



REVIEW OF AUTOMATIC SPRINKLER SYSTEMS

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Purpose

This Plan Review Guideline (PRG) is provides guidance regarding the information required to be submitted to the Marine Safety Center (MSC) for review of automatic sprinkler system arrangements on U.S. flagged inspected vessels.

Contact Information

If you have any questions or comments concerning this document, please contact the Marine Safety Center (MSC) by e-mail or phone. Please refer to Procedure Number E1-27.

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1. Applicability

This Plan Review Guideline (PRG) is applicable to installations of automatic sprinkler systems for accommodation and control spaces on U.S. flagged vessels.

2. Background

Unless otherwise noted, references for the following guidance are provided as corresponding paragraph numbers from NFPA 13-1996.

The design to later editions of NFPA 13 is acceptable provided the systems are 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. (*Plans and Calculations* section of *Marine Systems* chapter in post-1996 editions of NFPA 13)

3. References

Title 46 CFR 56.20, 56.50 & 56.60 (Subchapter F)

National Fire Protection Association (NFPA) 13, 1996 Edition, "Installation of Sprinkler Systems"

[Navigation and Vessel Inspection Circular \(NVIC\) 8-93](#) and [NVIC 8-93 Change 1](#), "Equivalent Alternatives to 46 CFR Subchapter H Requirements Related to Means of Escape, Safe Refuge Areas and Main Vertical Zone Length"

Policy File Memorandum (PFM) 1-97, "Guidance for Use of Exposed Copper Pipe with Automatic Fire Sprinkler and Water Mist Systems on U.S. Vessels"

[IMO Resolution MSC.44\(65\)](#), "Standards for Fixed Sprinkler Systems for High Speed Craft International Code for Fire Safety Systems (FSS Code)"

4. Definitions

Definitions are contained in NFPA 13, Chapter 3

5. Content

Piping Materials:

a. Ferrous piping materials shall conform to the material specifications and design standards listed in reference (b), tables 2-3.1 and 2-4.1. Ferrous materials subjected to salt water shall be galvanized or be extra heavy schedule material. Materials other than those noted are acceptable in wet pipe systems in accordance with their listing. (2-3, 2-4, 9-2.4)

b. Steel pipe < 8 inches in diameter, joined by threaded fittings, shall be a minimum of Schedule 40. Steel pipe ≥ 8 inches in diameter, joined by threaded fittings, shall be a minimum of Schedule 30. (2-3.3)

c. Steel pipe \leq 5 inches in diameter, joined by welding or rolled groove fittings, shall be a minimum of Schedule 10 (2-3.2). Listed grooved type fittings are acceptable only in sprinkler systems located outside of the engine room.

d. Copper pipe is limited to ASTM B-88, types K, L, M, and ASTM B-42 materials. Copper and brass pipe shall be used only in wet pipe systems protecting light and ordinary hazard areas; pressures shall not exceed 250 psi. (PFM 1-97 and 9-2.4.2)

e. Copper pipe shall not be located in, or routed through cargo or vehicle decks, machinery spaces containing boilers, internal combustion engines, pressurized fuel or lubricating line or storage spaces for combustible liquids or gasses under pressure. (PFM 1-97)

f. Joints and connections for ASTM B-88 tubing shall be brazed. Joints and connections for ASTM B-42 tubing shall be brazed, threaded or UL listed mechanical type. (PFM 1-97)

g. Brazing filler materials shall have a solidus melting temperature of not less than 1000⁰ F. Bcup-2, Bcup-3, Bcup-4, Bag-5, Bag-1, Bag-2 and Bag-7 filler materials are acceptable. (PFM 1-97)

h. Non-metallic piping is acceptable for wet pipe systems only in accordance with the following requirements:

(1) The materials must be listed by an USCG acceptable laboratory for use in wet pipe sprinkler systems. The piping must be installed in accordance with the listing. Additionally, the pipe must be located behind a B-15 barrier.

(2) Non-metallic piping not listed for use in sprinkler systems must meet IMO A.753(18) requirements for flame spread, fire endurance, smoke generations and toxicity, as appropriate.

i. Valves, drains, test valves, etc shall meet the requirements of 46 CFR 56.20 and 56.60. Valves with resiliently seats shall be positive shut-off or category A type valves constructed in accordance with the material specification and design requirements (9-2.6.2).

General Arrangements:

a. Partial installation of sprinklers is not acceptable. Spaces protected by other fire protection systems that are separated by A-60 boundaries from the sprinkled areas need not be provided with sprinklers. Concealed spaces constructed of or containing combustible materials shall be sprinklered (9-1.3 & 9-4.4)

b. Sprinkler zones shall not encompass more than two adjacent decks or more than one main vertical zone. Waterflow alarms shall be installed for every zone of the sprinkler system. (9-4-12.2).

c. The sprinkler system maximum coverage area on any one deck supplied by one sprinkler riser shall not exceed 52,000 ft² for a light or ordinary hazard and 40,000 ft² for an extra hazard. (4-2)

d. SOLAS vessels only: windows located along an egress route must be A-0 rated and be protected by the sprinkler system. (9-4.3 & SOLAS II-2 Reg. 4.1.3.3)

Design Calculations:

a. Select the correct occupancy hazard type for each protected space; see (1-4.7) for occupancy classification definitions. Light hazard includes public spaces and control stations; Ordinary Group I includes galleys, storage areas and laundries. (A-9-1.2)

b. Either the area-density or room design methods must be used to design the system. If using the area-density method, the water supply shall be based on the area-density curves shown in figure 5-2.3 of reference (b).

(1) For light hazard installations, a water application rate of 0.1 gpm/ft² over 1,500 ft² is common.

(2) For ordinary group I hazard installations, a water application rate of 0.15 gpm/ft² over 1,500 ft² is common. (9-5.1)

(3) SOLAS vessels require a minimum water application rate of 5 lpm/m² over 280 m² (0.12 gpm/ft² over 3,014 ft²). (Ref (f) Chapter 8.2.5.2.3)

c. Distribution piping pressure loss calculations shall be provided as a basis for the sprinkler pump flow and pressure requirements. Several design areas should be calculated to ensure the hydraulically most demanding area is ascertained. Sprinkler nozzle operating pressure shall not be < 10 psi. (9-2.1)

Sprinkler Heads:

a. Sprinklers shall be listed for the specific type hazard (light, ordinary, etc) and type of system (wet or dry) in which they are used. Manufacturer technical data sheets showing the listing should be provided. (4-3.1.1)

b. A sprinkler orifice shall not be less than a nominal 3/8 inches; the minimum nominal discharge coefficient (K factor) is 2.9. Sprinkler nozzle operating pressure shall not be less than 10 psi. (9-2.1)

c. Quick response sprinklers are required on vessels with long main vertical zones (Length > 131feet) for which NVIC 8-93 is applicable. (Contact MSC Hull Division for assistance in determining applicability)

d. A sufficient number of sprinklers must be provided for the coverage area based on the type sprinkler, hazard type and space construction. The maximum coverage areas are:

(1) Pendent sprinklers (4-6.2.2)

- (i) Light hazard/noncombustible or combustible unobstructed construction: 225 ft²
- (ii) Light hazard/combustible obstructed construction 168 ft²
- (iii) Ordinary hazard: 130 ft²
- (2) Sidewall sprinklers (4-7.2.2)
 - (i) Light hazard/noncombustible or limited combustible construction: 196 ft²
 - (ii) Light hazard/ combustible construction: 120 ft²
 - (iii) Ordinary hazard/noncombustible or limited combustible construction: 100 ft²
 - (iv) Ordinary hazard/combustible construction: 80 ft²

e. Sprinkler placement and spacing is based on the sprinkler type and hazard:

- (1) Pendent sprinklers (light and ordinary hazards) (4-6.3)
 - (i) Distance between sprinklers: 6' – 15'
 - (ii) Distance from walls: 4" – 7.5'
 - (iii) Distance below ceiling: 1" – 12"
- (2) Sidewall sprinklers (4-7.3)
 - (i) Distance between sprinklers in light hazards: 6' – 15'
 - (ii) Distance between sprinklers in ordinary hazards: 6' – 10'
 - (iii) Distance from walls in light hazards: 4" – 7'
 - (iv) Distance from walls in ordinary hazards: 4" – 5'
 - (v) Distance below ceilings: 4" – 6"

f. Sprinklers shall be installed to protect windows at a distance not to exceed 1 foot (0.3m) from the window; sprinkler spacing shall not exceed 6 feet (1.8m). The window surface should be wetted at a rate not less than 6 gpm/ft. (9-4.3)

g. Return bends are required on pendent type sprinklers that are used in wet pipe systems. (9-4.8)

Sprinkler Pumps, Pressure Tanks and Water Supply:

a. A dedicated pump sized to meet the water demand of the hydraulically most demanding area shall be provided. The pump shall be listed for marine service; UL listed fire pumps are acceptable. Pumps shall not exceed 120% of rated capacity. (9-6.3.1 & 2)

b. Two sources of power with separate feeders are required for all sprinkler system pumps. The normal source of power shall be the emergency switchboard. (9-6.3.4)

c. Vessels having extended main vertical zones (subject to NVIC 8-93), shall have two sprinkler pumps sized to meet the water demand of the hydraulically most demanding area. A dedicated fire pump is permitted to be used as the second pump provided that : (9-6.3.7)

- (1) The pump has the capacity to meet the fire hose and sprinkler system pressure and flow demands simultaneously.
- (2) A normally closed valve that opens automatically upon failure of the primary sprinkler pump segregates the fire main.
- (3) The fire pump starts automatically upon failure of the sprinkler pump or loss of sprinkler system pressure.

d. A pressure tank meeting the following requirements shall be provided. Details of an alternative installation (a dedicated pump in lieu of a pressure tank) are provided in the standard: (9-6.2.1 and A-7-2.3.3)

- (1) The tank volume shall be sufficient to provide the hydraulic most demanding area for one minute
- (2) For hydraulically calculated systems, the pressure tank design shall be sufficient to provide the initial tank charge pressure (P_i) as follows:

where:

$$P_i = ((P_f + 15)/A) - 15$$

P_i = initial tank pressure

P_f = final tank pressure (from calcs)

A = proportion of air in tank

e. The pressure tank shall be designed in accordance with ASME Pressure Vessel Code and be provided with a relief valve. (9-6.2.1). See Marine Safety Center PRG E1-19 for pressure vessel requirements.

f. A suitable means of replenishing the air under pressure and the fresh water standing charge in the tanks shall be provided. A sight glass shall be provided on the tank. (9-6.2.1)

g. Two sources of power with separate feeders are required for the air compressors that supply air to the pressure tank. The normal source of power shall be the emergency switchboard. (9-6.2.3)

h. Valves shall be provided on the pressure tank air connection to prevent backflow of water into the air system and to restrict the amount of air entering the tank. (9-6.2.6)

i. Fire department and Int'l shore connections shall be provided near the gangway or other location so that they are readily accessible to a land based fire department. Connections may be required on both sides of vessels depending on shore access arrangements. (9-2.7.1)

j. The firemain shall be cross-connected to the sprinkler system and fitted with a lockable, screw down, non-return valve to prevent backflow from the sprinkler system to the firemain. (9-6.4.3)

k. The fire department cross connect for a wet pipe system shall be connected downstream of the sprinkler pump discharge check valve. For a dry pipe system, the connection shall be located between the sprinkler pump check valve and the dry valve. (4-15.2.3)

l. Shut-off valves are prohibited in the fire department cross connect piping. A listed check valve shall be provided at each water supply including the fire dep't connection. (4-15.2.4.)

m. Dry pipe systems with capacities > 500 gallons shall be equipped with a listed quick opening device. Not more than 750 gallons system capacity shall be controlled by one dry pipe. Larger dry pipe non-gridded systems are acceptable if the design is such that water is delivered to the test connection within 60 seconds of activation. (3-2.3)

Alarms, Indicators, Test Connections, Drains and Supports:

a. Indicating, water supply and zone control valves shall be supervised in the open position at a central operating station. Locking open of valves is not an acceptable method of supervision. (9-2.6.1)

b. Monitoring devices and individual alarms, located at a central operating station, shall be provided for the following: (9-4.12)

- (1) Water supply valve positions
- (2) Sprinkler pump power and operation
- (3) Pressure tank level, pressure and temperature
- (4) Zone water flow alarms
- (5) Dry pipe valve pressures (as applicable)

c. Listed water flow alarms shall be provided for each zone. Paddle wheel type alarms are acceptable only on wet type systems. (2-9.1 & 2-9.2.4)

d. Test connections shall be provided for each water flow alarm and dry pipe valve. (4-15.1.1.3)

e. Flow alarm and dry pipe test connections shall not be less than 1 inch in diameter and shall have an orifice equivalent to that of the smallest sprinkler in the system. If required, the dry pipe test connection shall be located in the most distant sprinkler pipe. (4-15.4.2 & 3)

f. A drain/test connection shall be provided on the discharge side of the sprinkler pump. The pipe should be of adequate size to discharge the amount of water required by the hydraulically most demanding area. (9-6.3.5)

g. Drain and test lines shall not be connected to housekeeping, sewage or deck drains; drainage to the bilge is acceptable. Test/drain overboard discharge connections shall conform to the overboard discharge requirements of 46 CFR 56.50-95. (9-4.11).

h. For wet pipe systems, listed pressure gauges are required in each riser and on both sides of alarm check valves and at each alarm flow switch of a wet pipe system. (3-1.1)

i. Control, drain and test valves shall be provided with metal or plastic identification tags secured with corrosion resistant wire or chain. (2-7.3)

j. Pipes shall be supported by primary structural members of the vessel such as beams, girders, and stiffeners. Pipe supports shall be welded to the structure. Screw down type hangers are not permitted. With the exception of the portion welded to the structure, pipe supports shall be listed. (9-2.5.1)

k. U-hook type pipe supports shall be sized in accordance with table 2-6.4.1

Additional Requirements for Dry Pipe Systems:

a. For dry pipe systems, listed pressure gauges are required on both sides of the dry pipe valve, at the air compressor/receiver, air supply pipe to the dry pipe system, and at exhausters/accelerators. (3-2.1)

b. The compressed air source for a dry pipe system shall be capable of restoring normal pressure on the system within 30 minutes. (3-2.6.2)

c. The dry pipe air connection shall not be less than ½ inch in diameter and shall enter the system above the priming water level of the dry pipe. A renewable seat type stop valve and check valve are required. (3-2.6.3)

d. The dry pipe pressure shall be maintained IAW dry pipe valve instructions or 20 psi in excess of the pressure required to trip the valve. (3-2.6.7)

High Speed Craft Sprinkler Systems

a. Manual and automatic sprinkler systems for high speed craft shall be designed in accordance with reference (e).

6. Disclaimer

This guidance is not a substitute for applicable legal requirements, nor is it itself a rule. It is not intended to nor does it impose legally-binding requirements on any party. It represents the Coast Guard's current thinking on this topic and may assist industry, mariners, the general public, and the Coast Guard, as well as other federal and state regulators, in applying statutory and regulatory requirements. You can use an alternative approach for complying with these requirements if the approach satisfies the requirements of the applicable statutes and regulations.

If you want to discuss an alternative, you may contact MSC, the unit responsible for implementing this guidance.