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Standard Specification for Fire Hose Nozzles[1]

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1. Scope

1.1 This specification covers the design, manufacture and testing of fire hose nozzles intended for use with sea water or fresh water either in straight stream or adjustable spray patterns.

1.2 The values stated in SI units are to be regarded as the standard.

2. Referenced Documents

2.1 *ASTM Standards:*

A 313 Specification for Chromium-Nickel Stainless and Heat-Resisting Steel Spring Wire[2]

A 580/A 580M Specification for Stainless and Heat-Resisting Steel Wire[2]

A 582/A 582M Specification for Free-Machining Stainless and Heat-Resisting Steel Bars[3]

B 117 Practice for Salt Spray (Fog) Testing[4]

D 395 Test Methods for Rubber Property—Compression Set[5]

D 412 Test Methods for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers—Tension[5]

D 572 Test Method for Rubber Deterioration by Heat and Oxygen[5]

D 1193 Specification for Reagent Water[6]

2.2 *NFPA Standards:*

NFPA 1963 Standards for Screw Threads and Gaskets for Fire Hose Connections[7]

3. Terminology

3.1 *Definitions:*

3.1.1 *ball shut-off*—a spray nozzle configuration that stops the flow of water through the nozzle by rotating the ball through which the water flows so that the passage no longer aligns with the nozzle flow passage.

3.1.2 *break apart*—a feature that allows the nozzle tip to be disconnected from the nozzle body by virtue of a coupling identical to that on the hose end of the nozzle.

3.1.3 *constant flow rate spray nozzle*—an adjustable pattern nozzle in which the flow is delivered at a designed nozzle pressure. At the rated pressure, the nozzle will deliver a constant flow rate from straight stream through a wide angle pattern. This is accomplished by maintaining a constant orifice size during flow pattern adjustment.

3.1.4 *constant pressure (automatic) spray nozzle*—an adjustable pattern nozzle in which the pressure remains constant through a range of flows rates. The constant pressure provides the velocity for an effective stream reach at various flow rates. This is accomplished by means of a pressure-activated, self-adjusting orifice baffle.

3.1.5 *constant/select flow rate feature*—a nozzle feature that allows on-site adjustment of the orifice to change the flow rate to a predetermined value. The flow rate remains constant throughout the range of pattern selection from straight stream to wide angle spray.

3.1.6 *free swivel coupling*—a coupling between the nozzle and hose or between halves of a break-apart nozzle that is capable of being turned readily by hand; that is, a spanner wrench is not required to tighten the coupling to prevent leakage.

3.1.7 *flush*—a feature in a nozzle that allows the orifice to be opened so that small debris that might otherwise be trapped in the nozzle, causing pattern disruptions and flow variation, can pass through. When the flush feature is engaged, the nozzle pressure will drop and the pattern will deteriorate.

3.1.8 *lever-type control*—a control in which the handle operates along the axis of the nozzle.

3.1.9 *pistol grip*— a feature usually available as an attachment that allows a nozzle to be held like a pistol.

3.1.10 *rated pressure*—that pressure for which the nozzle is designed to operate at a specified flow rate(s).

3.1.11 *rotational-type control*—a control that rotates in a plane perpendicular to the axis of the nozzle.

4. Classification

4.1 Marine fire hose nozzles may be classified into four general construction types, as follows:

4.1.1 *Type I*—Pistol grip, lever-type control operated.

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[2] *Annual Book of ASTM Standards*, Vol 01.03.

[3] *Annual Book of ASTM Standards*, Vol 01.05.

[4] *Annual Book of ASTM Standards*, Vol 03.02.

[5] *Annual Book of ASTM Standards*, Vol 09.01.

[6] *Annual Book of ASTM Standards*, Vol 11.01.

[7] NFPA 1963 may be ordered by contacting the National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.

4.1.2 *Type II*—Nonpistol grip, lever-type control operated.

4.1.3 *Type III*—Break apart, pistol grip, lever-type control operated.

4.1.4 *Type IV*—Break apart, nonpistol grip, lever-type control operated.

4.2 Nozzle types may be subdivided into three general classes, as follows:

4.2.1 *Class I*—Constant flow rate.

4.2.2 *Class II*—Constant/select flow rate.

4.2.3 *Class III*—Constant pressure.

4.3 Classes may be subdivided into two general sizes, as follows:

4.3.1 *Size 38 mm*, with free swivel base.

4.3.2 *Size 64 mm*, with free swivel base.

5. Ordering Information

5.1 The following shall be specified when ordering:

5.1.1 Quantity,

5.1.2 Type (see 4.1),

5.1.3 Class (see 4.2),

5.1.4 Size (see 4.3),

5.1.5 Material (see 6.1.2, 9.8.1 and 12)[8]

5.1.6 Thread type[9]

6. Material and Manufacture

6.1 *Materials*:

6.1.1 All nozzle components and parts must be durable and demonstrate satisfactory operation during all performance tests in Section 9.

6.1.2 The nozzle body and any metal used in the construction of any part of the nozzle shall be corrosion resistant. Copper alloys containing more than 15 % zinc are prohibited in all parts that are in contact with the fluid flow. No aluminum alloys may be used except for nozzles being operated exclusively with fresh water. No ferrous material may be used except for the Type 300 series stainless steel for wire and springs in accordance with Specifications A 313 or A 580/A 580M and for screws and pins in accordance with Specification A 582/A 582M.

6.1.3 All nonmetallic materials or synthetic elastomers used to form a seal or gasket shall have the following properties:

6.1.3.1 uniform dimensions,

6.1.3.2 be of such size, shape, and resiliency as to withstand ordinary usage and foreign matter carried by water, including petrochemical solvents and high alkaline solutions such as those used for cleaning nozzles (see 6.2), and

6.1.3.3 be able to withstand ozone and ultraviolet light exposure if used on the external portion of the nozzle.

6.1.4 All materials shall have tensile set of not more than 5 mm as determined in accordance with 6.2.1, and compression set not more than 15 % as determined in accordance with 6.2.2.

6.2 *Specific Requirements for Rubber Sealing Materials*:

6.2.1 *Tensile Strength, Ultimate Elongation, and Tensile Set Tests*:

6.2.1.1 Tensile strength, ultimate elongation, and tensile set shall be determined in accordance with Test Method D 412, Method A, except that, for tensile set determinations, the elongation shall be maintained for only 3 min, and the tensile set shall be measured 3 min after release of the specimen. The elongation of a specimen for a tensile set determination is to be such that the bench marks 25 mm apart become separated to a distance of 76 mm.

6.2.1.2 If a specimen breaks outside the bench marks, or if either the measured tensile strength or ultimate elongation of the specimen is less than the required value, an additional specimen shall be tested, and those results shall be considered final. Results of tests for specimens that break in the curved portion just outside the bench marks may be accepted if the measured strength and elongation values are within the minimum requirements.

6.2.2 *Compression Set Test*:

6.2.2.1 Type I specimens of the material shall be prepared and the test conducted in accordance with Test Methods D 395, Method B. The specimens shall be exposed for 22 h at 22°C.

6.2.3 *Accelerated Aging Test*:

6.2.3.1 Specimens shall be prepared in the same manner as for tensile strength and ultimate elongation and ultimate elongation tests, except for the bench marks 25 mm apart that shall be stamped on the specimen after the test exposure. The exposure shall be conducted in accordance with Test Method D 572.

6.2.3.2 All materials must retain not less than 70 % of the as-received tensile strength and ultimate elongation after the accelerated aging test.

6.2.4 Silicone rubber (rubber having polyorganosiloxane as its characteristic constituent) shall have a tensile strength of not less than 3.5 MPa and at least 100 % ultimate elongation as determined in accordance with 9.3.2.

6.2.5 Sealing material other than silicone rubber shall have a tensile strength of not less than 10 MPa and at least 200 % ultimate elongation as determined in accordance with 6.2.1.

7. Configuration

7.1 All nozzles shall consist of the following components and design:

7.1.1 Nozzle body

7.1.2 Free swivel coupling

7.1.3 Shutoffs

7.1.4 Shutoff seats

7.1.5 Shutoff handle

7.1.6 Bumper guard

7.1.7 Seals

7.1.8 Flushing feature

7.1.9 Pistol grip (optional)

7.1.10 Break apart feature (optional)

7.2 Nozzles shall be provided with a lever-type control shutoff handle which shall be in the closed position when the handle is closest to the discharge end of the nozzle. Lever-type control of the flow rate must also be by means of the shutoff handle.

7.2.1 The inside clearances of the shutoff handle shall be a minimum of 75 mm wide by 25 mm high.

7.2.2 The shutoff handle shall be of such a size that the

[8] Nozzle material should be galvanically compatible with the intended fire hose couplings.

[9] Threads should conform to a recognized industry standard such as NFPA 1963.

operator's hand in a fireman's glove and closed on the handle does not interfere with the operation of the shutoff handle in any position.

7.3 Spray pattern adjustment shall be by means of rotational controls. Rotational controls shall traverse from a wide angle spray pattern to narrow angle, to straight stream in a clockwise manner when viewed from the hose coupling end of the nozzle. The wide and narrow angle spray patterns shall be enhanced with an impinging action by means of a minimum of one and a maximum of two rows of fixed or rotating teeth concentric to the discharge orifice.

7.4 Nozzles shall have a capability of clearing or flushing debris from the nozzle without shutting down the hose line. This may be accomplished either through the full open nozzle position or through a flush feature of the nozzle.

7.4.1 If used, the flush feature shall have a separate control, incorporate a detent, or shall required increased force to operate, to indicate to the firefighter when the flush feature is being engaged.

7.5 All features and controls shall be operable by one hand of the operator while the other hand is holding the nozzle.

7.6 A bumper shall be provided at the discharge end of the nozzle for protection against physical damage. The nozzle stem shall not extend past the bumper in any of the flow positions including flush.

7.7 The pistol grip, if one is provided, shall have four finger notches on the tip side and the minimum span and width shall be suitable for use with a hand wearing a typical fireman's glove.

7.8 Couplings shall be of a free swivel type.

7.9 Each nozzle shall be provided with a resilient gasket fitted in the nozzle coupling recess. The gasket shall have dimensions in accordance with NFPA 1963. Type III and IV nozzles shall incorporate an additional gasket to accommodate the break-apart feature.

7.10 Nozzles for use with 38-mm hoses shall weigh not more than 4.53 kg. Nozzles for use with 64-mm hoses shall weigh not more than 5.9 kg.

7.11 Shutoff seats shall be self-adjusting or shall be adjustable without disassembly of the nozzle.

7.12 All features which incorporate a stop, detent, separate control, or increased force to engage shall be clearly labeled, including the open and shutoff positions, pattern selection, and flow rate selection.

8. Workmanship, Finish and Appearance

8.1 All parts and assemblies of the nozzle including castings, forgings, molded parts, stampings, bearings, machined surfaces and welded parts shall be clean and free from sand, dirt, fins, pits, spurs, scale, flux, and other foreign material. All exposed edges shall be rounded or chamfered.

9. Design Qualification Tests

9.1 Four first production run specimens shall be randomly selected and subjected to the tests described in 9.3 through 9.13 in sequential order.

9.2 The specimens shall exhibit no permanent deformation that interferes with their proper operation during any test.

9.3 Nonmetallic components shall be subjected to the following specific testing:

9.3.1 *Aging Exposure*:

9.3.1.1 Aging tests shall be performed before all other tests identified in this standard.

9.3.1.2 The specimens shall be subjected to air-oven aging for 180 days at 70°C and then allowed to cool at least 24 h in air at 25°C and 50 % relative humidity.

9.3.1.3 At the conclusion of the test, the specimens shall be inspected and all functions shall be operated to ensure they operate properly. Cracking, crazing, or any other condition that interferes with the proper operation of any specimen shall constitute failure of this test.

9.3.2 *Ultraviolet Light-Water Exposure*:

9.3.2.1 Nozzle designs with exposed nonmetallic parts shall be subjected to ultraviolet light and water for 720 h.

9.3.2.2 The ultraviolet light shall be obtained from two stationary enclosed carbon-arc lamps. The arc of each lamp is to be formed between two vertical carbon electrodes, 13 mm in diameter, located at the center of a revolvable vertical cylinder, 787 mm in diameter and 450 mm in height. Each arc is to be enclosed with a number PX Pyrex-glass globe.

9.3.2.3 The water shall conform to Type IV water in Specification D 1193.

9.3.2.4 The specimens are to be mounted vertically on the inside of the revolvable cylinder, arcing the lamps, and the cylinder continuously revolved around the stationary lamps at 1 revolution per minute. A system is to be provided so that each specimen in turn is sprayed with water as the cylinder revolves. During the operating cycle, each specimen is to be exposed to the light and water spray for 3 min and the light only for 17 min (total 20 min). The air temperature within the revolving cylinder of the apparatus during operations is to be maintained at 65°C.

9.3.2.5 At the conclusion of the test, the specimens shall be inspected and all functions shall be operated to ensure they operate properly. Cracking, crazing, or any other condition which interferes with the proper operation of any specimen shall constitute failure of this test.

9.4 *Discharge Calibration Test*:

9.4.1 Constant flow rate specimens shall flow the rated discharge, plus 10 %, minus 0 %, measured at rated pressure, through the entire range of pattern setting from straight stream to wide angle spray.

9.4.2 Constant/select flow rate specimens shall flow the rated discharge, plus 10 %, minus 0 %, measured at rated pressure, for each flow rate selection through the entire range of pattern setting from straight stream to wide angle spray.

9.4.3 Constant flow rate specimens and select flow rate specimens are to be installed on a piezometer fitting of the same size as the nominal inlet thread size, attached to a calibrated laboratory quality flow meter, and supplied with a source of pressurized water. The water flow rate in liters per minute is to be recorded through the full range of pattern selection.

9.4.4 Constant pressure specimens shall be tested beginning with the minimum rated flow. The pressure at this flow shall be recorded. The flow rate and nozzle pressure shall be monitored through the entire range of pattern selection from straight

stream to wide angle spray. Any deviation over 2 % in flow rate or pressure shall constitute failure of this test. The flow rate shall be slowly increased to the maximum rated flow while the pressure is monitored. At the maximum rated flow, the flow rate and pressure shall be monitored throughout the entire range of pattern selection. Any deviation over 2 % in flow rate or pressure shall constitute failure of this test.

9.5 *Flow Pattern Test*:

9.5.1 Specimens shall develop discharge flow patterns varying from straight stream to wide angle spray while maintaining either constant flow rate or constant pressure.

9.5.2 The straight stream pattern setting shall provide a cohesive jet capable of delivering 90 % of the rated flow within a circle 400 mm in diameter at a distance of 8 m from the nozzle.

9.5.3 The spray pattern settings shall provide a full and uniform spray pattern of small droplets, and the spray pattern adjustments shall provide spray pattern angles ranging from 25° for narrow angle spray through at least 120° for wide angle spray at maximum flow rate.

9.6 *Flushing Test*:

9.6.1 The specimens shall be held vertically, discharge end down, and the controls placed in the flush position. A 7-mm ball must pass through each specimen without changes in the control position. The inability to pass the test ball will be considered failure of this test.

9.7 *Control Tests*:

9.7.1 *Lever-type controls*:

9.7.1.1 Not more than 80 N nor less than 35 N shall be required to open or close the shutoff handle against a minimum of 700-kPa nozzle inlet pressure.

9.7.1.2 The specimens shall be mounted in the closed position and subjected to a static pressure of 700 kPa. A dynomometer, which records the maximum force reading, shall be attached to the shutoff handle, where the handle would normally be held during operation. The shutoff handle shall be moved from the fully closed to fully open position for the full range of pattern adjustment. The maximum force shall be recorded. Next, the specimens shall be placed in the full flowing position and the inlet pressure shall be adjusted to 700 kPa. With this new pressure adjustment, the dynomometer shall be used when moving the shutoff handle through the full range of positions and maximum force again measured and recorded. The maximum force recorded in both directions shall not be greater than permitted in 9.7.1.1.

9.7.1.3 The specimens shall be mounted without any water pressure being applied and the shutoff handle shall be placed in a closed position. The handle shall be moved from the closed position and the force required to move the handle shall be measured with the dynomometer. The force to move the handle shall not be less than permitted in 9.7.1.1.

9.7.2 *Rotational-type controls*:

9.7.2.1 Designs incorporating rotational controls shall have the torque required to rotate the sleeve determined while the specimen inlet pressure is 700 kPa.

9.7.2.2 A length of twine or string, not to exceed 2-mm diameter, shall be wrapped around each specimen at the point where each specimen would normally be held while rotating the sleeve. The string shall be of sufficient length to wrap around each specimen at least six turns. The first two turns will overlap the starting end of the string, and the balance of the turns will not overlap any other turn. A force gauge, which records the maximum force reading, will be attached to a loop in the free end of the string.

9.7.2.3 The sleeve shall be rotated by pulling the force gauge perpendicular to the center of the axis of each specimen. As the pattern sleeve rotates, the string will unwind, so that the force always remains tangential to the sleeve.

9.7.2.4 The sleeve shall be rotated in either direction through the entire range of rotation and the maximum torque shall be calculated. The torque shall not be more than 2 N-m nor less than 0.5 N-m.

9.7.2.5 Free swivel-type couplings shall be tested in accordance with 9.7.2.2 through 9.7.2.4. The force required to rotate each specimen once the swivel is tightened onto a coupling shall be at least 50 N not less than 5 N greater than the force required to rotate the specimen controls.

9.8 *Corrosion Exposure*:

9.8.1 This test is not required for aluminum nozzles because of the restriction on their use in fresh water service only.

9.8.2 The specimens shall be supported vertically and exposed to salt spray as specified by Test Method B 117, Salt Spray (Fog) Testing, for 120 h.

9.8.3 After completion of the salt spray test, all controls shall operate without sticking or binding. There shall be no evidence of galvanic corrosion between dissimilar metals. For metallic specimens, this test shall be conducted immediately after the tests specified in 9.7.

9.9 *High Temperature Test*:

9.9.1 The specimens are to be conditioned at 60°C for 24 h. Immediately after being removed from the heating chamber, the specimens shall be tested for proper function of all controls. There shall be no binding, sticking, or malfunction of any function.

9.9.2 Within 3 min of removal from the heating chamber, the specimens shall be subjected to the Rough Usage Test in 9.11.

9.10 *Low Temperature Test*:

9.10.1 The specimens are to be conditioned at −37°C for 24 h. Immediately after being removed from the cooling chamber, the specimens shall be tested for proper operation. There shall be no binding, sticking, or malfunction of any function.

9.10.2 Within 3 min of removal from the cooling chamber, the specimens shall be subjected to the Rough Usage Test in 9.11.

9.11 *Rough Usage Test*:

9.11.1 Two of the four specimens shall be connected to a dry hose and dropped twice from a height of 2 m onto a concrete surface such that the point of impact is on the lever and twice such that the point of impact is on a side 90° from the lever. The same two specimens shall then be dropped twice from a height of 600 mm such that the point of impact is squarely on the discharge end of the nozzle. The two other specimens shall be connected to a wet hose and placed in the shutoff position. The static pressure shall be increased to 700 kPa. The test from the 2-m height shall be repeated. Specimens equipped with

pistol grips shall also be dropped twice while unconnected so that the point of contact is on the grip.

9.11.2 Following the drop test, the specimens shall be examined for cracking, breaking, and deformation that interferes with their proper operation. Specimens developing cracks or broken sections or failing to operate properly are considered failed.

9.11.3 Following the drop tests, the specimens shall be subjected to the Leakage Test and Hydrostatic Pressure Test in accordance with 9.12 and 9.13, respectively.

9.12 *Leakage Test*:

9.12.1 The leakage test shall be conducted during the Hydrostatic Pressure Test.

9.12.2 At the point during the Hydrostatic Pressure Test in which the hydrostatic pressure is the greater of 4000 kPa or 1½ times the rated pressure, the shutoff shall be fully opened and closed. After the shutoff has been closed, the leakage shall be measured and recorded. The maximum leakage allowed through the discharge orifice is ½ mL per min. There shall be no leakage through any part of the specimens other than the discharge orifice.

9.12.3 The leakage shall be measured and recorded again when the specimens are subjected to the final hydrostatic pressure in 9.13. Increases in leakage shall not exceed 1 mL per min.

9.13 *Hydrostatic Pressure Test*:

9.13.1 The specimens shall be rigidly mounted in a closed position. The static pressure shall be increased to 350 kPa and held for 30 s. The static pressure shall be increased in 350-kPa increments and held for 30 s at each pressure to a maximum static pressure of 7000 kPa. The final pressure shall be held for 1 min without rupture of any specimen.

9.14 *Operator Protection Test*:

9.14.1 Each specimen shall be coupled to a hose and rigidly mounted at a height of 1 m to the center of the specimen body. The specimen may be slightly inclined to simulate the typical position during normal use. The pressure shall be increased to an inlet pressure of 700 kPa. The water must be clear and clean, such as that from a municipal water supply.

9.14.2 A cross or grid on which to mount radiometers shall be positioned 300 mm directly behind the specimen body. The structure shall be perpendicular to the vertical plane of the specimen.

9.14.3 Radiometers shall be mounted on the structure at a distance of 600 mm above the specimen, 300 mm to the right, 300 mm to the left, and 300 mm below the specimen.

9.14.4 A heat source, such as a grid, tree, or framework of natural gas nozzles, shall be positioned directly in front of the specimen. The heat source must be located at a horizontal distance from the specimen so that it will not be cooled when operating the specimen wide angle spray pattern.

9.14.5 The heat source shall be operated to obtain a heat flux value of at least 26 kW/m^2 measured by the radiometers. The specimen shall be set to the wide angle flow pattern, opened, and tested for each rated flow. The heat flux shall be recorded for each radiometer and the average calculated.

9.14.6 The average heat flux obtained during each test must be 5.7 kW/m^2 or lower, and no individual heat flux value may be greater than 8.0 kW/m^2.

9.15 *Horizontal Distance*:

9.15.1 The specimens shall be coupled to a hose, rigidly mounted at a height of 1 m in the open position. The flow pressure shall be set at 350 kPa.

9.15.2 The specimens shall be placed in the straight stream position. The specimens may be inclined to achieve the maximum reach. For 38-mm designs, the horizontal distance from the nozzle orifice to the center of the water pattern at its furthest point shall be at least 18 m. For 64-mm designs, this distance shall be at least 24 m.

9.15.3 The test shall be repeated with the inlet pressure increased to 700 kPa. For 38-mm designs, the horizontal distance from the nozzle orifice to the center of the water pattern at its furthest point shall be at least 27 m. For 64-mm designs, this distance shall be at least 36 m.

10. Quality Conformance Testing

10.1 *Sampling for Quality Conformance Testing*:

10.1.1 A quantity of completed specimens in accordance with Table 1 shall be randomly selected from each lot and subjected to the Discharge Calibration Test, Flow Pattern Test, and Leakage Test described in 9.4, 9.5 and 9.12, respectively. The Leakage Test shall be conducted using the rated pressure and the maximum leakage allowed through the discharge orifice is ¼ mL per min. If one or more defects are found in any specimen, the entire lot represented by the specimen shall be considered failed. If a lot is considered failed, the entire lot may be screened for the defective characteristic(s).

11. Certification

11.1 When specified in the purchase order or contract, the purchaser shall be furnished certification that samples from each lot have been tested and inspected as directed in this specification and the requirements have been met. When specified in the purchase order or contract, a report of the test results shall be furnished.

12. Product Marking

12.1 In addition to markings required by any other section, the name of the manufacturer, the manufacturer's model number, the size (see 4.3), the thread type, and ASTM specification designation shall be marked on each nozzle. Furthermore, all nozzles manufactured with aluminum alloys shall be marked with the phrase "F.W. Only." All required markings, whether embossed or attached, shall be permanent and legible.

13. Keywords

13.1 fire hose; fire protection; marine; nozzle; ship; shipboard equipment

TABLE 1 Sampling for Quality Conformance Testing

Lot Size	Sample Size
2–8	All
9–300	10 %–8 minimum
Over 301	5 %–30 minimum