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An American National Standard

Standard Test Method for Shipboard Fixed Foam Firefighting Systems[1]

This standard is issued under the fixed designation F 1994; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This test method covers shipboard, fixed (installed) foam/sprinkling firefighting systems.

1.2 Satisfactory completion of these tests indicates functional performance of the fixed foam firefighting system and may be used to demonstrate the system installation's compliance with the design characteristics of the system.

1.3 Tests made in conformity with this test method are intended to demonstrate the installation and operation of an installed, fixed foam firefighting system. As it includes regulatory requirements, this standard addresses those vessels subject to regulations and ship classification rules. However, the methods stated herein are suitable for unregulated commercial vessels, pleasure craft, military vessels, and similar vessels that are not required to meet regulations for firefighting systems.

1.4 *Limitations*:

1.4.1 International requirements, national regulations, and ship classification rules must be consulted. The following regulatory requirements and classification society rules were considered in the preparation of this test method:

1.4.1.1 International Convention for the Safety of Life at Sea (SOLAS), 1974 SOLAS Convention, 1978 SOLAS Protocol, and the 1981 and 1983 SOLAS Amendments, II-2/8, "Fixed low-expansion foam extinguishing systems in machinery spaces,"

1.4.1.2 U.S. Government regulations included in 46 CFR 76, 46 CFR 95, and 46 CFR 108 as those regulations are written and enforced by the United States Cost Guard, and

1.4.1.3 The American Bureau of Shipping (ABS) *Rules for Building and Classing Steel Vessels*. However, the owner will designate the specific classification society which is to be used to classify a particular vessel.

1.4.2 The requirements, regulations, and rules for a specific design must be selected by the owner based on the planned operating profile for the vessel.

1.4.3 This test method reflects international requirements, U.S. Government regulations, and ABS rules in effect at the time it was prepared, and may not include requirements adopted subsequent to the effective date of this test method.

1.4.4 This test method does not include requirements for the selection, design, installation, and maintenance of foam firefighting systems. It applies to installed systems whose designs meet all applicable international requirements, national regulations, and ship classification rules.

1.5 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 The following documents apply to this test method only to the extent referenced herein. However, they may be further invoked by the ship owner as part of the design requirements for the vessel.

2.2 *ASTM Standards:*

A 795 Specification for Seamless Steel Pipe for Fire Protection Use[2]

F 998 Specification for Centrifugal Pumps, Shipboard Use[3]

F 1030 Practice for Selection of Valve Operators[3]

F 1155 Practice for Selection and Application of Piping System Materials[3]

F 1198 Guide for Shipboard Fire Detection Systems[3]

F 1333 Specification for Construction of Fire and Foam Station Cabinets[3]

F 1370 Specification for Pressure-Reducing Valves for Water Systems, Shipboard[3]

F 1508 Specification for Angle Style, Pressure Relief Valves for Steam, Gas, and Liquid Services[3]

F 1510 Specification for Rotary Positive Displacement Pumps, Commercial Ships Use[3]

F 1547 Guide Listing Relevant Standards and PUbvlications for Commercial Shipbuilding[3]

[1] This test method is under the jurisdiction of ASTM Committee F-25 on Ships and Marine Technology and is the direct responsibility of Subcommittee F25.07 on General Requirements.

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[2] *Annual Book of ASTM Standards*, Vol 01.01.

[3] *Annual Book of ASTM Standards*, Vol 01.07.

2.3 *Code of Federal Regulations* (CFR):[4]
Title 46, Part 76, Fire Protection Equipment, Subpart 76.17, Foam Extinguishing Systems, Details[4]
Title 46, Part 76, Subpart 76.23, Manual Sprinkling System, Details[4]
Title 46, Part 95, Fire Protection Equipment, Subpart 95.17, Foam Extinguishing Systems, Details[4]
Title 46, Part 108, Design and Equipment, Subpart D, Fire Extinguishing Systems, §108.459–§108.477[4]
2.4 *ABS Rules for Building and Classing Steel Vessels:*
Part 4, Section 6 Pumps and Piping Systems[5]
Part 4, Section 9 Fire Extinguishing Systems[5]
Part 4, Section 11 Shipboard Automatic and Remote-control Systems
5/4B.11 Fire Protection and Fire Extinction[5]
2.5 *IACS Documents:*
Comparable rules also are published by other members of the International Association of Classification Societies[6]
2.6 *IMO SOLAS Regulations:*
SOLAS II-2 Construction – Fire Protection, Fire Detection and Fire Extinction[7]
2.7 *ANSI Standard:*
B16.34 Small Butt Welding End Valves[8]
2.8 *NFPA Publications:*
NFPA 11 Standard for Low Expansion Foam[9]
2.9 *SNAME Bulletins:*
Technical & Research Bulletin 3-39 Guide for Shop and Installation Tests[10]
Technical & Research Bulletin 3-47 Guide for Sea Trials[10]

3. Terminology

3.1 Refer to Annex A1 for terminology used in this test method related to fixed foam firefighting system installations and their testing. Actual terminology used for fixed foam firefighting systems may vary depending upon the desires of the owner or system designer, or both.

4. Significance and Use

4.1 This test method is applicable to fixed foam firefighting systems, including foam generation equipment, foam distribution system piping and valves, sprinkler arrangement and operation, hose reel unit operation, and system controls, as those components are included in the system for a particular application.

4.1.1 Foam systems for machinery spaces are tested using those portions of this test method which apply to the installed components. Suitable adaptation of this test method is made for use with systems which do not include all hardware components described herein.

4.1.2 Deck foam systems are tested per the manufacturer's design criteria.

4.2 This test method demonstrates: satisfactory installation of an entire fixed foam/sprinkling system and its associated controls; and effective operation of portions of the foam distribution system and foam maker sprinkling nozzles for selected zones.

4.2.1 This test method verifies application rates and areas of coverage for each type of discharge device of the fixed foam firefighting system.

4.2.2 The satisfactory operation of the system in the selected zones is a measure of overall system capacity and anticipated operation for emergency use. The test, however, may not be representative of all emergency operating conditions that may vary with changes in the number of zones that are activated simultaneously, the material condition of the distribution and sprinkling components as they are maintained over time, and restoration of the system following its use for testing or actual emergencies.

4.3 Test procedures shall be prepared for the conduct of tests of foam firefighting systems in specific vessels. Those procedures shall be tailored to the system design for the system as installed and operated in each vessel.

4.3.1 Tests accomplished in accordance with approved test procedures may be sufficient to demonstrate that the vessel meets the regulatory and classification requirements for the vessel.

4.3.2 Approval of test procedures by a classification society may be necessary.

4.3.3 Test procedures must state operating parameters and values (for example, flow rate, pressure, time to activate) which define pass/fail criteria for each test.

4.4 Certification of the vessel or classification of the vessel or both by the regulatory bodies may require that tests be witnessed by a marine inspector or surveyor or both who represents both regulatory bodies.

4.5 *Interpretation of Results*:

4.5.1 Leakage at any piping system mechanical joint that is corrected "on-the-spot" is not cause for test rejection.

4.5.2 Any erratic operation detected in the zone control valves, seawater sprinkling pump discharge bypass-overboard valves, or control devices is cause for rejection of the test. The component causing the erratic operation shall be repaired or replaced and a retest performed.

4.5.3 Any operation which does not meet the pass/fail criteria defined by the test procedure(s) is cause for rejection of the test. The cause of the failure shall be determined, the design or installation, or both, corrected as appropriate, and a retest performed.

5. Hazards

5.1 *Safety Hazards*—The following safety precautions must be taken when conducting tests in accordance with test procedures that conform with this test method. However, this is

[4] Available from Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.
[5] Available from the American Bureau of Shipping (ABS): ABS Americas, ABS Plaza, 16855 Northchase Dr., Houston, TX 77060.
[6] Other IACS members and locations at which their publications are available are identified by Guide F 1547 at Section 4. Publication lists of some IACS members can be found in Guide F 1547, Section 5.
[7] *International Convention for the Safety of Life at Sea* (SOLAS) is available from International Maritime Organization (IMO), 4 Albert Embankment, London, England SE1 7SR.
[8] Available from American National Standards Institute, 11 W. 42nd St., 13th Floor, New York, NY 10036.
[9] Available from National Fire Protection Assoc., Batterymarch Park, Quincy, MA 02269.
[10] Available from Society of Naval Architects and Marine Engineers, 601 Pavonia Ave., Jersey City, NJ 07306.

not an inclusive listing of all hazards which may occur when this test method is followed, see 1.5. Appropriate safety hazard statements must be included in test procedures that conform with this test method.

5.1.1 Live control circuits are exercised during tests performed in accordance with this test method. This can result in the inadvertent discharge of seawater or seawater/foam solution.

5.1.1.1 Remote operation of valves which allow discharge of fluids directly into interior spaces of the vessel is required.

5.1.1.2 Tag out electrical circuits or tag closed valves as appropriate for each test.

5.1.2 The fixed foam firefighting system includes relief valves and pressure-regulating valves which limit the internal pressures to which piping and valves of the system are subjected. Failure of these devices to control or limit system pressure may result in component failures.

5.1.3 The following safety and control devices are required to conduct the tests:

5.1.3.1 Pumps' relief valves;

5.1.3.2 Seawater sprinkling pump discharge bypass-overboard relief valves which must be set in accordance with the maximum system operating pressure; and

5.1.3.3 Zone sprinkling control, remotely operated valves, as applicable.

5.1.4 All precautions to ensure safety of life and equipment protection in compliance with the industrial facility's and vessel's established safety precautions shall be followed at all times in the conduct of foam firefighting system tests.

5.1.5 Portions of the fixed foam firefighting system should not be disabled or isolated for tests until just before the a specific test event is scheduled to commence. This will leave the system functional for use in case of an actual fire.

5.2 *Precautionary Statements*—The following precautions should be taken when conducting tests in accordance with test procedures which conform with this test method. Appropriate precautions and warning statements must be included in test procedures that conform with this test method.

5.2.1 All appropriate electrical circuits must be de-energized and tagged when doing any test or demonstration involving contact with electrical conductors.

5.2.2 It is against environmental regulations to discharge seawater/foam solutions within 3 miles of shore in the United States. Care must be taken to prevent discharge of foam into coastal waters of any country. Therefore, all in-port testing is to be accomplished using fresh water or clean seawater. Foam concentration testing, by dispersion of actual seawater/foam solution, is to be accomplished only when underway, well outside coastal waters, or the seawater/foam solution is discharged to a containment vessel for disposal in conformance with local regulations.

5.2.3 Sprinkling or other discharge into interior spaces can lead to water or seawater/foam solution accumulation. Vessel stability can be dangerously affected if dewatering systems are not fully functional and operating. Operators must closely monitor the amount of water accumulated on deck during any phase of demonstrations or testing. Demonstrations or testing should be suspended if such accumulation cannot be controlled and sufficient stability maintained.

5.2.4 All equipment or surfaces that could be damaged by water during testing, in way of hose reel discharge areas or in zones where fresh water or seawater/foam solutions will be discharged from foam maker sprinkling nozzles, or both, should be covered with plastic or otherwise protected from the discharge.

5.2.5 Any piping flanges that formerly were blanked to conduct hydrostatic testing of the foam distribution system should be inspected for tightness during the operational tests.

5.2.6 Precaution shall be taken to ensure proper valve alignment to prevent flooding the vessel during any test requiring operation of the seawater sprinkling system, seawater sprinkling pumps, foam proportioning pumps, and foam concentrate transfer pumps.

5.2.7 Any tests requiring seawater or seawater/foam solution to be pumped through foam distribution system piping shall be conducted only after precautions have been taken to insure the watertight integrity at the maximum system operating pressure of all affected piping and valves.

5.2.8 Appropriate zone control valves shall be tagged closed during in-port testing to preclude accidental discharge of foam concentrate entering the distributive system or being discharged overboard.

5.2.9 Isolate system areas or zones that are not used in a specific test.

5.3 *Remedial Statements*—System restoration following demonstrations should include the following actions.

5.3.1 Restore all electrical power to the pumps and controls. Ensure that all electrical and control circuits are set for normal operation.

5.3.2 Ensure that tags installed on remotely operated valves have been removed.

5.3.3 Ensure that all distribution piping and valves are aligned for normal operation.

5.3.4 Clean up all areas and equipment that may have been wetted by sprinkling or flooding incidental to these demonstrations.

5.3.5 Remove any "socks" or other devices installed to contain water or foam discharged during demonstrations.

5.3.6 Remove any test instrumentation or gauges installed for the demonstrations.

5.3.7 Ensure that foam concentrate tanks are filled with foam concentrate.

6. Overview of Fixed Foam Firefighting System Tests

6.1 There are two phases of testing the fixed foam and seawater sprinkling system: system installation tests and system operational tests.

6.2 Installation testing is intended to demonstrate the integrity of the system as it was installed in the vessel. It comprises a series of tests to demonstrate that the foam/sprinkling system is completely installed. It is essential that this testing be completed before accomplishing any operational tests using seawater or foam.

6.3 Operational testing is intended to demonstrate that the system operates in each of its designed modes of operation. System operational testing is accomplished through a series of

individual tests to exercise all elements of the system. Some tests will be performed with the vessel in port; other tests will be done with the vessel underway.

7. Prerequisite Requirements

7.1 The following test materials are required to conduct the tests:

7.1.1 Freshwater, sufficient to fill repeatedly all foam concentrate tanks for in-port tests.

7.1.2 Foam maker pressure test fittings composed of the following: adaptors to install the fitting in-line with a sprinkler nozzle with branch connection to a globe needle valve and pressure gage.

7.1.3 Sufficient foam concentrate to conduct demonstrations and tests called for within this standard.

7.2 The following equipments and systems are involved in the testing. Required testing of individual equipments shall have been completed before testing the foam firefighting system.

7.2.1 All seawater and sprinkling/foam distribution system and transfer system piping in the foam firefighting system.

7.2.2 All installed foam proportioners and foam concentrate tanks.

7.2.3 Foam concentrate, foam concentrate transfer, and seawater sprinkling pumps.

7.2.4 Foam maker sprinkling nozzles, hose reels, and zone control valves.

7.2.5 Damage control console (DCC) or other central control station operating controls, local control station control panels, and fire control station operating controls.

8. Preparation for Testing

8.1 The following prerequisite testing shall have been completed satisfactorily before commencing system tests of the foam firefighting system.

8.1.1 *Control System*—Testing of the central control station's DCC, including any remote alarms or operations conducted through the DCC, shall have been completed using any separate test procedures developed for that equipment.

8.1.1.1 Such testing may be accomplished in accordance with Guide F 1198 and should meet the test requirements of that guide.

8.1.1.2 Ensure continuity of all electrical signal or fiber optic cable connections from the DCC to each remotely operated valve and its associated local control panel, the fire control station, and each foam proportioning station and its associated pumps and valves.

8.1.2 *Piping and Valves*—Testing of individual piping runs and valves, including hydrostatic tests, shall have been completed using any separate test procedures developed for fluid distributive systems. Documentation should be provided before starting the foam system tests.

8.1.2.1 Pipe and valves used for foam distribution should meet the test requirements of the material specifications for items cited by Table 10, "Dry Fire Main, Foam, Sprinkling, Deckwash, Tank Cleaning Piping," of Practice F 1155.

8.1.2.2 The piping associated with foam proportioners seawater valves should meet the testing requirements of Specification A 795.

8.1.2.3 Remotely operated valve operators should be meet the testing requirements of Practice F 1030.

8.1.2.4 Pressure regulating valves should meet testing requirements for pressure-reducing valves such as those found in Specification F 1370.

8.1.2.5 Relief valves, when a component of piping systems, should meet the test requirements of Specification F 1508.

8.1.2.6 Butterfly-type quick acting valves should meet the testing requirements of ANSI B16.34.

8.1.3 *Operating Stations*—Testing of the following operating stations to ensure electrical power is available, continuity of electrical signal or fiber optic cable connections between the DCC and the remotely controlled valve(s) or pumps, and proper operation of the control consoles or panels at each station shall have been completed using any separate test procedures developed for that equipment.

8.1.3.1 Fire control station, including signal connections to the foam proportioning stations,

8.1.3.2 Foam proportioning stations,

8.1.3.3 Zone control stations, including signal connections to the foam proportioning stations, and

8.1.3.4 Hose reel unit controls, including signal connections to the foam proportioning stations.

8.1.4 *Foam Transfer Stations*—Testing of individual components, including hydrostatic tests, shall have been completed using the separate test procedures for foam transfer stations. Pipe and valves used for foam transfer should meet the test requirements of the material specifications for items cited by Table 10, "Dry Fire Main, Foam, Sprinkling, Deckwash, Tank Cleaning Piping," of Practice F 1155.

8.1.5 Test relief valves and pressure-regulating valves for proper settings. Components such as pumps that have integral relief valves or bypass valves may have such valve settings verified as part of testing that component.

8.2 The following actions shall have been completed before commencement of tests of the applicable portions (or all) of the foam firefighting system. (**Warning**—Safety procedures shall be followed to tag out electrical circuits or tag closed valves as appropriate for that portion of the test.)

8.2.1 Isolate system areas that are not used in a specific portion of the test. (**Warning**—Close and tag valves to isolate portions of the system including zones and hose reel units that will not be tested. Visually confirm all designated valves are closed.)

8.2.2 Install the test fittings (see 7.1.3) in the hydraulically most remote foam maker nozzles between the reducer from the branch connection and the nozzle inlet. Install pressure gages. Adjust the isolation valves as necessary during conduct of the test to obtain readings without excessive pressure fluctuation or water hammer.

9. Conduct of System Tests

9.1 *Foam Concentrate Tank Hydrostatic Test*—Verify there is a certification of the tank that it will withstand, at a minimum, the hydrostatic pressure to be seen as it is installed in the system. Lacking such certification, the foam concentrate tank shall be tested as follows.

9.1.1 Temporarily blank all openings except the overflow piping. Fill the tank with fresh water to the top of the overflow

piping to establish maximum the hydrostatic head pressure. Retain this pressure for a sufficient period of time to complete the visual inspection. Check tank external boundaries for leakage and structural damage.

9.1.2 Upon completion of the hydrostatic test, remove all temporary blanks or plugs, or both. Freshwater may be retained for use during pump operational tests and hose reel tests.

9.1.3 All tanks and associated piping must be drained of all water before the introduction of foam concentrate into the tanks.

9.2 *Pump Installation Test*—Each seawater sprinkling pump and foam concentrate pump shall be tested.

9.2.1 Ensure that each pump and motor shaft alignment is completed and that the pump rotates freely when turned by hand.

9.2.2 Verify integrity of all piping and electrical connections to each pump and its motor.

9.3 Pump motor and controller operational tests: each seawater sprinkling pump, foam concentrate pump, and foam concentrate transfer pump shall be tested.

9.3.1 Perform insulation resistance checks before (cold) and after (hot) the operational test. (**Warning**—Ensure all electrical power is secured to pump motors before conducting insulation resistance checks.)

9.3.2 Conduct an operational test with the pump and motor unit running and the system aligned to provide continuous operation. Pump and motor operation shall be without indications of internal rubbing (for example, noise or vibration) or other external signs of degrading performance. Pump output pressure shall be constant over the operating period. Motor amperage shall not exceed name plate data during steady state operation.

9.3.3 Additional requirements for seawater sprinkling pump tests. (**Warning**—Ensure seawater isolation valves to the foam proportioners and its seawater bypass are closed and tagged.)

9.3.3.1 Align the pump to take suction from the sea and discharge overboard.

9.3.3.2 Seawater sprinkling pump relief valves should be set at the design operating pressure. Pressure control valves should be adjusted so that the valves control pressure changes to design criteria.

9.3.3.3 Demonstrate operation of sprinkling pump's associated remotely operated valves by running the pump with system isolation valves closed. Ensure overboard isolation valves are fully open and discharge pressure gauges indicate the design operating pressure.

9.3.4 Additional requirements for foam concentrate pump tests.

9.3.4.1 Foam concentrate pumps and seawater sprinkling pumps typically are tested simultaneously because they do not have individual controllers. In such instances, they both are started together at the master controller.

9.3.4.2 Ensure that the foam concentrate isolation valves to the foam proportioner are closed and tagged. Fill the foam concentrate tank with freshwater or foam concentrate to an adequate level to assure continuous suction. Align the pump to take suction from the tank and discharge back into the tank.

9.4 Zone control valve and hose reel unit operational demonstrations: Each zone control valve and hose reel unit shall be tested. (**Warning**—In addition to other precautions, the following steps are to be taken prior to demonstrations.)

9.4.1 Secure electrical power to the foam concentrate pumps. Ensure that appropriate remotely operated valves are closed and tagged. Set up the system for SEAWATER operation before initiating each OPEN command.

9.4.1.1 Ensure that all distribution piping downstream of the proportioners is aligned for normal operation.

9.4.1.2 Provide protection for all areas and equipment that may be water damaged by sprinkling or flooding incidental to these demonstrations.

9.4.1.3 Ensure that the vessel's dewatering system(s) is fully functional and operating in areas where liquids might be discharged. (**Warning**—The amount of liquid on deck should be closely monitored during these demonstrations.)

9.4.2 Demonstration of hose reel units, if installed in the vessel.

9.4.2.1 Demonstrate the ability of each hose reel control START command to activate the sprinkling/foam system. Ensure the start-up sequence is accomplished by observing the seawater sprinkling pump master controller.

9.4.2.2 Verify seawater exits satisfactorily from the hose nozzle.

9.4.3 Demonstration of zone control valves. Demonstrate the ability of each zone control OPEN command to activate the sprinkling/foam system. Demonstrate the ability to secure each zone with CLOSE commands.

9.4.3.1 Ensure the start-up sequence is accomplished by observing the seawater sprinkling pump master controller. Observe operation of the remotely operated valve by moving from the fully closed to the fully open position and from fully open to the fully closed position.

9.4.3.2 Initiate local activation by initiating the OPEN command using each zone control local station. Close the remotely operated valve by initiating the CLOSE command.

9.4.3.3 Initiate remote activation with an OPEN command from DCC for each zone control valve. Close each remotely operating valve by initiating the CLOSE command.

9.4.3.4 Demonstrate operation of engine room bilge sprinkling and any other engine room foam systems from the fire control station. Initiate activation with an OPEN command; close the remotely operated valves by initiating the CLOSE command.

9.4.3.5 After the remotely operated valve for a particular zone is closed, secure the seawater sprinkling pump before the next demonstration of that zone or a different zone. Only one zone should be demonstrated at a time to verify proper coordination of the OPEN commands and activation of the seawater sprinkling pump.

9.5 Sprinkling/foam system operational test: A full operational test of the entire system shall be conducted before the vessel getting underway.

9.5.1 Prior to the test, complete the following steps.

9.5.1.1 Determine the two zones with the highest combined flow rate. If one or both of these zones are interior to the vessel, and two or more zones that are in weather will develop the

same or higher flow rates, the weather zones may be tested in lieu of two interior zones.

9.5.1.2 Determine the two foam maker nozzles that are hydraulically most remote from each foam proportioning station. Install test fittings (see 7.1.2) on those nozzles.

9.5.1.3 Isolate all zone control valves that will not be included in the test. (**Warning**—In addition to other precautions, provide protection for all areas and equipment that may be water damaged by sprinkling or flooding incidental to this test. "Socks" or other devices may be installed to contain the discharge from foam maker nozzles and directly route it to an area in which such discharge will be collected.) (**Warning**—The vessel's dewatering system(s) must be fully functional before conduct of these demonstrations. The amount of liquid on deck should be closely monitored during these demonstrations.)

9.5.1.4 Verify that the seawater sprinkler pump sequential start time delays have been set. The primary foam proportioning station's pump start sequence must have a shorter time delay than the secondary foam proportioning station's pump.

9.5.1.5 Ensure that all foam concentrate tanks are filled with freshwater and that the tank levels are recorded. This step must accomplished for the demonstration of each foam proportioning station and must be repeated for the full system demonstration.

9.5.1.6 Ensure that educators, pumps, or other equipment needed to dewater the vessel during and after testing are in proper working order.

9.5.2 Demonstrate the ability of each foam proportioning station to be locally started and stopped using the seawater sprinkling pump master controller.

9.5.3 Demonstrate the ability of each foam proportioning station to be remotely started and stopped using commands from DCC.

9.5.3.1 In accordance with the design, demonstrate the proper mode is activated when the SEAWATER mode or FOAM mode is selected.

9.5.3.2 When a SEAWATER mode selector is provided, ensure that the foam proportioning station, when operated in the SEAWATER mode, defaults to the FOAM mode when it is secured.

9.5.4 Demonstrate the ability of each foam proportioning station to deliver fresh water (in lieu of using foam concentrate). Isolate other foam proportioning stations from the system during these demonstrations.

9.5.4.1 Locally start the pumps for a foam station in the SEAWATER mode. When good flow has been established to the selected zone, switch from the SEAWATER mode to the FOAM mode. Operate in the FOAM mode for 20 min and secure the Foam Proportioning Station.

9.5.4.2 Select the single zone requiring the highest flow rate (see 9.5.1.1). Determine the pressure reading at the most distant nozzle in that zone. Verify full flow from all nozzles in the selected zone.

9.5.4.3 Determine the pressure reading a the two hydraulically most distant nozzles from the foam proportioning station (see 9.5.1.2), regardless of the zone in which located. The minimum pressure shall not be less than that specified by the manufacturer of the foam maker nozzle for proper operation of the nozzle.

9.5.4.4 Excess water should be dumped overboard during the test of each foam proportioning station. Verify the design operating pressure is available at all times at the outlet main from the station.

9.5.5 Conduct a foam concentrate transfer demonstration. It should be conducted only after all tests requiring that freshwater be used in the foam concentrate tanks have been completed satisfactorily. This demonstration is to be conducted using foam concentrate only.

9.5.5.1 Remove all water from the foam concentrate tank, from the foam concentrate piping serving the proportioners, and from the foam transfer piping.

9.5.5.2 Demonstrate the operation of the hand transfer pump at each foam proportioning station. Using the hand transfer pump, transfer foam concentrate from a bulk shipping drum or barrel to the foam concentrate tank. Empty the drum.

9.5.5.3 Demonstrate the operation of each motor driven, foam concentrate transfer pump, if such pumps are installed in the vessel.

(a) (*a*) The operational test (see 9.3.2) should be completed before commencing this demonstration.

(b) (*b*) Conduct an operational demonstration of the pump by aligning it to take suction from the foam tank and discharge either back into the foam concentrate tank or to the concentrate tank at another foam proportioning station.

(c) (*c*) Fill the foam concentrate tank in one of the foam proportioning stations to at least half full. Demonstration transfer of concentrate by using the concentrate transfer pump to transfer all of the concentrate to another station.

9.5.6 Additional requirements for foam concentrate transfer pump tests, if installed in the vessel. (**Warning**—Ensure all appropriate remotely operated valves are closed and tagged to prevent contamination of the foam concentrate with freshwater or seawater.

9.5.6.1 Verify setting of the relief valve for the pump.

9.5.6.2 Fill the foam concentrate tank for the foam proportioning station with foam concentrate. Align the transfer pump to take suction from the tank and discharge either back to the tank or to another foam station. Commence an operational test of sufficient duration for the pump to have completely drained the tank twice, with the pump operating at its rated capacity. During the final portion of that test, transfer sufficient foam concentrate to another foam proportioning station to observe a change in level in that station's tank.

9.5.6.3 Repeat the test for the transfer pump at each foam proportioning station until all stations have been tested.

9.6 *Foam Concentrate Tests*—A full operational test of the entire system shall be conducted with the vessel underway.

9.6.1 Before the full system operational test, complete the following steps.

9.6.1.1 Determine the two zones with the highest combined flow rate (see 9.5.1.1). Weather zones may be tested in lieu of interior zones.

9.6.1.2 Isolate all zone control valves that will not be included in the test. This should not be done until immediately

prior to the test to allow the zones to be used in case of actual emergency. (**Warning**—Provide protection for all areas and equipment that may be water damaged by sprinkling or flooding incidental to this test.)

9.6.1.3 Ensure that all foam concentrate tanks are filled with foam concentrate and that the tank levels are recorded.

9.6.2 Conduct the full operational test. This test will require the simultaneous operation of all foam proportioning stations, using foam concentrate. (**Warning**—The amount of liquid that accumulates on deck should be closely monitored during this test.)

9.6.2.1 If provided with a SEAWATER mode selector, start the seawater sprinkling pumps in the SEAWATER mode. When good flow has been established to all selected zones, switch from the SEAWATER mode to the FOAM mode.

(a) (*a*) Operate in the foam mode for at least 3 min after foam comes out of the nozzles.

(b) (*b*) Secure the foam proportioning station after samples have been taken.

(c) (*c*) Collect samples of the foam from the most and least remote locations in each zone. Samples are to be taken after 3 min of foam discharge.

(d) (*d*) Samples shall be analyzed to determine that the proper foam concentrate percentage is achieved at all locations throughout the test, as per design. Foam samples are to be tested for concentration in accordance with NFPA standard.

9.6.2.2 Excess water should be dumped overboard during the test of each foam proportioning station. Verify the design operating pressure is available at all times at the outlet main from the foam proportioning station.

9.6.2.3 Demonstrate the operation of each hose reel unit, if any are installed in the vessel. Accomplish the following when demonstrating of the hose reel(s):

(a) (*a*) Operate in the foam mode for 10 min.

(b) (*b*) Collect samples of the foam. Samples are to be taken after 5 and 10 min of operation. Samples shall be analyzed, in accordance with NFPA standard, to determine that the proper foam concentrate percentage is achieved throughout the test.

(c) (*c*) Drain the system when the test is complete.

10. Ordering Information

10.1 Ordering documentation for testing foam firefighting systems in accordance with this standard test method shall include the following information, as required, to describe the system adequately.

10.1.1 ASTM designation and year of issue,

10.1.2 Specifications for testing various components of the system,

10.1.3 Number of foam proportioning stations in the system,

10.1.4 Number and type of pumps in the system,

10.1.5 Number and service location of hose reel units in the system,

10.1.6 Prerequisite test requirements based on specifications invoked for components of the system, as described in 8.1,

10.1.7 Regulation accuracy required, if other than given in 3.5,

10.1.8 Pressure and capacity requirements, if specified by the owner, and

10.1.9 Foam system design USCG certification, if applicable.

11. Report

11.1 Report the following information:

11.1.1 Name of the industrial facility conducting the tests;

11.1.2 Date of tests and demonstrations;

11.1.3 Set of design drawings describing installation of the foam firefighting system and associated controls;

11.1.4 Nameplate data for each pump, motor, and controller;

11.1.5 Numerical data in tabular and graphic form (with identification of limits or pass/fail criteria):

11.1.5.1 Pump installation alignments;

11.1.5.2 Operational test data including: motor voltage, motor amperage, motor insulation resistance, revolutions per minute, pump suction and discharge pressures, and, any unusual conditions noted.

11.1.5.3 Identification of all hose reels demonstrated;

11.1.5.4 Identification of all sprinkling zones demonstrated for local and remote operation;

11.1.5.5 Time delays for foam proportioning station pumps;

11.1.5.6 Identification of foam proportioning stations demonstrated for local and remote operation;

11.1.5.7 Results of in-port testing using fresh water in lieu of foam concentrate: capacity of each foam concentrate tank, level of fresh water in each tank at start and conclusion of the demonstration for each zone, zones used in the demonstrations, pressure readings at most remote nozzles, and, any unusual conditions noted;

11.1.5.8 Results of underway testing using foam concentrate: seawater/foam measured ratios for each sample taken, zones used in the demonstrations, hose reels demonstrated, and any unusual conditions noted.

11.2 Report the following information for each failure to meet the accept/reject criteria of the test procedures:

11.2.1 Specific metrics of the failure,

11.2.2 Description of action(s) taken to correct the failure, and

11.2.3 Results of the retesting of all failed portions of the test procedure, including any applicable data of 11.1.

12. Precision and Bias

12.1 *Precision*—It is not possible to specify the precision of the procedure in this test method for fixed foam firefighting systems because results will vary from vessel to vessel or may vary for the same system on a single vessel owing to:

12.1.1 The test instrumentation and test setup will vary;

12.1.2 The designs of different systems will produce different values; and

12.1.3 The test procedures prepared by different industrial facilities that perform the testing over the life of the vessel.

12.2 *Bias*—No information can be presented on the bias of the procedure in this test method for fixed foam firefighting systems because of variances in the design of each vessel's installation.

ANNEX

(Mandatory Information)

A1. TERMINOLOGY: GLOSSARY OF TERMS USED IN THIS TEST METHOD FOR FOAM FIREFIGHTING SYSTEMS

A1.1 *Use of This Glossary of Terms*:

A1.1.1 Test requirements associated with the terms described in this annex are for reference only. Specific test requirements are imposed using the ordering data for individual components.

A1.1.2 These terms are for reference only; components of a particular fixed fire fighting system may be identified by different nomenclature as part of the system design.

A1.2 Terms used in this test method for fixed foam firefighting systems.

A1.2.1 *bias*—the difference between the average measured test result and the accepted reference values (or accept/reject criteria); it measures in an inverse manner the accuracy of a test.

A1.2.2 *bilge sprinkling system*—a fixed foam sprinkling system in the bilges of a machinery space; includes distribution piping and foam maker sprinkling nozzles.

A1.2.3 *control system*—the electrical system used to monitor and control all of the equipment associated with the foam firefighting system. The control system includes the panels and consoles from which the foam fighting system can be operated and the interconnecting electrical signal cables or fiber optics.

A1.2.4 *damage control console (DCC)*—the central console in the control system at which the firefighting system can be monitored and controlled. Such console may be part of a fire detection system installation.

A1.2.5 *foam concentrate*—liquid solution that is mixed with seawater to make fire fighting foam.

A1.2.6 *foam distribution system*—the piping and valves that distribute seawater/foam solution from foam proportioning stations to nozzles or hose reels throughout the vessel, or both.

A1.2.7 *fixed foam firefighting system*—the tanks, pumps, interconnecting piping, foam distribution system piping and valves, local controls, foam maker sprinkling nozzles, and hose reels to provide seawater/foam solution to fight fires.

A1.2.8 *foam maker sprinkling nozzle*—a nozzle that mixes air with seawater/foam solution to sprinkle foam.

A1.2.9 *foam proportioners*—a unit that mixes foam concentrate and seawater in the proper proportions to make seawater/foam solution.

A1.2.10 *foam transfer system*—the pumps, piping, and valves that are used to transfer foam concentrate from one foam proportioning station to another.

A1.2.11 *hose reel unit*—a fixed unit that includes a reel and drum assembly from which a hose with foam maker nozzle can be deployed to allow portable direction of foam at the site of a fire. Some vessels may use a hose rack in a foam station cabinet such as one described by Specification F 1333 without a local proportioners, using seawater/foam solution from the foam distribution system in lieu of a local foam proportioners.

A1.2.12 *local control panel*—the panel that controls the valve operator for a zone control valve or hose reel unit isolation valve.

A1.2.13 *master controller, seawater sprinkling pump*—the motor controller for the seawater sprinkling pump; it also may be the motor controller for the foam concentrate pump.

A1.2.14 *precision*—a measurement concept that expresses the ability to generate test results that agree with each other in absolute magnitude.

A1.2.15 *pressure, design operating*—pressure used in design to determine the required minimum thickness and minimum mechanical properties (of the foam firefighting system).

A1.2.16 *pressure, hydrostatic head*—the static pressure at any point in the system created by a vertical column of liquid from that point to the highest point in system. Alternately, the pressure at any point in a tank created by vertical column of the liquid carried in that tank, from that point to the highest point in the tank vent.

A1.2.17 *pressure, maximum system operating*—the maximum pressure at which the foam firefighting system can be operated; typically, the highest pressure setting of any pressure relief device in the system.

A1.2.18 *pump, foam concentrate*—the pump that provides foam concentrate from the foam concentrate tank to the foam proportioners; they typically are Specification F 1510, Class A pumps sized with a capacity to provide foam simultaneously to the two largest zones in the vessel and should meet the test requirements of that specification.

A1.2.19 *pump, foam concentrate transfer*—a pump used to transfer foam concentrate solution from one foam proportioning station to another; they typically are Specification F 1510, Class A pumps sized with a relatively low capacity and should meet the test requirements of that specification.

A1.2.20 *pump, hand transfer*—a pump used to transfer foam concentrate from pails or barrels into foam concentrate tanks.

A1.2.21 *pump, seawater sprinkling*—a pump that takes sea suction and pumps seawater to the foam proportioners; they typically are Specification F 998, Class 5 pumps and should meet the test requirements of that specification.

A1.2.22 *seawater/foam solution*—a mixture of foam concentrate and seawater in proper proportions to make foam when discharged through a foam maker sprinkling nozzle or hose reel unit foam nozzle.

A1.2.23 *station, fire control*—the location used to monitor and control all of the equipment associated with the firefighting system in the engine room(s) and casing. The panels or console from which the engine room foam firefighting system can be operated and the interconnecting electrical signal cables or fiber optics are located at this station.

A1.2.24 *station, foam proportioning*—the location at which seawater/foam solution is generated and from which it is pumped to sprinkling zones, hose reels, and the engine room(s). This station typically includes the seawater sprinkling pump, foam concentrate tank, foam proportioning pump, foam proportioners, foam transfer pump, interconnecting piping and valves, and their controls.

A1.2.25 *station foam transfer*—a location which includes a pump concentrate transfer pump and control devices necessary to move foam concentrate.

A1.2.26 *station, hose reel*—a location used to monitor and control a foam hose reel unit.

A1.2.27 *station, local control*—a location at which an operator can monitor and control the foam sprinkling system in a zone.

A1.2.28 *tank, foam concentrate*—a tank for bulk stowage of foam concentrate; it is connected to the suction side of the foam concentrate pump.

A1.2.29 *valve, bypass-overboard*—a valve that allows the discharge of a pump in the fixed foam firefighting system to bypass the foam distribution system and be discharged overboard. Such valves also can function as relief valves which discharge overboard when the system pressure exceeds the valve's set pressure.

A1.2.30 *valve, foam proportioners seawater supply*—a valve on the seawater inlet side of a foam proportioners that isolates it from its source of seawater, either the fire main or a seawater sprinkling pump.

A1.2.31 *valve, hose reel*—the quick opening valve that isolates a hose reel unit from the distribution main or risers for the seawater/foam solution.

A1.2.32 *valve, remotely operated*—a valve that uses an electric or hydraulic power-actuated operator to change its position. Remotely operated valves in the foam firefighting system can be positioned by either local or remote actuation and can be positioned using a manual operator.

A1.2.33 *valve, pressure regulating*—a valve that senses total pressure in the distribution piping downstream of the valve and adjusts the flow through the valve to maintain that pressure at a set level.

A1.2.34 *valve, relief*—a pressure-activated valve designed to relieve excessive pressure automatically. Such valves in the foam firefighting system can be integral to the system's pumps or be a component of piping systems.

A1.2.35 *valve, seawater bypass*—the valve that bypasses the foam proportioners, allowing the foam firefighting system to distribute only seawater.

A1.2.36 *valve, sprinkling pump seawater suction*—the sea value on the seawater side of the seawater sprinkling pump.

A1.2.37 *valve, zone control*—the quick opening valve that isolates a zone from the distribution main or risers for the seawater/foam solution.

A1.2.38 *zone*—a section of the foam distribution system that includes all piping, valves, and sprinklers for a defined area of the ship.