of light on all piers and walks. Where lights must of necessity be placed on piers, the transformers and meters should be located on the land end.
- (d) Location of marine railways or hoists so that they are adjacent to open water and not partially obstructed by moored or moving boats. These facilities may be vital in an emergency.
- 123. Construction: The variety of fire perils to which active marinas are exposed make it desirable to use as much fire resistive construction as feasible, and it is recommended that applicable provisions of the NFPA "Standard for the Construction and Protection of Piers and Wharves" (NFPA No. 87) be followed.

- (a) Bulkheads and main mooring piers should preferably be of concrete or masonry construction. Where wood construction is employed, adequate separation of main mooring piers is of added importance in order to reduce the fire exposure hazard.
- (b) Except for service piers, ordinary catwalk construction is permissible for mooring piers but a minimum width of 2 feet for catwalks not exceeding 50 feet in length is recommended and where this length is exceeded, the width should not be less than 4 feet to permit easy transfer of wheeled fire fighting equipment.
- (c) As a means of reducing the possibility of spread of fire from one pier to another by oil on the surface of the water, consideration should be given to provision of suitable fire breaks. Their number would depend upon the extent of the berthing area and the number of mooring piers. They may take the form of aprons extending the length of the pier and extending vertically from the pier deck to a point below extreme low water. Additionally, the provision of fire breaks at intervals not exceeding 75 feet, is recommended to prevent the spread of fire along the undersides of piers.

# 13. SPECIAL HAZARDS

- 130. All hazardous materials, liquids, stores and operations should be given particular consideration relative to fire prevention and the availability of fire protection equipment.
- 131. Storage and Handling of Fuels (Gasoline, Light Oils, etc.): The transfer of flammable liquids from one container to another is often accompanied by the liberation of flammable or explosive vapors and the presence of such vapors, diluted in air, normally constitutes the greatest fire hazard.
- (a) The fueling station should be so located as to minimize the exposure of all other plant facilities. Where tide and weather exposure conditions permit, all fuel handling operations should be outside the berthing area.
  - 1. Outside fueling stations, whether stationary or floating, should be so located as to minimize exposure to mooring piers and other property in case of fire or other emergency at the station.
  - 2. Inside fueling stations should be located near an exit opening or other location where, in case of fire on board

a boat alongside, the boat may be quickly removed from the marina without endangering other boats at their berths.

3. Outside berths and connections should be provided for tank barges or fuel supply boats for use when filling fuel storage tanks.

NOTE: Floating fueling stations are subject to the Tank Vessel Regulations of the United States Coast Guard.

- (b) Fuel storage tanks at fuel service stations shall be located only on shore or, with the express permission of the authority having jurisdiction, on a pier of the solid filled type. Approved dispensing units with or without integral pumps may be located on shore, piers of the solid filled type, open piers, or floating docks.
- (c) Fuel storage tanks should be installed in accordance with the Flammable Liquids Code (NFPA No. 30), and in accordance with all state and local ordinances.
- (d) Underground fuel storage tanks should be securely anchored where they are located subject to flooding or tidal conditions, and the applicable precautions outlined in Protection of Tanks Containing Flammable Liquids in Locations That May Be Flooded (NFPA No. 30A), shall be observed.
- (e) Fuel pipelines shall be installed in accordance with the provisions of the "Flammable Liquids Code" (NFPA No. 30).
- (f) "Dispensing units for transferring fuels from storage tanks should be in accordance with provisions of the Flammable Liquids Code (NFPA No. 30). Every fuel delivery nozzle should be equipped with a self-closing control valve, which will shut off the flow of fuel when the operator's hand is removed from the nozzle. The use of any automatic nozzle is prohibited."
- (g) Boat fueling operations should always be carefully accomplished in accordance with Sec. 732 "Fire Protection Standards for Motor Craft," (NFPA No. 302). (See paragraph 169.)
- (h) Gasoline and other flammable liquids stored in drums should be kept separated from other plant facilities, and stored and dispensed in accordance with the applicable requirements of the Flammable Liquids Code (NFPA No. 30).

- (i) Hand carriage of gasoline within the plant area should be restricted to approved safety containers with filling of containers permitted only at the drum. Open buckets or cans should never be used.
- (j) Gasoline should never be used as a cleaner in any part of the premises or on board boats. Only soaps, detergents, and approved solvents should be used.
- (k) Storage of liquefied petroleum gas cylinders, whether charged or empty should be isolated in an open shed or an outside area and be in accordance with Division V of the Standards on Liquefied Petroleum Gases (NFPA No. 58).
- 132. Storage and Handling of Paints and Spirits: These liquids have high inherent flammability and require careful storage and handling.
- (a) A building, preferably of non-combustible or fire resistive construction well separated from other working and storage areas, should be provided for the storage and mixing of paints. If this is not feasible, a room within a building should be effectively partitioned from the rest of the building for paint storage and mixing.
- (b) Only quantities of paint as required should be permitted on the job.
- **133.** Lumber Storage: Flame spread is often rapid in fires involving stored lumber where adequate precautions are not taken. Some basic considerations are:
- (a) Main stocks of lumber should be stored in a specifically segregated area, whether outside or in a separated shed.
- (b) Piles should be neatly stacked, and wide aisles maintained between individual piles to permit access and to prevent spread of fire.
- (c) Particular care should be taken to maintain a clean ground surface free of debris, long grass, weeds, etc.
- 134. Heating: Heating equipment which is defective, improperly installed, or misused is a serious fire hazard. The following recommendations are therefore of particular importance:

The National Electrical Code provides basic standards to be observed in the design, selection and installation of electrical wiring and equipment. The recommendations set forth herein supplement and relate the requirements of the National Electrical Code to the specific hazards and combinations of hazards found in marinas, boatyards, boat basins and establishments of similar type.

- 141. General: All electrical wiring, conduit, enclosures and equipment, and the provision of circuit protective devices, shall conform to the applicable requirements of the National Electrical Code and to the applicable requirements of this standard.
- 142. Power Supply: Incoming power supply from a public utility system shall be designed and installed in relation to the calculated demand load.
- (a) Primary service feeders shall be supported on poles or structures reserved for that purpose.
- (b) In multi-phase power supply facilities particular care shall be taken to arrange for equally balanced phase loads to the extent possible.
- (c) Primary power, when introduced in excess of 250 volts, shall be transformed to reduce the private system to not in excess of 250 volts.
- (d) Transformers shall be installed, when located within the private property area, in compliance with the requirements of Article 450, National Electrical Code; with the additional requirement that all transformers reducing the voltage of the main power supply shall be located above the level of possible flooding by abnormally high water.
- (e) Main service equipment, including service disconnecting equipment, meters and associated equipment and main panel shall not be mounted on, or attached to walls or other parts of structures which are not of fire-resistive construction. If installed outdoors it shall be suitably protected from the weather; located above the level of possible flooding by abnormally high water and protected against access by unauthorized persons. In other respects the main service installation shall conform to the requirements of Article 230, National Electrical Code.
- (f) When auxiliary stand-by power supply equipment is provided and driven by an internal combustion engine, it,

shall be separately housed in a ventilated fire-resistive structure located above the level of possible flooding by abnormally high water and containing only the auxiliary power unit and the necessary controls for the engine. Interior lighting shall be connected to the public utility circuit with a standard battery powered emergency lighting fixture permanently installed. The fuel supply tank or tanks for this equipment shall be located outside of the structure, and shall fully comply with the requirements of this standard related to the storage and handling of flammable liquid fuels.

- (g) The transfer switch for use in connecting an auxiliary emergency generator to the selected load circuits shall be a manually operated double throw switch, with wiring arranged to disconnect the selected circuits from the normal power source before the auxiliary source is connected to these circuits, and shall be of proper rating to make and break the full load current for all the selected circuits. The transfer switch shall be mounted on the exterior of the structure containing the auxiliary power generating equipment, within a cast metal enclosure having a gasketed cover and an external operating handle arranged to be locked in either position. Wiring connections to the transfer switch shall be made through full weight rigid metal conduit threaded into the enclosure, which shall be adequately grounded. The transfer switch installation shall otherwise comply with the requirements of Section 373–2, National Electrical Code.
- 143. Grounding: Effective grounding of all non-current-carrying metal parts of the electrical system, and provision of suitable equipment-grounding facilities at all outlets provided for the connection of portable equipment, including outlets provided for the connection of shore power to vessels afloat, are of utmost importance in marinas, boatyards, boat basins and similar establishments. This is due to the exposure of electrical systems and equipment to water, damp or wet earth and to other grounded or partially grounded conductive parts and the consequent danger to life and possibility of high energy sparking adjacent to combustible materials.
- (a) The means and methods of providing an effective ground to the non-current-carrying metal parts of the electrical system, and for equipment and portable appliances connected thereto, shall comply with the requirements of

- Article 250, National Electrical Code. The alternate means of protection as described in Section 250–1, National Electrical Code, shall not be accepted as a substitute for the complete grounding requirements as provided herein, in marinas, boatyards, boat basins, and similar establishments.
- (b) The partial or complete burial of a metal enclosure in earth shall not be accepted as a substitute for the grounding requirements as provided herein with respect to such enclosure.
- (c) It is recommended that an anode of suitable material and capacity be suspended in the water in any slip or berthing space where metal hulls are stored or berthed and shall be connected to the equipment ground conductor of the electrical system.
- 144. Damp or Wet Locations: Due to the many areas of marinas, boatyards, boat basins and similar establishments which consist of sheds or shed-like structures having large openings exposed to the weather and to flying spray and atmospheric moisture, the continuous danger of abnormally high water and the extension of electrical sytems into exposed areas in direct contact with water, wet or damp atmosphere, all areas of a marina, boatyard, boat basin or similar establishment which are subject to tidal flooding or submersion, shall, for the purposes of this standard, be considered "Wet Locations" as defined in Article 100, National Electrical Code. Other areas shall be considered "Damp Locations" as defined in that Code. Exceptions are such buildings and structures as are so constructed and used as to be normally sealed against the weather by standard doors and windows and located above tidal flooding.
- (a) The entire electrical system shall be of weather-proof or watertight design as defined in Article 100, National Electrical Code, subject to location considerations as required above. To provide the best possible assurance that water or moisture will not enter conduits, boxes or enclosures only full weight rigid metallic conduit, enclosures and boxes of cast metal with threaded conduit connections and cast metal gasketed covers shall be used except that where there is need for continuous flexibility the use of non-metallic sheathed cable, Type NMC will be permitted. At the point of entrance of Type NMC cable into boxes and enclosures protection against the entrance of water or moisture shall be provided by the use of packed glands or ter-

minal tubes of marine types. Boxes and enclosures of non-metallic type, and those having knock-out type conduit entrances shall not be used.

- (b) Metal parts such as conduit, boxes, enclosures, hangers, straps, screws, etc., shall be of corrosion resistant materials or shall be protected against corrosion by corrosion resistant materials. In locations exposed to immersion in salt water or to salt water spray the metal parts shall be of brass or bronze. Where practicable, the use of dissimilar metals anywhere in the system, in contact with each other, shall be avoided to eliminate the possibility of galvanic action.
- (c) Switches, circuit breakers and panels shall be enclosed in cast metal housings with cast metal gasketed covers provided with external operating handles, and shall be installed in conformity with the requirements of Section 373-2, National Electrical Code.
- (d) Overcurrent protection equipment shall be provided by the use of circuit breakers instead of fuses to avoid the difficulty of fuse replacement in gasketed enclosures.
- (e) Lighting fixtures shall conform to the requirements of Section 410–4 and Section 410–5, National Electrical Code and additionally shall be located to prevent damage by contact with stored or moving material.
- (f) Receptacles installed for the purpose of attachment of portable equipment or appliances, including receptacles to be used for providing shore power to vessels afloat, and rated not in excess of 20 amperes at 150 volts, shall be of the grounding type conforming to Sections 410–54 and 410–55, National Electrical Code. Attachment plugs for use with such receptacles shall conform to the requirements of Section 410–56, National Electrical Code.
- (g) Receptacles installed for the purpose of attachment of portable equipment or appliances, including receptacles to be used for providing shore power to vessels afloat, and rated in excess of 20 amperes, shall be rated specifically for the required current. Such receptacles shall have, in addition to the current carrying contacts, an extra grounding contact so arranged that the matching attachment plug can enter the receptacles only in a manner to connect the grounding contacts of the plug and receptacles and not otherwise.

- (h) All receptacles installed in Wet Locations shall be enclosed in cast metal housings having cast metal gasketed covers, arranged with a threaded metal cap to close the receptacle opening. The cap shall be attached to the enclosure by a substantial link type chain or by a permanent arm. The use of self draining enclosures arranged with conduit connection at the top is recommended. The threaded cap is to be put in place and maintained tight whenever the receptacle is not in use.
- (i) Attachment plugs for use with receptacle outlets rated in excess of 20 amperes shall be equipped with threaded metal collars to engage the threaded opening of receptacle enclosures to close the receptacle opening when the plug is inserted into the receptacle.
- (j) Portable cords used in Wet Locations shall be either Type SO or Type ST, rated as water resistant by Underwriters' Laboratories, Inc. with conductors not smaller than No. 14, and including an equipment ground conductor in addition to the current-carrying conductors. The equipment ground conductor in each portable cord used in a Wet Location shall be attached to the grounding pin of the attachment plug and shall be arranged at the other end of the portable cord for attachment by a screw or bolt to any metallic housing or other exposed non-current carrying metal part of the appliance or equipment which is to receive power through the portable cord. The required connection of the equipment ground conductor to the exposed metal part or parts of the equipment to be served by the portable cord shall be made before the attachment plug is inserted into the receptacle.
- (k) Shore power connections to vessels afloat shall be protected by a circuit breaker located at and protecting that outlet only and which is calibrated to trip at 20 amperes or less.
- (l) It is recommended that the portable cord used to connect a shore outlet to a vessel be provided by the management of the shore facility and shall be of the type required by these standards and having a jacket of distinctive color for safety.
- 145. Wiring: As there are usually several buildings in addition to extensive outdoor locations to which electrical service for power and lighting must be extended in marinas, boat-

yards, boat basins and similar establishments, it is recommended that to the extent possible, wiring be installed underground in manner conforming to the requirements of Sections 300-7 and 310-6, National Electrical Code.

(a) Should it be found impractical to install all wiring underground, overhead wiring construction should be thoughtfully arranged to avoid possibility of contact with equipment or vessels when being moved through the yard. Minimum clearances shall be provided as follows:

Above open areas: 18 feet above grade.
Above buildings: 8 feet above highest point of roof.
Above roadways or driveways leading to vessel storage areas: a minimum of 18 feet and at least 3 feet, 6 inches above the maximum height of any moving equipment in use in the yard.

Proper warning signs shall be placed in suitable locations to warn operators of moving equipment, boat carriers, etc., of the wire clearance to be encountered.

- (b) Metal poles, lighting standards and other metal supports which carry or enclose electrical wiring shall be effectively grounded.
- (c) Overhead wiring of branch circuits and feeders shall be installed in a manner to fully comply with the requirements of Article 730, National Electrical Code except that clearances shall conform to those required by this standard instead of those required by Section 730-19, National Electrical Code.
- (d) Wiring on piers, wharves and bulkheads, permanently supported by driven piles or other solid foundations shall be installed to conform to the requirements of this standard for Wet Locations. Attachment of electrical conduit and equipment shall be made to permanent structural members of such structures.
- (e) Wiring on piers constructed of a series of floating sections shall be of the flexible cable type containing the necessary number of properly sized conductors including an adequate equipment grounding conductor of gauge not less than the current carrying conductors. The cable shall be not less than No. 8 AWG Type SO or ST with RW or TW grade insulation UL labelled and jacket marked "Water Resistant" Types SO or ST bearing US Bureau of Mines Listing number conforming to Flame Resistant requirements of that bureau. Where the cable passes through structural members of the floating sections of the pier, or is

otherwise subject to abrasion or chafing, it shall be protected by a sleeve of heavy rubber or Neoprene permanently attached to the structure.

- 1. To avoid long runs of cables (on floating piers) which contain a multiplicity of conductors, it is recommended that such cables be considered as feeders and branch circuits be taken off at junction boxes to provide service to shore power receptacle outlets and to float or pier lighting fixtures and equipped with overcurrent protection at the location of the equipment served by the branch cricuit.
- 2. A cast metal junction box with a cast metal gasketed cover and containing the required number of properly sized and arranged terminals shall be installed on each individual floating section. The point of entrance of the cable into each junction box shall be protected by a marine type gland or terminal tube, threaded into the wall of the junction box and packed to prevent entrance of water or moisture into the box. The conductors shall be fitted with proper terminal lugs and the equipment ground conductor shall be attached by a suitable screw or bolt to the interior of each junction box.
- 3. The cable connection from shore to a floating pier shall be arranged with sufficient slack, properly located and supported, to accommodate pier movement due to waves, traffic on the pier and tidal action. Arrangements shall be provided to prevent vessels and other floating objects from making contact with the cable.
- 146. Hazardous Locations: There are usually several locations in each marina, boatyard, boat basin and similar establishment which, by reason of the use and occupancy, must be equipped electrically in manner specified in the appropriate sections of Article 500, National Electrical Code. Additionally, due to the fact that such hazardous locations often combine additional environmental conditions causing them to be also classed as Wet Locations, considerable thought and effort should be devoted to the design, selection and installation of electrical facilities in such locations to assure maximum safety.
- (a) Only qualified persons, as defined in Article 100, National Electrical Code, shall be permitted to use, handle, install or repair electrical systems or facilities within any area classed as "hazardous."

- (b) Fuel storage and dispensing stations constitute a major hazard and shall be constructed and arranged as provided elsewhere herein. When located indoors the electrical system and equipment shall conform to the requirements of Article 500, National Electrical Code; when located outdoors an area within 20 feet in all directions from the limits of the fuel storage or dispensing equipment shall be considered a hazardous area and the same requirements as related to indoor locations shall apply.
  - 1. Only the electrical equipment and wiring necessary for the handling and dispensing of the fuels shall be installed within the hazardous area at any outdoor storage or dispensing station. Lighting fixtures for such locations, and the switches controlling shall be located beyond the hazardous area.
  - 2. The equipment ground wire of the electrical system, or other approved ground connection, shall be arranged to extend adequate grounding protection to the metal nozzle of each fuel dispensing apparatus.
  - 3. Wiring within the hazardous area where gasoline or other fuels are stored, pumped or dispensed shall be of the UL-rated gasoline and oil resistant type (nylon jacket type TW) in conduit.
  - 4. There shall be no shore power receptacle outlet located within any hazardous area. Vessels shall remain at fueling stations only long enough to take on required fuel; repair operations or berthing for any purpose other than loading fuel shall be forbidden within any hazardous area. Suitable signs, stating this restriction shall be prominently displayed at all fuel dispensing stations.
- (c) The storage of lacquers, solvents, paints, varnishes and alcohol, when in sealed containers shall not cause the area of such storage to be classed as "hazardous." Areas wherein such volatile and flammable materials are dispensed, mixed or used shall be considered Hazardous Locations and the electrical wiring and equipment therein shall conform to the requirements of Article 500, National Electrical Code, for Class I, Group D, Division 1 atmospheres.
- (d) Where Class I Hazardous Areas, as described in Article 500, National Electrical Code, exist on piers served by non-metallic sheathed cable necessary for flexibility,

entrances of the cable into boxes and enclosures by such cable shall be protected by the use of standard approved Class I sealing fittings, with approved packing and compound, located next to the box or enclosure, in addition to the marine type gland or terminal tube required for wet locations as described elsewhere in this standard which gland or terminal tube shall be threaded into the Class I sealing fitting and the Class I sealing fitting shall be threaded into the box or enclosure.

- (e) The application of paint, lacquer, varnish or other similar types of volatile or flammable materials, by spray method, when done indoors, shall be restricted to a properly constructed spray booth in which the electrical wiring and equipment shall conform to the requirements of Article 516, National Electrical Code. When these operations are performed outdoors, they should be performed only in an area reserved for that purpose, containing no property of value except that upon which the work is being performed; containing no combustible materials except those necessary for the work being done, and containing no electrical equipment except that which is necessary for the required spray operation, which shall be of the type approved for Class I Hazardous Locations.
- 147. Marine Hoists, Railways, Cranes and Monorails: Motors and controls for marine hoists and railways shall be located above the possibility of flooding by abnormally high water. Wiring and equipment located in an area described herein as a Wet Location shall conform to the requirements of this standard for such locations.
- (a) Where cranes or monorails are installed inside of buildings for hoisting or transporting vessels or heavy equipment, the power for electrified crane bridges and for electrified hoists shall be supplied by a system of enclosed trolley busway of the required ampere rating, located parallel to the crane track or monorail and above the level of possible flooding by abnormally high water. The use of open wire conductors or of cable reels for supplying power to any hoist or motor operated on a crane or monorail is prohibited. The trolley busway system shall be of metal enclosed type, with the enclosure properly grounded as described elsewhere herein and protected by over-current devices as required by Sections 610–41 and 610–42, National Electrical Code. The insulating members of the trolley busway system, including

those in the trolleys shall be of non-moisture absorbing materials, or treated to prevent moisture absorption, and shall be arc-resistant.

- (b) Where it is necessary to provide electric power to a mobile crane or hoist in the yard, and a trailing cable is involved, it shall consist of the parallel Type W cable with a jacket of distinctive color for safety.
- 148. Circuit Breakers For Use in Outdoor Locations: Circuit breakers having a trip rating of not in excess of 50 amperes, and installed outdoors in cast metal housings with gasketed covers, in locations exposed to the direct rays of the sun, shall be of the fully magnetic type with no thermally operated elements.
- 149. Tests: On completion of the installation of the electrical system it shall be subjected to an insulation test in the presence of the representative of the authority having jurisdiction. The test shall meet the requirements of Section 110-19, National Electrical Code.

# 15. MAINTENANCE OF ELECTRICAL WIRING AND EQUIPMENT

- 150. It is recommended that a complete monthly inspection of all electrical wiring, conduit, hangers, supports, connections, outlets, appliances, devices and portable cords installed or used in a marina, boatyard, boat basin or similar establishment be made by an assigned representative of the management. The general conditions of use of electrical equipment and the atmospheric conditions contribute to unusual wear and tear as well as rapid corrosion of exposed metal parts. All corroded, worn, broken or improper materials should be replaced or repaired immediately. The use of tape to repair broken or cracked insulation or sheathing on portable cords should not be tolerated. The inspection should take particular notice of the conditions noted below:
- (a) Areas being used for purposes not originally contemplated and which introduce hazards greater than those for which the electrical system was designed.
  - (b) Locked areas or equipment being left open.
- (c) The use of portable electrical equipment which is not properly and adequately grounded as required by this standard. Special attention to be given to portable cords

used by vessels for connection to shore power outlets. Such cords should meet the requirements of this standard and should not be permitted to lie on or across pier walkways or to trail into the water.

- (d) Portable cords used for permanent wiring.
- (e) Damaged or inoperative switches, lighting fixtures and receptacle outlets.
- (f) Receptacle outlets on which closure caps have been left off when the receptacle is not in use.
  - (g) Overloading of electrical circuits.
- (h) The use of "jumpers" between special types of receptacles and common connectors which defeats the purpose for which special receptacles were installed.
- (i) The introduction into Hazardous Areas of unsuitable appliances.

### 16. OPERATIONAL HAZARDS

- 161. Conditions on Individual Boats: Boats are received in various conditions of maintenance and cleanliness. This, coupled with the repairing, servicing, and storing boats, greatly influences the degree of fire peril.
- (a) Unless familiar with conditions on board, the management should have an inspection made of boats received for repair, servicing, or storage. This should be accomplished as soon as practicable after arrival of a boat and before commencement of any work aboard. The inspection should determine:
  - 1. Presence of combustible vapors in any compartment.
  - 2. General maintenance and cleanliness, and location of any combustible materials which require removal or protection for the safe accomplishment of the particular work involved.
  - 3. Quantity, type, and apparent condition of fire extinguishing equipment on board.

The resulting information, along with directions covering necessary precautions, should be made known to the employees responsible for accomplishing the servicing work, and if warranted, any basically unsafe conditions and desirable corrections should be discussed with the boat owner.

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- (b) The following are recommended general precautions for improving on-board conditions relative to the accomplishment of repair work:
  - 1. Smoking in the working area should be prohibited.
  - 2. Loose combustibles in way of any hazardous work should be removed.
  - 3. Unprotected battery terminals should be suitably covered to prevent inadvertent shorting from dropped tools or otherwise. The ungrounded battery lead should be disconnected.
  - 4. Only experienced personnel should be employed in the removal or installation of storage batteries.
  - 5. Protective coverings or shields, used to protect engines, accessories or combustibles, should be of fire resistant materials.
  - 6. Precautions recommended elsewhere herein for specific kinds of work should be followed.
- 162. Paint Removing and Painting: Paint removing operations, the preparation of surfaces for refinishing and painting, involve marked fire hazards which require the practice of effective precautions. The following are among the more important precautions:
- (a) The process of paint removal by burning with a blow torch involves an inherent and obvious hazard and is not recommended, nor is the use of paint removers which contain flammable liquids or solvents. It is recognized, however, that removal of some coatings necessitates use of these methods, and if used, such methods should be confined to exterior surfaces of boats. Under no circumstances should such methods be used within sheds or in close proximity to other craft. All fuel tank vents should be effectively plugged before burning off is commenced, and plugs removed immediately upon completion of burning operations. Only trained yard personnel should be permitted to handle blow torch paint removing operations.
- (b) Recommended methods for removing paint include scraping, machine and hand sanding, wire brushing, and the use of non-flammable removers.
- (c) Hand painting in the open involves little hazard as flammable vapors in sufficient density are not likely to accu-

mulate, but painting in boat interiors or in shops requires good ventilation.

- (d) No open flame or the operation of spark producing equipment of any kind should be permitted where painting, sanding, scraping or wire brushing work is performed in confined areas, such as boat interiors.
- (e) Where flammable vapors might exist, portable electric lamps should be equipped with guards and outer globes as recommended by the National Electrical Code, Article 500.
- (f) An adequate supply of fire extinguishing equipment should be quickly available to all areas where painting or refinishing is in process.

NOTE: For additional information see "Standard for Spray Finishing Using Flammable Materials." (NFPA No. 33)

- 163. Welding, Brazing, Soldering, and Cutting: Considerable fire hazard exists whether welding is accomplished by gas or electric arc methods. Metal cutting by flame is perhaps even more hazardous in that sparks are more numerous and are scattered greater distances from the work. The following recommendations are particularly important:
- (a) These operations should be restricted to a shop specifically provided for the purpose or in an open area. Such a shop should be of non-combustible or fire-resistive construction including its flooring, and all combustibles should be kept well away from the shop or area.
- (b) Only experienced personnel should be permitted to handle welding, brazing, soldering, and cutting work.
- (c) When welding or cutting in or on a boat, the following precautions should be taken:
  - 1. Where practicable, all combustible materials in way of hazardous repair work should be moved to a safe location aboard or ashore. Temporary protective coverings, such as tarpaulins, should be used to protect combustible materials which cannot be moved, and these coverings should be of either non-combustible material or be properly flame-proofed.
  - 2. The area should be absolutely free of combustible vapor, and flammable liquids.

- 3. All openings such as hatches, ports, tank openings, etc., through which sparks might pass, should be protected.
- 4. Non-combustible tarpaulins, properly flame-proofed tarpaulins or metal shields should be set around the work in process to restrict the travel of sparks.
- 5. Careful check should be made of conditions on the opposite side of decks or bulkheads for the possibility of damage by heat or fire before welding or cutting is commenced on them.
- (d) Neither welding nor cutting processes should be attempted on a fuel tank unless one of the following provisions has been complied with:
  - 1. The tank has been freed of flammable vapor or inerted in accordance with NFPA "Standards for the Control of Gas Hazards on Vessels to be Repaired" (NFPA No. 306) and a certificate obtained from a Certificated Gas Chemist\*.
  - 2. The tank has been cleaned or otherwise safeguarded in accordance with NFPA "Standard Procedures for Cleaning or Safeguarding Small Tanks and Containers" (NFPA No. 327).
- (e) All welding and cutting equipment should be maintained in the best possible condition. Oxy-acetylene hose should be neatly coiled and stored in a cool location, free from grease, oil, etc. Spare gas cylinders should be limited to five or less and be kept in a well ventilated locker. Electric welding equipment should conform to the provisions of Paragraph 124 of the National Electrical Code.
- (f) Wherever welding or cutting operations are in process, adequate fire extinguishing equipment should be at hand.

NOTE: For additional information, see NFPA pamphlets "Preventing Cutting and Welding Fires" and "Sparks Astray."

<sup>\*</sup> The holder of a valid certificate issued by the American Bureau of Shipping establishing him as a person qualified to determine whether repairs and alterations which may involve gas hazards, can be undertaken with safety.

- 164. Woodworking: Improper arrangement of equipment and machinery in congested areas causes accumulations of sawdust, shavings, and wood waste which constitute hazards frequently neglected. The following safety precautions are recommended:
- (a) Good housekeeping is essential. Waste and refuse should be removed daily.
- (b) Care should be taken to prevent the accumulation of dust anywhere. Damp sawdust conducts electricity and should be removed from electrical equipment, switches, etc. Dry dust is easily ignited and is a potential flash fire hazard.
- (c) Installation of blowers for automatic conduction of sawdust and shavings from saws and planers is strongly recommended. The NFPA "Standards for Blower and Exhaust Systems" (NFPA No. 91), should be consulted on this subject.
- (d) Machines should never be left unattended while in operation.
- (e) The area provided to accommodate boats undergoing repair should be large enough to permit free access all around and under them. A check should be made of any boat in this area to make certain it is free of explosive vapors or other hazards.
- (f) All volatile liquids required should be kept to a minimum and handled in safety cans.
- (g) A liberal supply of appropriate first aid fire extinguishing equipment should be distributed so that units are handy from any point of shops or repair areas.
- **165. Machine Work:** Sparks from work in process combined with combustible accumulations in metal dusts, cuttings, borings, etc., are hazards.
- (a) It is recommended that the machine shop be housed in a separate noncombustible or fire-resistive building.
- (b) If the machine shop is located in a building housing other shops, *e.g.*, woodworking, it should be effectively partitioned, preferably by a fire wall. It is important that dust or shavings from such shops as the woodworking be prevented from drifting into the machine shop.
- (c) The continuous maintenance of cleanliness, and of machines and motors in good repair is essential.

- (d) All flammable liquids required should be kept to a minimum and handled in approved safety cans.
- (e) Engine test stands should be segregated from other shop activities. Such stands should be located in a separate building or in a cut-off area near an exterior wall to permit a short, direct exhaust system and external location of fuel supplies. The exhaust piping and silencing equipment should be suitably lagged with a clearance of at least 30 inches from all woodwork, and the system should include suitable provisions against the emission of sparks.
  - 1. Fuel supply tanks for diesel oil or gasoline should be located outside of buildings and well separated from engine exhaust discharge. Fuel feed lines from tanks to bed should be installed in accordance with good practice and be equipped with stop valves at tank and at stand. Extreme care should be taken to be certain the fuel systems are always grounded. Use of approved flexible fuel line connectors at engine bed end of fuel feed lines is recommended. Gravity flow of fuel from exterior tanks to test stands is not recommended.
  - 2. The engine test stand equipment should include a permanent engine cooling system which can be adjusted to meet the requirements of various engine types.
- (f) Liberal provisions of fire extinguishing equipment for Class B and C fires is recommended. (See Part II.)
- 166. Battery Service and Storage: Hydrogen gas liberated from storage batteries constitutes both a fire and an explosion hazard. The following precautions are therefore recommended:
- (a) A separate room, or properly enclosed space shall be provided for battery charging operations. The area shall be reserved for that use only and shall not contain other materials.
  - 1. Ventilation of the battery room is vital. Air inlets at, or below, the level of the battery racks with adequate exhausts at ceiling, are required. A vent stack equipped with natural draft exhaust head to aid in providing an upward draft is desirable.
- (b) The room and the electrical system and equipment within it shall conform to the requirements of Sections 503–15 and 511–7, National Electrical Code.

- (c) Battery chargers used should have separate control switches. A master switch should control all chargers.
- (d) Charging equipment must be well secured, protected from physical damage and so located as to permit good ventilation all around it.
- (e) Racks for storing and charging use should be substantial, suitably insulated, reasonably open and permit the setting of batteries so that no pockets, in which gases might accumulate, can be formed.
- (f) Use of insulated tools and battery clips equipped with rubber cuffs to prevent short circuits is recommended.
- (g) All battery servicing work should be accomplished by experienced personnel only. The following specific precautions should be followed:
  - 1. Smoking should be prohibited in the battery room.
  - 2. No open flame or spark producing work should be undertaken in the battery room.
  - 3. No volatile liquids should be stored or used in the battery room.
  - 4. Cell caps should be kept tight while connecting or disconnecting batteries.
  - 5. Battery tongs or other appropriate carrying devices should be used when removing or lifting batteries.
  - 6. Leads should never be connected or disconnected if power is being supplied to or released by batteries.
- (h) Suitable first aid fire extinguishing equipment, preferably automatic, should be provided in battery rooms.
- 167. Servicing Liquefied Petroleum Gas Systems: The extreme care necessary to safe operations involving gasoline is also essential with liquefied petroleum gases.
- (a) Changing of cylinders should be performed in accordance with Paragraph 742(c) of "Fire Protection Standard for Motor Craft." (NFPA No. 302)
- (b) Checks for leaks in liquefied petroleum gas systems must never be made with flame. Use of liquid detergent or soapy water solution is recommended.

NOTE: For further information, see "Standard on Liquefied Petroleum Gases." (NFPA No. 58)

- 168. Boat Storage: Fire prevention, relative to boats in storage, should be considered as consisting of two basic parts; namely, that relative to conditions within boats and that relative to the storage facilities.
- (a) It is imperative that hazardous conditions within boats be detected and corrected.
  - 1. All loose combustibles should be removed and stored in suitable lockers or segregated areas as desirable.
  - 2. Liquefied petroleum gas cylinders, alcohol or kerosene from galley fuel tanks and any reserve fuel supplies for the galley should be removed.
  - 3. Batteries should be removed.
  - 4. If fuel is removed from tanks, fuel lines, and accessories, this operation must be conducted with due regard to the hazards involved. If facilities or personnel are not adequate for the safe handling of this work, it should not be undertaken. In any event, stop valves at tanks should be tightly closed.
  - 5. Managements should see that extreme care is taken to check tanks and fuel systems for leaks.
  - 6. Good ventilation should be provided for hulls, especially bilges.
- (b) Boats in storage should be placed in such a manner as to provide good access to each. Subject to control by the physical features of sheds, wet basin's or outside areas, the grouping of boats is recommended with minimum open spaces of 3 feet between boats at deck and passages wide enough to permit movement of fire equipment between groups.
  - 1. Smoking should be prohibited in storage sheds and within boats.
  - 2. Covers placed over boats stored in the open should be properly flame-proofed. Sheet metal, canvas treated with fire retardant or wood similarly treated is recommended. The use of untreated canvas for this purpose is hazardous practice.
  - 3. Suitable lockers or facilities should be provided for boat gear, with care exercised to see that no items subject to spontaneous ignition are included, such as oil skin clothing, etc.

- 4. Ground, floor surfaces, and boat cradles should be kept free of combustible rubbish.
- 5. No flammable liquids or materials should be stored in boat storage areas.
- 6. Shore electrical power should be disconnected whenever boats are unattended.
- (c) Printed regulations, boat storage agreements, etc., should include specific references to the permissible activities of boat owners, boat crews, or independently hired outside contractors within the premises. Items recommended for inclusion in such regulations follow:
  - 1. Designation of areas where smoking is permissible and strict prohibition of smoking aboard boats in storage or in storage sheds.
  - 2. Prohibition of the use of portable open flame heaters on board stored boats.
  - 3. Restriction of paint removing work by other than employees to non-hazardous methods.
  - 4. Restriction on work performed by other than employees to daylight hours, preferably the regular operating hours or such times as employees are present.
  - 5. Prohibition of the use of flammable liquids for cleaning.
  - 6. Prohibition against living aboard boats in dry storage.
  - 7. Specific request for cooperation in the maintenance of general cleanliness throughout the premises.
- 169. Fueling Boats: Specific attention is called to Section 11 and Paragraph 131.
- (a) No tank barge or other supply boat should be permitted within the berthing area.
- (b) All boat fueling operations should be carefully accomplished in accordance with Section 732, "Fire Protection Standard for Motor Craft" (NFPA No. 302) as quoted below:
  - "732. Utmost care shall be exercised during fueling operations.
  - (a) Fueling should never be undertaken at night except under well lighted conditions.

- (b) During fueling operations, smoking shall be forbidden on board or anywhere nearby.
- (c) Before opening tanks the following precautions shall be observed:
  - 1. All engines, motors, fans shall be shut down.
  - Galley stoves shall be extinguished. (Coal fires shall be banked.)
  - 3. All ports, windows, doors and hatches shall be closed.
  - 4. Quantity of fuel to be taken aboard shall be determined in advance of fueling operations.
- (d) The fuel delivery nozzle shall be put in contact with the fill pipe before the flow of fuel is commenced and this contact shall be continuously maintained until the flow has stopped. There is a serious hazard from static discharge unless this rule is observed.
- (e) Tanks shall not be completely filled. Allow a minimum of 2 per cent of tank space for expansion. This space allowance should be 6 per cent if the fuel being taken aboard is 32° F. or below in temperature.
- (f) After fuel flow has stopped:
  - 1. Fill cap shall be tightly secured.
  - 2. Any spillage whatsoever shall be wiped up completely.
  - 3. Entire boat shall be opened and allowed to ventilate for at least five minutes before starting any engines or lighting galley fires."
- (c) Fueling from cans should be prohibited at berths, but may be permitted at the fueling station.
- (d) The use of approved portable filling buggies at fueling stations is permissible.

# PART II — FIRE PROTECTION

20. Despite the most careful vigilance and effort, fire has many opportunities to strike active boat servicing establishments. Woodworking, paint removing and spraying, welding and cutting, handling gasoline and other highly flammable liquids, etc., are all continuing operations, and all are extra hazardous. Further, the facilities are frequently in locations quite isolated from public protection. Hence, the selection, location and maintenance of the proper type of fire fighting equipment is essential.

- 201. Classification of Fires: For all practical purposes there are three general classes of fires. Marinas and boat-yards are exposed to all three.
  - Class A fires, defined as fires in ordinary combustible materials such as wood, cloth and paper where the "quenching-cooling" effect of quantities of water or solutions containing large percentages of water is most effective in reducing the temperature of the burning material below the ignition temperature and is, therefore, of first importance.
  - Class B fires, defined as fires in flammable petroleum products or other flammable liquids, greases, etc. where the "blanketing-smothering" effect of oxygen-excluding media is most effective. Among the extinguishing agents for Class B fires are carbon dioxide, dry chemical, and foam.
  - Class C fires, defined as fires involving electrical equipment where the electrical nonconductivity of the extinguishing media is of first importance. Among the extinguishing agents for Class C fires are carbon dioxide and dry chemical.

### 21. PRIVATE FIRE PROTECTION

Immediate transmission of an alarm to the municipal fire department upon the first discovery of a fire should be a basic rule. Then make the most prompt and effective use of the equipment at hand.

- 211. Analysis of Hazards: The means and methods desirable for adequate first aid fire protection will vary considerably for individual boat servicing establishments. Factors which should influence the type and extinguishing power of fire fighting equipment selected include:
  - 1. life and property values at risk
  - 2. class, rapidity of spread, and intensity of fire anticipated
  - 3. accessibility of area to be protected
  - 4. temperature to which fire equipment may be exposed
  - 5. time interval between transmission of alarm and arrival of public fire department.
- 212. Division of Plant into Fire Protection Areas: Due to the extreme variation of hazards present in the course of operations, it is recommended that a layout plan be prepared and maintained. This plan should be used to determine the fire protection required by the various separated working areas. The plan should be descriptive and include:

- 1. area, type of construction, usage, sub-division and spacing of all buildings
- 2. entries, internal roadways, and passages
- 3. outside boat storage areas
- 4. marine railways and lifts
- 5. docks and piers
- 6. fueling facilities including fuel storage
- 7. adjacent premises and their occupancies
- (a) Consideration of the fire potential existing in adjacent premises is essential in measuring the degree of exposure from fire originating within those premises.
- (b) When the fire protection provisions required are determined, they should be incorporated in the completed layout plan, which can then be effectively used to educate and familiarize employees with the location and use of the equipment.
- 213. Fixed Fire Extinguishing Equipment: Both automatic and hand operated devices of approved types are available which, when properly installed, maintained and handled, will provide means for controlling and extinguishing incipient fires. Among these are the following:
- (a) AUTOMATIC SPRINKLERS: These are considered the most important of all fire protective devices when correctly installed, with an abundant and constant water supply at proper pressure, and maintained so as to be operative at all times. Sprinkler systems have been found very reliable and satisfactory for use in practically all types of structures and under nearly all conditions of fire hazards. Wet or dry pipe systems are available and, where subject to temperatures below freezing even for short periods, the dry pipe system is essential. Installation of sprinkler systems should be entrusted to reliable, specialized contractors only, and should be in accordance with the "Standard for the Installation of Sprinkler Systems" (NFPA No. 13). Regular inspection and maintenance of systems at reasonable intervals is necessary.
- (b) STANDPIPE AND HOSE SYSTEMS: These systems provide a quick means of applying an effective quenching stream on incipient fires and also can be used to control more advanced fires or to prevent their spread.

- 1. For average marina or boatyard structure, standpipes should be not less than 2 inches in diameter, and should be placed so as to require hose lengths of about 100 feet with which to reach the area under protection with serviceable water streams. Approved unlined linen hose is recommended for heated or dry locations, but where conditions are moist, approved single-jacket cotton-rubber-lined hose having jacket treated to prevent mildew should be used. Hose should be 1½-inch diameter with 3/8-inch nozzles.
- 2. A systematic and regular check of all parts of a standpipe system is essential. A capable employee should be entrusted with his work and held responsible for the maintenance of the system in an instantly operative condition.

NOTE: For details relative to standpipe and hose systems see "Standard for the Installation of Standpipe and Hose Systems." (NFPA No. 14.)

- (c) Underground Fire Lines with Hydrants: For establishments encompassing considerable area, and having berthing facilities, underground fire line systems with hydrants are highly recommended. Such systems should be connected to the public water supply if available, and this connection should be independent of other public water service lines within the premises. If a public water supply connection is not available or feasible, an underground fire line should be supplied by an approved fire pump of not less than 500-gpm capacity, depending upon the extent of the premises. Fire pumps should take suction from a fresh water supply but, if necessary, salt water may be used. It should be noted that ordinary trade pumps, while efficient for general service, are seldom reliable under the stress of fire demands and are not approved for such purpose.
  - 1. In laying out a fire line system, the piping should be run to serve all buildings, piers, repair docks, outside boat storage areas, and areas used to store combustibles such as lumber. Hydrants should be so located as to keep hose lines as short as practicable, preferably not over 250 feet. The guiding requirement should be the ability to apply two effective streams to every exterior part of the area serviced by the hose normally attached to the hydrant. Hydrants should be located in relation to buildings so as to be accessible and usable under any anticipated conditions of fire.