



**NATIONAL
FIRE CODES®**

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31.1 General.

31.1.1

Chapter 31 outlines the deletions, modifications, and additions that shall be required for marine application. The applicability of Chapter 31 shall be determined by the authority having jurisdiction.

31.1.2

All other requirements of this standard shall apply to merchant vessel systems except as modified by this chapter.

31.1.3 * Occupancy Classifications.

Marine environment classifications shall be in accordance with Section 4.3.

31.1.4 * Partial Installations.

31.1.4.1

Partial installation of automatic sprinklers shall not be permitted, unless the requirements of 31.1.4.2 or 31.1.4.3 are met.

31.1.4.2

Spaces shall be permitted to be protected with an alternative, approved fire suppression system where such areas are separated from the sprinklered areas with a 1-hour-rated assembly.

31.1.4.3

The requirements of 31.1.4.1 shall not apply where specific sections of this standard permit the omission of sprinklers.

31.2 System Components, Hardware, and Use.

31.2.1 *

Sprinklers shall have a K-factor of K-2.8 (40) or greater.

31.2.2 *

Sprinkler piping penetrations shall be designed to preserve the fire integrity of the ceiling or bulkhead penetrated.

31.2.3 Spare Sprinklers.

31.2.3.1

The required stock of spare sprinklers shall be carried for each type of sprinkler installed onboard the vessel.

31.2.3.2

Where fewer than six sprinklers of a particular type are installed, 100 percent spares shall be kept in stock.

31.2.3.3

Where applicable, at least one elastometric gasket shall be kept in the cabinet for each fire department connection that is installed onboard the vessel.

31.2.3.4

The cabinet containing spare sprinklers, special wrenches, and elastometric gaskets shall be located in the same central safety station that contains the alarm annunciator panel(s) and supervisory indicators.

31.2.4 System Pipe and Fittings.

31.2.4.1 *

When ferrous materials are used for piping between the sea chest and zone control valves, these materials shall be protected against corrosion by hot dip galvanizing or by the use of Schedule 80 piping.

31.2.4.2

Maximum design pressure for copper and brass pipe shall not exceed 250 psi (17.2 bar).

31.2.5 Pipe Support.**31.2.5.1 ***

Pipe supports shall comply with the following:

- (1) Pipe supports shall be designed to provide adequate lateral, longitudinal, and vertical sway bracing.
- (2) The design shall account for the degree of bracing, which varies with the route and operation of the vessel.
- (3) Bracing shall be designed to ensure the following:
 - (a) Slamming, heaving, and rolling will not shift sprinkler piping, potentially moving sprinklers above ceilings, bulkheads, or other obstructions.
 - (b) Piping and sprinklers will remain in place at a steady heel angle at least equal to the maximum required damaged survival angle.
- (4) Pipe supports shall be welded to the structure.
- (5) Hangers that can loosen during ship motion or vibration, such as screw-down-type hangers, shall not be permitted.
- (6) Hangers that are listed for seismic use shall be permitted to be used in accordance with their listing.

31.2.5.2

Sprinkler piping shall be supported by the primary structural members of the vessel such as beams, girders, and stiffeners.

31.2.5.3 *

The components of hanger assemblies that are welded directly to the ship structure shall not be required to be listed.

31.2.5.4 *

U-hook sizes shall be no less than that specified in Table 17.2.1.4.

31.2.6 Valves.**31.2.6.1 ***

All indicating, supply, and zone control valves shall be supervised open from a central safety station.

31.2.6.2

Drain and test valves shall meet the applicable requirements of 46 CFR 56.20 and 56.60.

31.2.6.3

Valve markings shall include the information required by 46 CFR 56.20-5(a).

31.2.7 Fire Department Connections and International Shore Connections.**31.2.7.1 ***

A fire department connection and an International Shore Connection shall be installed.

31.2.7.2

The requirements for a fire department connection in 31.2.7.1 shall not apply to vessels that operate primarily on international voyages.

31.2.7.3

Connections shall be located near the gangway or other shore access point so that they are accessible to the land-based fire department.

31.2.7.4

Fire department and International Shore Connections shall be colored and marked so that the connections are easily located from the shore access point (i.e., gangway location) and will not be confused with a firemain connection.

31.2.7.5

An 18 in. × 18 in. (450 mm × 450 mm) sign displaying the symbol for fire department connection as shown in Table 5.2 of NFPA 170 shall be placed at the connection so that it is in plain sight from the shore access point.

31.2.7.6

Connections on both sides of the vessel shall be provided where shore access arrangements make it necessary.

31.2.7.7 *

Fire department connection thread type shall be compatible with fire department equipment.

31.2.7.8

International shore connections shall comply with ASTM F1121, *Standard Specification for International Shore Connections for Marine Fire Applications*.

31.3 System Requirements.**31.3.1 * Relief Valves.**

Relief valves shall be provided on all wet pipe systems.

31.3.2 Spare Detection Devices.

The number of spare detection devices or fusible elements used for protection systems that shall be carried per temperature rating is as follows:

- (1) Vessels shall have two spare detection devices or fusible elements when operating voyages are normally less than 24 hours.
- (2) Vessels shall have four spare detection devices or fusible elements when operating voyages are normally more than 24 hours.

31.3.3 System Piping Supervision.

All preaction sprinkler systems shall be supervised regardless of the number of sprinklers supplied.

31.3.4 Circulating Closed Loop Systems.

Circulating closed loop systems shall not be permitted.

31.4 Installation Requirements.**31.4.1 Temperature Zones.**

Intermediate-temperature-rated sprinklers shall be installed under a noninsulated steel deck that is exposed to sunlight.

31.4.2 * Residential Sprinklers.

Residential sprinklers shall be permitted for use only in sleeping accommodation areas.

31.4.3 Window Protection.

Where required, windows shall be protected by sprinklers installed at a distance not exceeding 1 ft (300 mm) from the glazing at a spacing not exceeding 6 ft (1.8 m) such that the entire glazing surface is wetted at a linear density not less than 6 gpm/ft (75 mm/min), unless listed window sprinkler protection systems are installed in accordance with their installation and testing criteria.

31.4.4 * Concealed Spaces.**31.4.4.1**

Concealed spaces that are constructed of combustible materials, or materials with combustible finishes or that contain combustible materials, shall be sprinklered.

31.4.4.2

The requirements of 31.4.4.1 shall not apply to concealed spaces that contain only nonmetallic piping that is continuously filled with water.

31.4.5 Vertical Shafts.**31.4.5.1**

Sprinklers shall not be required in vertical shafts used as duct, electrical, or pipe shafts that are nonaccessible, noncombustible, and enclosed in an A-Class-rated assembly.

31.4.5.2

Stairway enclosures shall be fully sprinklered.

31.4.6 Bath Modules.

Sprinklers shall be installed in bath modules (full room modules) constructed with combustible materials, regardless of room fire load.

31.4.7 Ceiling Types.

Drop-out ceilings shall not be used in conjunction with sprinklers.

31.4.8 Return Bends.

31.4.8.1

To prevent sediment buildup, return bends shall be installed in all shipboard sprinkler systems where pendent-type or dry pendent-type sprinklers are used in wet systems (*see Figure 16.3.12.2*).

31.4.8.2

Consideration shall be given concerning the intrusion of saltwater into the system.

31.4.8.3

Specifically, sprinklers shall not be rendered ineffective by corrosion related to saltwater entrapment within the return bend.

31.4.9 Hose Connections.

Sprinkler system piping shall not be used to supply hose connections or hose connections for fire department use.

31.4.10 Heat-Sensitive Piping Materials.

31.4.10.1

Portions of the piping system constructed with a heat-sensitive material shall be subject to the following restrictions:

- (1) Piping shall be of non-heat-sensitive type from the sea suction up through the penetration of the last A-Class barrier enclosing the space(s) in which the heat-sensitive piping is installed.
- (2) B-Class draft stops shall be fitted not more than 45 ft (14 m) apart between the marine thermal barrier (*see definitions in Chapter 3 and 31.1.3*) and the deck or shell.
- (3) Portions of a system that are constructed from heat-sensitive materials shall be installed behind a marine thermal barrier, unless the provisions of item (4) are met.
- (4)* Piping materials with brazed joints shall not be required to be installed behind a marine thermal barrier, provided the following conditions are met:
 - (a) The system is of the wet pipe type.
 - (b) The piping is not located in spaces containing boilers, internal combustion engines, or piping containing flammable or combustible liquids or gases under pressure, cargo holds, or vehicle decks.
 - (c) A relief valve in compliance with 8.1.2 is installed in each section of piping that is capable of being isolated by a valve(s).
 - (d) A valve(s) isolating the section of piping from the remainder of the system is installed in accordance with 31.4.10.2 and 31.4.10.3.

31.4.10.2

Each zone in which heat-sensitive piping is installed shall be fitted with a valve capable of segregating that zone from the remainder of the system.

31.4.10.3

The valve shall be supervised and located outside of the zone controlled and within an accessible compartment having A-Class boundaries or within a Type 1 stair.

31.4.11 Discharge of Drain Lines.

31.4.11.1

Drain lines shall not be connected to housekeeping, sewage, or deck drains. Drains shall be permitted to be discharged to bilges.

31.4.11.2

Overboard discharges shall meet the requirements of 46 CFR 56.50-95 and shall be corrosion resistant in accordance with 46 CFR 56.60.

31.4.11.3

Systems that contain water additives that are not permitted to be discharged into the environment shall be specially designed to prevent such discharge.

31.4.11.4

Discharges shall be provided with a down-turned elbow.

31.4.12 Alarm Signals and Devices.**31.4.12.1 ***

A visual and audible alarm signal shall be given at the central safety station to indicate when the system is in operation or when a condition that would impair the satisfactory operation of the system exists.

31.4.12.2

Alarm signals shall be provided for, but not limited to, each of the following: monitoring position of control valves, fire pump power supplies and operating condition, water tank levels and temperatures, zone waterflow alarms, pressure of tanks, and air pressure on dry pipe valves.

31.4.12.3

Alarms shall give a distinct indication for each individual system component that is monitored.

31.4.12.4

An audible alarm shall be given at the central safety station within 30 seconds of waterflow.

31.4.12.5

Waterflow alarms shall be installed for every zone of the sprinkler system.

31.4.12.6

Sprinkler zones shall not encompass more than two adjacent decks or encompass more than one main vertical zone.

31.4.12.7

Electrically operated alarm attachments shall comply with, meet, and be installed in accordance with the requirements of 46 CFR, Subchapter J, "Electrical Engineering."

31.4.12.8

All wiring shall be chosen and installed in accordance with IEEE 45, *Recommended Practice for Electrical Installations on Shipboard*.

31.4.13 Test Connections.

Where test connections are below the bulkhead deck, they shall comply with the overboard discharge arrangements of 46 CFR 56.50-95.

31.4.14 Protection of Copper Tubing.

Copper tubing materials shall be protected against physical damage in areas where vehicles and stores handling equipment operate.

31.5 Design Approaches.**31.5.1 Design Options.****31.5.1.1**

Marine sprinkler systems shall be designed using the hydraulic calculation procedure of Chapter 23.

31.5.1.2

The pipe schedule method shall not be used to determine the water demand requirements.

31.5.2 * Window Protection.

Minimum water demand requirements shall include sprinklers that are installed for the protection of windows as described in 31.4.3.

31.5.3 * Hose Stream Allowance.

No allowance for hose stream use shall be required.

31.6 Plans and Calculations.

31.6.1 Additional Information.

The pressure tank size, high-pressure relief setting, high- and low-water alarm settings, low-pressure alarm setting, and pump start pressure shall be provided.

31.6.2

Sprinklers specifically installed for the protection of windows under 31.4.3 shall be permitted to be of a different size from those protecting the remainder of the occupancy classification.

31.6.3

All of the window sprinklers, however, shall be of the same size.

31.6.4 *

Marine sprinkler systems shall be designed and installed to be fully operational without a reduction in system performance when the vessel is upright and inclined at the angles of inclination specified in 46 CFR 58.01-40.

31.7 Water Supplies.

31.7.1 General.

The water supply requirements for marine applications shall be in accordance with Section 31.7.

31.7.2 Pressure Tank.

31.7.2.1

Unless the requirements of 31.7.2.2 are met, a pressure tank shall be provided. The pressure tank shall be sized and constructed so that the following occurs:

- (1) The tank shall contain a standing charge of freshwater equal to that specified by Table 31.7.2.1.
- (2) The pressure tank shall be sized in accordance with 5.2.4.
- (3) A glass gauge shall be provided to indicate the correct level of water within the pressure tank.
- (4) Arrangements shall be provided for maintaining an air pressure in the tank such that, while the standing charge of water is being expended, the pressure will not be less than that necessary to provide the design pressure and flow of the hydraulically most remote design area.
- (5) Suitable means of replenishing the air under pressure and the freshwater standing charge in the tank shall be provided.
- (6) Tank construction shall be in accordance with the applicable requirements of 46 CFR, Subchapter F, "Marine Engineering."

Table 31.7.2.1 Required Water Supply

System Type	Additional Water Volume
Wet pipe system	Flow requirement of the hydraulically most remote system demand for 1 minute
Preaction system Deluge system Dry pipe system	Flow requirement of the hydraulically most remote system demand for 1 minute of system demand plus the volume needed to fill all dry piping

31.7.2.2 Pressure Tank Alternative.

In lieu of a pressure tank, a dedicated pump connected to a freshwater tank shall be permitted to be used, provided the following conditions are met:

- (1) The pump is listed for marine use and is sized to meet the required system demand.
- (2) The suction for the fire pump is located below the suction for the freshwater system so that there shall be a minimum water supply of at least 1 minute for the required system demand.
- (3) Pressure switches are provided in the system and the controller for the pump that automatically start the pump within 10 seconds after detection of a pressure drop of more than 5 percent.
- (4) There shall be a reduced pressure zone backflow preventer to prevent contamination of the potable water system by saltwater.

- (5) This pump has at least two sources of power. Where the sources of power are electrical, these shall be a main generator and an emergency source of power. One supply shall be taken from the main switchboard, by separate feeder reserved solely for that purpose. This feeder shall be run to an automatic changeover switch situated near the sprinkler unit, and the switch shall normally be kept closed to the feeder from the emergency switchboard. The changeover switch shall be clearly labeled, and no other switch shall be permitted in these feeders.

31.7.2.3 Relief Valves.

31.7.2.3.1

Relief valves shall be installed on the tank to avoid overpressurization and false actuation of any dry pipe valve.

31.7.2.3.2

Relief valves shall comply with 46 CFR 54.15-10.

31.7.2.4 Power Source.

31.7.2.4.1

There shall be not less than two sources of power for the compressors that supply air to the pressure tank.

31.7.2.4.2

Where the sources of power are electrical, these shall be a main generator and an emergency source of power.

31.7.2.4.3

One supply shall be taken from the main switchboard, by separate feeders reserved solely for that purpose.

31.7.2.4.4

Such feeders shall be run to a changeover switch situated near the air compressor, and the switch normally shall be kept closed to the feeder from the emergency switchboard.

31.7.2.4.5

The changeover switch shall be clearly labeled, and no other switch shall be permitted in these feeders.

31.7.2.5 Multiple Tanks.

31.7.2.5.1

More than one pressure tank can be installed, provided that each is treated as a single water source when determining valve arrangements.

31.7.2.5.2

Check valves shall be installed to prohibit flow from tank to tank or from pump to tank, unless the tank is designed to hold only pressurized air.

31.7.2.6

In systems subject to use with saltwater, valves shall be so arranged as to prohibit contamination of the pressure tank with saltwater.

31.7.2.7 *

Where applicable, a means shall be provided to restrict the amount of air that can enter the pressure tank from the air supply system. A means shall also be provided to prevent water from backflowing into the air supply system.

31.7.3 Fire Pump.

31.7.3.1

A dedicated, automatically controlled pump that is listed for marine service, which takes suction from the sea, shall be provided to supply the sprinkler system.

31.7.3.2

Where two pumps are required to ensure the reliability of the water supply, the pump that supplies the fire main shall be allowed to serve as the second fire pump.

31.7.3.3 *

The pump shall be sized to meet the water demand of the hydraulically most demanding area.

31.7.3.4

Pumps shall be designed to not exceed 120 percent of the rated capacity of the pump.

31.7.3.5

The system shall be designed so that, before the supply falls below the design criteria, the fire pump shall be automatically started and shall supply water to the system until manually shut off.

31.7.3.6

Where pump and freshwater tank arrangement is used in lieu of the pressure tank, there must be a pressure switch that senses a system pressure drop of 25 percent, and the controller must automatically start the fire pump(s) if pressure is not restored within 20 seconds.

31.7.3.7

There shall be not less than two sources of power supply for the fire pumps. Where the sources of power are electrical, these shall be a main generator and an emergency source of power.

31.7.3.8

One supply shall be taken from the main switchboard by separate feeders reserved solely for that purpose.

31.7.3.9

Such feeders shall be run to a changeover switch situated near to the sprinkler unit, and the switch normally shall be kept closed to the feeder from the emergency switchboard.

31.7.3.10

The changeover switch shall be clearly labeled, and no other switch shall be permitted in these feeders.

31.7.3.11 Test Valves.

31.7.3.11.1

A test valve(s) shall be installed on the discharge side of the pump with a short open-ended discharge pipe.

31.7.3.11.2

The area of the pipe shall be adequate to permit the release of the required water output to supply the demand of the hydraulically most remote area.

31.7.3.12 Multiple Pumps.

31.7.3.12.1

Where two fire pumps are required to ensure the reliability of the water supply, each fire pump shall meet the requirements of 31.7.3.1 through 31.7.3.4.

31.7.3.12.2

In addition, a system that is required to have more than one pump shall be designed to accommodate the following features:

- (1)* Pump controls and system sensors shall be arranged such that the secondary pump will automatically operate if the primary pump fails to operate or deliver the required water pressure and flow. *[Figure A.31.7.3.12.2(1) is an example of an acceptable dual pump arrangement.]*
- (2) Both pumps shall be served from normal and emergency power sources. However, where approved by the authority having jurisdiction, the secondary pump shall be permitted to be nonelectrically driven.
- (3) Pump failure or operation shall be indicated at the central safety station.

31.7.3.13 *

If not specifically prohibited, the fire pump that supplies the fire main shall be permitted to be used as the second pump, provided the following conditions are met:

- (1) The pump is adequately sized to meet the required fire hose and sprinkler system pressure and flow demands simultaneously.
- (2) The fire main system is segregated from the sprinkler system by a normally closed valve that is designed to automatically open upon failure of the designated fire pump.

- (3) The fire pump that supplies the fire main is automatically started in the event of dedicated fire pump failure or loss of pressure in the sprinkler main. (See Figure A.31.7.3.13.)

31.7.4 Water Supply Configurations.

31.7.4.1

The pressure tank and fire pump shall be located in a position reasonably remote from any machinery space of Category A.

31.7.4.2

All valves within the water supply piping system shall be supervised.

31.7.4.3

Only freshwater shall be used as the initial charge within the piping network.

31.7.4.4

The sprinkler system shall be cross-connected with the ship's fire main system and fitted with a lockable screw-down nonreturn valve such that backflow from the sprinkler system to the fire main is prevented.

31.7.4.5

The piping, tanks, and pumps that make up the water supply shall be installed in accordance with the applicable requirements of 46 CFR, Subchapter F, "Marine Engineering."

31.7.4.6 *

When a shorewater supply is to be used during extended dockside periods, the water supply shall be qualified in the manner described in 5.2.2.

31.7.4.7

Tests shall be conducted in accordance with the requirements of the local shore-based authority having jurisdiction.

31.7.4.8

The water supply information listed in Section 4.5 shall then be provided to the authority having jurisdiction.

31.8 System Acceptance.

31.8.1 Hydrostatic Tests.

In addition to the interior piping, the test required by 29.2.1.8 shall also be conducted on all external water supply connections including international shore and fireboat connections.

31.8.2 Alarm Test.

A waterflow test shall result in an alarm at the central safety station within 30 seconds after flow through the test connection begins.

31.8.3 Operational Tests.

31.8.3.1

Pressure tank and pump operation, valve actuation, and waterflow shall also be tested.

31.8.3.2

Pump operation and performance shall be tested in accordance with Chapter 14 of NFPA 20.

31.9 System Instructions and Maintenance.

31.9.1

Instructions for operation, inspection, maintenance, and testing shall be kept on the vessel.

31.9.2

Records of inspections, tests, and maintenance required by NFPA 25 shall also be kept on the vessel.