



Standard Test Method for Shipboard Fixed Foam Firefighting Systems¹

This standard is issued under the fixed designation F1994; 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 Coast 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:²

A795/A795M Specification for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use

F998 Specification for Centrifugal Pump, Shipboard Use

F1030 Practice for Selection of Valve Operators

F1155 Practice for Selection and Application of Piping System Materials

F1198 Guide for Shipboard Fire Detection Systems

F1333 Specification for Construction of Fire and Foam Station Cabinets

F1370 Specification for Pressure-Reducing Valves for Water Systems, Shipboard

F1508 Specification for Angle Style, Pressure Relief Valves for Steam, Gas, and Liquid Services

F1510 Specification for Rotary Positive Displacement Pumps, Ships Use

F1547 Guide Listing Relevant Standards and Publications for Commercial Shipbuilding

2.3 *Code of Federal Regulations (CFR):*³

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

Current edition approved May 1, 2005. Published May 2005. Originally approved in 1999. Last previous edition approved in 1999 as F1994 – 99. DOI: 10.1520/F1994-99R05.

² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

³ Available from U.S. Government Printing Office Superintendent of Documents, 732 N. Capitol St., NW, Mail Stop: SDE, Washington, DC 20401.

Title 46, Part 76, Fire Protection Equipment, Subpart 76.17,
Foam Extinguishing Systems, Details

Title 46, Part 76, Subpart 76.23, Manual Sprinkling System,
Details

Title 46, Part 95, Fire Protection Equipment, Subpart 95.17,
Foam Extinguishing Systems, Details

Title 46, Part 108, Design and Equipment, Subpart D, Fire
Extinguishing Systems, §108.459–§108.477

2.4 *ABS Rules for Building and Classing Steel Vessels*:⁴

Part 4, Section 6 Pumps and Piping Systems

Part 4, Section 9 Fire Extinguishing Systems

Part 4, Section 11 Shipboard Automatic and Remote-control
Systems

5/4B.11 Fire Protection and Fire Extinction

2.5 *IACS Documents*:⁵

Comparable rules also are published by other members of
the International Association of Classification Societies ⁵

2.6 *IMO SOLAS Regulations*:⁶

SOLAS II-2 Construction – Fire Protection, Fire Detection
and Fire Extinction

2.7 *ANSI Standard*:⁷

B16.34 Small Butt Welding End Valves

2.8 *NFPA Publications*:⁸

NFPA 11 Standard for Low Expansion Foam

2.9 *SNAME Bulletins*:⁹

Technical & Research Bulletin 3-39 Guide for Shop and
Installation Tests

Technical & Research Bulletin 3-47 Guide for Sea Trials⁹

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

⁴ Available from American Bureau of Shipping (ABS), ABS Plaza, 16855 Northchase Dr., Houston, TX 77060.

⁵ Other IACS members and locations at which their publications are available are identified by Guide **F1547** at Section 4. Publication lists of some IACS members can be found in Guide **F1547**, Section 5.

⁶ *International Convention for the Safety of Life at Sea (SOLAS)* is available from International Maritime Organization (IMO), 4 Albert Embankment, London, England SE1 7SR.

⁷ Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036.

⁸ Available from National Fire Protection Association (NFPA), 1 Batterymarch Park, Quincy, MA 02269-9101.

⁹ Available from Society of Naval Architects and Marine Engineers, 601 Pavonia Ave., Jersey City, NJ 07306.

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 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 F1198 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 F1155.

8.1.2.2 The piping associated with foam proportioners seawater valves should meet the testing requirements of Specification A795/A795M.

8.1.2.3 Remotely operated valve operators should meet the testing requirements of Practice F1030.

8.1.2.4 Pressure regulating valves should meet testing requirements for pressure-reducing valves such as those found in Specification F1370.

8.1.2.5 Relief valves, when a component of piping systems, should meet the test requirements of Specification F1508.

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 F1155.

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