NFPA® 1964

Standard for Spray Nozzles

2008 Edition



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NFPA® 1964

Standard for

Spray Nozzles

2008 Edition

This edition of NFPA 1964, *Standard for Spray Nozzles,* was prepared by the Technical Committee on Fire Hose. It was issued by the Standards Council on December 11, 2007, with an effective date of December 31, 2007, and supersedes all previous editions.

This edition of NFPA 1964 was approved as an American National Standard on December 31, 2007.

Origin and Development of NFPA 1964

The first edition of NFPA 1964 was adopted in 1988 based on a need for a standard that applied to portable adjustable-pattern nozzles for general fire department use and for use on hose attached to standpipes. In the second edition, the text was editorially reworked to make the document more usable, and the details of a few of the test procedures were revised to better reflect how the nozzles are used in the field. The 1998 edition allowed for rating nozzles at other than the traditional 6.9 bar (100 psi); added requirements for marine nozzles; and clarified the testing process, methods, and procedures to improve the understanding of the compliance testing required.

The 2003 edition expanded the document to cover master stream spray nozzles up to 7570 L/min (2000 gpm) in addition to handline spray nozzles. Requirements for marking nozzles were allowed to be in either SI or U.S. units. The pass/fail criteria for some tests were revised to base them on requirements for the nozzle in the standard rather than on results of previous testing. The parenthetical expression "(Shutoff and Tip)" was removed from the title of the standard. The document was completely revised for compliance with the *Manual of Style for NFPA Technical Committee Documents*, and changes were made to improve the clarity of the requirements.

The 2008 edition of this standard is a general update and review by the committee.

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NOTE: Membership on a committee shall not in and of itself constitute an endorsement of the Association or any document developed by the committee on which the member serves.

Committee Scope: This Committee shall have primary responsibility for documents on the size and design of fire hose connections, and the performance, maintenance, and selection of all types of fire hose, couplings, nozzles, and accessory equipment.

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NFPA 1964

Standard for

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Changes other than editorial are indicated by a vertical rule beside the paragraph, table, or figure in which the change occurred. These rules are included as an aid to the user in identifying changes from the previous edition. Where one or more complete paragraphs have been deleted, the deletion is indicated by a bullet (•) between the paragraphs that remain.

Information on referenced publications can be found in Chapter 2 and Annex B.

Chapter 1 Administration

1.1* Scope. This standard covers the requirements for new adjustable-pattern spray nozzles intended for general fire-fighting use, for marine and offshore platform fire-fighting use, or for use with fire hoses affixed to standpipe systems.

1.2 Purpose. The purpose of this standard shall be to provide minimum performance requirements for fire-fighting spray nozzles to assure purchasers or authorities having jurisdiction that nozzles that comply with this standard are suitable for fire suppression use.

1.3 Application. These requirements shall apply to the following:

(1) Manually operated basic spray, constant gallonage, and constant pressure spray nozzles whether designed as handline nozzles or master stream nozzles
(2) Nozzles that have a rated discharge of 7570 L/min (2000 gpm) or less
(3) Nozzles for use on Class A and Class B fires

1.4 Equivalency. Nothing in this standard shall prevent the use of systems, methods, or devices of equivalent or superior quality, strength, fire resistance, effectiveness, durability, and safety over those prescribed by this standard. Technical documentation shall be submitted to the authority having jurisdiction to demonstrate equivalency. The system, method, or device shall be approved for the intended purpose by the authority having jurisdiction.

1.5* Units of Measurement. In this standard, metric values for measurement are followed by an equivalent in U.S. units. Either set of values can be used, but the same set of values (either SI or U.S. units) shall be used throughout.

Chapter 2 Referenced Publications

2.1 General. The documents or portions thereof listed in this chapter are referenced within this standard and shall be considered part of the requirements of this document.

2.2 NFPA Publications. National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02169-7471.

NFPA 1963, *Standard for Fire Hose Connections,* 2003 edition.

2.3 Other Publications.

2.3.1 ASTM Publications. American Society for Testing and Materials, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959.

ASTM B 117, *Standard Practice for Operating Salt Spray (Fog) Apparatus,* 1997.

ASTM D 395, *Standard Test Methods for Rubber Property — Compression Set,* 1998.

ASTM D 412, *Standard Test Methods for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers — Tension,* 1998.

ASTM D 573, *Standard Test Method for Rubber — Deterioration in an Air Oven,* 1999.

2.3.2 ISO Publications. International Organization for Standardization, 1, ch. de la Voie-Creuse, Case postale 56, CH-1211 Genève 20, Switzerland.

ISO 9001, *Quality Systems — Model for quality assurance in design, development, production, installation, and servicing,* 1994.

ISO 9002, *Quality Systems — Model for quality assurance in production, installation, and servicing,* 1994.

2.3.3 Other Publications.

Merriam-Webster's Collegiate Dictionary, 11th edition, Merriam-Webster, Inc., Springfield, MA, 2003.

2.4 References for Extracts in Mandatory Sections. (Reserved)

Chapter 3 Definitions

3.1 General. The definitions contained in this chapter shall apply to the terms used in this standard. Where terms are not defined in this chapter or within another chapter, they shall be defined using their ordinarily accepted meanings within the context in which they are used. *Merriam-Webster's Collegiate Dictionary,* 11th edition, shall be the source for the ordinarily accepted meaning.

3.2 NFPA Official Definitions.

3.2.1* Approved. Acceptable to the authority having jurisdiction.

3.2.2* Authority Having Jurisdiction (AHJ). An organization, office, or individual responsible for enforcing the requirements of a code or standard, or for approving equipment, materials, an installation, or a procedure.

3.2.3 Shall. Indicates a mandatory requirement.

3.2.4 Should. Indicates a recommendation or that which is advised but not required.

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3.3 General Definitions.

3.3.1 Control.

3.3.1.1 ***Lever-Type Control.*** A control in which the handle operates along the axis of the nozzle.

3.3.1.2 ***Rotational-Type Control.*** A control that rotates in a plane perpendicular to the axis of the nozzle.

3.3.2* Flush. A nozzle feature that allows the orifice to be opened so that small debris that could otherwise be trapped in the nozzle, causing pattern disruptions and discharge variation, can pass through.

3.3.3 Full-Time Swivel. A connection that allows one side of the connection to swivel or rotate in relation to the other side after the connection has been tightened together.

3.3.4* Handline Nozzle. A nozzle with a rated discharge of less than 1325 L/min (350 gpm).

3.3.5* Master Stream Nozzle. A nozzle with a rated discharge of 1325 L/min (350 gpm) or greater.

3.3.6 Pressure.

3.3.6.1* ***Normal Pressure.*** Pressure created by forces acting perpendicular to the pipe wall at the point where a pressure tap is made.

3.3.6.2* ***Nozzle Pressure.*** The normal pressure measured at the inlet of the nozzle.

3.3.6.3 ***Rated Pressure.*** The pressure at which a nozzle is designed to operate to produce a specified discharge.

3.3.6.3.1 ***Maximum Rated Pressure.*** The maximum pressure at which the manufacturer determines it is safe to operate the nozzle.

3.3.7 Rated Discharge. The rate(s) at which a nozzle is designed to flow water when operated at its rated pressure.

3.3.8 Spray Nozzle. An appliance intended for connection to a hose line or monitor to discharge water in either a spray pattern or a straight stream pattern as selected by the operator.

3.3.8.1* ***Basic Spray Nozzle.*** An adjustable-pattern spray nozzle in which the rated discharge is delivered at a designated nozzle pressure and nozzle setting.

3.3.8.2* ***Constant Gallonage Spray Nozzle.*** An adjustable-pattern spray nozzle that discharges a constant discharge rate throughout the range of patterns from a straight stream to a wide spray at a designed nozzle pressure.

3.3.8.3* ***Constant Pressure (Automatic) Spray Nozzle.*** An adjustable-pattern spray nozzle in which the pressure remains relatively constant through a range of discharge rates.

3.3.8.4* ***Constant/Select Gallonage Spray Nozzle.*** A constant discharge rate spray nozzle with a feature that allows manual adjustment of the orifice to effect a predetermined discharge rate while the nozzle is flowing.

3.3.9 Standpipe System. An arrangement of piping, valves, hose connections, and allied equipment installed in a building or structure such that, when supplied with adequate water, allows attached hose lines to be used to extinguish a fire.

Chapter 4 Operational Design Requirements

4.1 Discharge Performance.

4.1.1* The nozzle rating shall be expressed as a rated discharge at a rated pressure [e.g., 225 L/min at 6.9 bar (60 gpm at 100 psi)].

4.1.2 Basic spray nozzles shall flow no less than the rated discharge and no more than 10 percent over the rated discharge at the rated pressure when tested in accordance with Section 6.1.

4.1.3 Constant gallonage spray nozzles shall flow no less than the rated discharge at the rated pressure and no more than 10 percent over the rated discharge at the rated pressure when tested in accordance with Section 6.1.

4.1.4 Constant/select gallonage spray nozzles shall meet the requirements of 4.1.3 at each predetermined discharge rate.

4.1.5 Constant pressure (automatic) spray nozzles shall maintain their rated pressure ±1 bar (±15 psi) throughout the rated discharge range when tested in accordance with Section 6.1.

4.2 Discharge Pattern.

4.2.1 Spray nozzles shall be capable of developing discharge patterns varying from straight stream to at least 100 degrees spray angle.

4.2.2 The straight stream pattern setting shall provide a cohesive jet capable of delivering 90 percent of the rated discharge within a circle 305 mm (12 in.) in diameter at a distance of 3 m (10 ft) from the nozzle if the nozzle's rated discharge is less than 1325 L/min (350 gpm), and within a circle 381 mm (15 in.) in diameter at a distance of 3 m (10 ft) from the nozzle if the nozzle's rated discharge is 1325 L/min (350 gpm) or greater.

4.2.3* Spray pattern settings shall provide a full and uniform spray pattern.

4.3* Spray Nozzle Controls.

4.3.1 If the spray nozzle is designed to be used on a handline, the nozzle shall have a water discharge control capable of functions ranging from full discharge to complete shutoff of the nozzle discharge. This control device shall be permitted to be a permanently mounted valve or a break-apart shutoff butt assembly.

4.3.2 Nozzles equipped with a lever-operated shutoff handle shall be in the closed position when the handle is closest to the discharge end of the nozzle.

4.3.3 Nozzles equipped with a linear-acting pattern control lever or handle shall be in the straight stream position when the handle is closest to the discharge end of the nozzle.

4.3.4 Rotational controls shall traverse from a wide angle spray pattern to narrow spray, to straight stream, and to shutoff position on nozzles so equipped, in a clockwise manner, when viewed from the rear of the nozzle.

4.3.5 Trigger-type lever controls shall be in the open position when squeezed and the closed position when released.

4.3.6 Lever-type controls shall require a force of no more than 71.2 N (16 lbf) and no less than 13.4 N (3 lbf) to open or close the shutoff or to adjust the stream pattern when tested in accordance with 6.3.1.

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4.3.7 For rotational-type controls, the operational force required to change the pattern setting and change the discharge, as well as to just close (without discharge), to fully close, to just open (leak), and to fully open the valve, shall not exceed 178 N (40 lbf) and shall not be less than 13.4 N (3 lbf) when tested in accordance with 6.3.2 and 6.3.4.

4.3.8* All controls for nozzle functions such as pattern selection, flush, discharge adjustments, and shutoff shall operate with a force not greater than 25 percent over the maximum allowed at 6.9 bar (100 psi) after the entire nozzle has been subjected to a pressure of the higher of either 20.7 bar (300 psi) or one and one-half times the maximum rated pressure for 3 minutes.

4.3.9 Full-Time Swivel.

4.3.9.1 Nozzles equipped with a full-time swivel shall require a minimum force of 44.5 N (10 lbf) to rotate the nozzle when tested in accordance with 6.3.3.

4.3.9.2 Nozzles equipped with both rotational pattern controls and a full-time swivel shall have the force required to rotate the full-time swivel at least 4.5 N (1 lbf) greater than the force required to rotate the pattern control, as defined in 4.3.7.

4.4* Threads. All spray nozzles, shutoffs, and tips shall be manufactured with National Hose (NH) thread conforming to NFPA 1963, unless otherwise designated by the AHJ.

4.5 Flushing. All spray nozzles shall be designed to clear or flush the size of debris specified in Table 4.5 from the nozzle without shutting off the water to the hose. This flushing shall be permitted to be accomplished either through the full open nozzle position or through a flush feature of the nozzle.

Table 4.5 Size of Debris Nozzle Must Clear

Rated Discharge		Size of Steel Ball	
L/min	gpm	mm	in.
<230	<60	3.18	⅛
230–570	60–150	4.76	3⁄16
>570	>150	6.35	¼

4.5.1 Nozzles shall be tested in accordance with Section 6.2 to verify compliance with Section 4.5.

4.5.2 Nozzles equipped with a flush feature shall have a separate control or detent, or require increased force to indicate to the fire fighter when the flush feature is being engaged.

4.6 Leakage. Nozzles equipped with a shutoff shall be pressurized to 55.2 bar (800 psi) or one and one-half times the rated pressure, whichever is higher, after all air has been bled from the nozzle and the shutoff has been closed.

4.6.1 The pressure shall be held for 3 minutes and the leakage, if any, shall be measured.

4.6.2 The maximum leakage allowed through the discharge orifice shall be 12 drops per minute (½ ml/min).

4.6.3 Leakage through any part of the nozzle other than the discharge orifice shall not be permitted.

4.7 Rough-Handling Tests for Handline Nozzles.

4.7.1 Handline nozzles shall be capable of continued operation after being subjected to the rough-handling tests in Section 6.7.

4.7.2 The nozzle shall not deform or break beyond the point where it affects the operational use of the nozzle as defined in the requirements of this standard.

4.7.3 All nozzle functions such as pattern selection, flush, discharge adjustment, and shutoff shall operate as described in Section 4.3. The operating force shall not increase more than 10 percent from that allowed before the test.

4.7.4 Following performance of the test in 4.7.3, samples shall again be subjected to the leakage test defined in Section 4.6. The leakage shall not increase by more than 10 percent from that allowed before the test.

4.8 Rough-Handling Tests for Master Stream Nozzles.

4.8.1 Master stream nozzles shall be capable of continued operation after being subjected to the rough-handling tests in Section 6.8. This requirement shall not apply to flange-mounted nozzles.

4.8.2 The nozzle shall not deform or break beyond the point where it affects the operational use of the nozzle as defined in the requirements of this standard.

4.8.3 All nozzle functions such as pattern selection, flush, discharge adjustment, and shutoff shall operate as described in Section 4.3. The operating force shall not increase more than 10 percent from that allowed before the test.

4.9 Handholds, Handgrips, and Ladder Hooks.

4.9.1 Dual handholds, single handgrips, or ladder hooks provided on handline nozzles shall support a 1335 N (300 lbf) nozzle reaction force when tested in accordance with Section 6.12.

4.9.2 If more than one feature is provided on the same nozzle, each feature shall be tested separately.

4.9.3 Test samples that distort or develop cracks or broken sections shall be considered as having failed to meet the test criteria.

4.10 Markings.

4.10.1 Each nozzle shall be permanently identified with the following information using figures and letters not less than 4.8 mm (3⁄16 in.) in height:

(1) Name of manufacturer
(2) Unique product or model designation
(3) All other markings required by this standard

4.10.2 All markings of pressure or flow shall be permitted to be in either SI or U.S. units.

4.10.3 Each spray nozzle shall be marked with the rated pressure of the nozzle.

4.10.4 Each spray nozzle shall be marked with the flow rate at positions of straight stream and full spray.

4.10.4.1 Select gallonage nozzles shall be marked to indicate the flow rate at each setting.

4.10.4.2 Constant pressure (automatic) nozzles shall be marked with the minimum and maximum discharge.

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4.10.5 Nozzles equipped with a flush feature shall indicate the flush operating position with the word "FLUSH."

4.10.6 Adjustable-pattern nozzles shall be marked to indicate straight stream and spray pattern settings, or arrows shall indicate the direction of adjustments for straight stream or spray pattern.

4.11 Handline Nozzles for Use in Marine and Offshore Platform Applications. Handline spray nozzles intended for firefighting use by personnel aboard ships and offshore platforms, and for other marine applications, shall meet the requirements of this section.

4.11.1 The nozzle shall comply with all of the requirements of this standard.

4.11.2 The nozzle shall be of the constant gallonage during pattern change type and shall use a lever-type shutoff.

4.11.3 The nozzle shall be constructed of materials having inherent resistance to corrosion, or of materials that are coated, finished, or otherwise protected such that the material withstands unprotected outdoor exposure including the following:

(1) Prolonged sunlight
(2) Continuous salt air
(3) Saltwater residue

4.11.4 Nozzles shall be marked "Flush With Fresh Water After Each Use."

4.11.5 Salt Spray Resistance.

4.11.5.1 Nozzles on Vessels on Saltwater Routes.

4.11.5.1.1 When nozzles are tested for corrosion resistance in accordance with Section 5.4 and Section 6.9, they shall be subject to 720 hours of exposure to the salt spray with the nozzle shutoff valve in the open position in order to allow salt spray infiltration.

4.11.5.1.2 Nozzles shall be permanently marked "Marine."

4.11.5.2 Nozzles on Vessels with Routes Limited to Lakes and Other Bodies of Fresh Water. Nozzles shall be permanently marked "Marine — Fresh Water Only."

4.11.6* Nozzle Rating.

4.11.6.1 Nozzle for 38 mm or 45 mm (1½ in. or 1¾ in.) Hose.

4.11.6.1.1 Each marine nozzle for use with 38 mm or 45 mm (1½ in. or 1¾ in.) hose shall be permanently marked with the rated pressure or pressure range.

4.11.6.1.2 The rated pressure shall be the minimum nozzle pressure necessary to separately accomplish all of the requirements of 4.11.6.1.2(A) through 4.11.6.1.2(C).

(A) The spray pattern shall be adequately developed to meet the performance requirement of 4.2.3.

(B) The straight stream shall have a minimum effective reach of 17 m (55 ft).

(C) The nozzle shall be capable of flowing 340 L/min (90 gpm) at its rated pressure.

4.11.6.2 Nozzle for 65 mm (2½ in.) Hose.

4.11.6.2.1 Each marine nozzle for use with 65 mm (2½ in.) hose shall be permanently marked with the rated pressure or pressure range.

4.11.6.2.2 The rated pressure shall be the minimum nozzle pressure necessary to separately accomplish all of the requirements of 4.11.6.2.2(A) through 4.11.6.2.2(C).

(A) The spray pattern shall be adequately developed to meet the performance requirement of 4.2.3.

(B) The straight stream shall have a minimum effective reach of 20 m (65 ft).

(C) The nozzle shall be capable of flowing 852 L/min (225 gpm) at its rated pressure.

4.11.7 Marine nozzles shall be listed and marked to identify the listing organization.

4.11.7.1 Nozzles manufactured to comply with this standard under a process certified to ISO 9001 or ISO 9002, by a marine classification society or other organization acceptable to the AHJ shall not be required to meet 4.11.7.

4.11.7.2* Nozzles manufactured under a quality control program approved by the AHJ shall not be required to meet 4.11.7.

4.11.8 Each nozzle shall be tested by the manufacturer for flow calibration, pattern, and leakage to ensure compliance with the manufacturer's specifications.

Chapter 5 Construction Materials

5.1* Hydrostatic Strength.

5.1.1 Nozzles shall be designed to withstand a hydrostatic pressure of 62 bar (900 psi) or three times the maximum rated pressure, whichever is higher.

5.1.2 The hydrostatic strength shall be confirmed by testing in accordance with Section 6.4.

5.2 High-Temperature Exposure.

5.2.1 The nozzle shall be capable of operation after storage in temperatures of 57°C (135°F).

5.2.2 Test samples that develop cracks or broken sections, or that fail to meet the operational control requirements in Section 4.3 after being tested in accordance with Section 6.5, shall be considered as having failed to meet this requirement.

5.3 Low-Temperature Exposure.

5.3.1 The dry nozzle shall be capable of operation in temperatures as low as –32°C (–25°F).

5.3.2 Test samples that develop cracks or broken sections, or that fail to meet the operational control requirements in Section 4.3 after being tested in accordance with Section 6.6, shall be considered as having failed to meet this requirement.

5.4* Corrosion Exposure.

5.4.1 All functions such as pattern selection, flush, discharge adjustments, and shutoff shall continue to meet the requirements of Section 4.3 after the nozzle has been subjected to a salt spray test in accordance with Section 6.9.

5.4.2 The nozzle shall then be tested for any leakage in accordance with Section 4.6.

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5.5 Ultraviolet Light and Water Exposure of Nonmetallic Nozzle Components.

5.5.1 Exposed nonmetallic parts on a nozzle shall not crack or craze when subjected to ultraviolet light and water.

5.5.2 If the nozzle has exposed nonmetallic parts, it shall be tested as described in Section 6.10.

5.5.3 At the conclusion of the test, the nozzle shall be inspected for cracking or crazing, the presence of which indicates failure of the test.

5.5.4 All functions such as pattern selection, flush, discharge adjustment, and shutoff shall continue to meet the requirements in Section 4.3.

5.6 Aging Exposure of Nonmetallic Nozzle Components.

5.6.1 A nozzle with nonmetallic components, other than rubber gaskets where a nozzle connects to a hose line, shall be subjected to the air-oven aging test as described in Section 6.11.

5.6.2 The nozzle shall then meet the rough usage requirements in Section 4.7 for handline nozzles or Section 4.8 for master stream nozzles.

5.6.3 At the conclusion of this testing, the nozzle shall be inspected for cracking or crazing, the presence of which indicates failure of the test.

5.7 Stress Cracking. Nozzles or components made from copper alloys containing more than 15 percent zinc shall withstand exposure to a moist ammonia–air mixture without developing stress cracks when tested in accordance with Section 6.13.

5.8 Rubber Sealing Materials.

5.8.1 A rubber material or synthetic elastomer used to form a seal shall have the properties described in 5.8.1.1 through 5.8.1.4 in the as-received condition.

5.8.1.1* Silicone rubber shall have a tensile strength of not less than 3.4 MPa (500 psi) and at least 100 percent ultimate elongation, determined in accordance with Section 6.14.

5.8.1.2 Material other than silicone rubber shall have a tensile strength of not less than 10.3 MPa (1500 psi) and at least 200 percent ultimate elongation, determined in accordance with Section 6.14.

5.8.1.3 The rubber material or synthetic elastomer shall have a tensile set of not more than 19 percent, determined in accordance with 6.14.1.

5.8.1.4 The rubber material or synthetic elastomer shall have a compression set of not more than 15 percent, determined in accordance with Section 6.15.

5.8.2 The rubber material or synthetic elastomer shall have not less than 80 percent of the as-received tensile strength and not less than 50 percent of the as-received ultimate elongation after it has been through the accelerated aging test in accordance with Section 6.16.

Chapter 6 Test Methods

6.1 Discharge Test.

6.1.1 Test Equipment.

6.1.1.1 Pressure gauges connected to a piezometer ring shall be used to measure the water pressure at the nozzle inlet.

6.1.1.2 When testing nozzles equipped with a 38 mm (1½ in.) connection at a discharge rate of 946 L/min (250 gpm) and higher, the pressure gauge shall be mounted on a 65 mm (2½ in.) waterway.

6.1.1.2.1 A tapered adaptor shall be used between the 65 mm (2½ in.) waterway and the 38 mm (1½ in.) inlet to the nozzle.

6.1.1.2.2 The maximum included angle of the adaptor shall be 30 degrees.

6.1.2 Test Procedure.

6.1.2.1 The nozzle shall be mounted such that the discharge rate through the nozzle and pressure at the inlet to the nozzle can be measured.

6.1.2.2 With the shutoff fully open, the inlet pressure shall be adjusted to the rated pressure, ±2 percent.

6.1.2.3 Basic spray nozzles shall be tested and discharge measurement taken in both straight stream and wide angle spray pattern settings after the nozzle pressure has been adjusted as specified in 6.1.2.2 for each of the pattern settings.

6.1.2.4 Constant gallonage spray nozzles shall be tested and the discharge shall be monitored through the full range of pattern selection.

6.1.2.5 Constant/select gallonage spray nozzles shall be tested at each discrete discharge selection.

6.1.2.5.1 The nozzle pressure shall be adjusted as specified in 6.1.2.2 for each discrete discharge selection.

6.1.2.5.2 The discharge shall be monitored through the entire range of pattern selection.

6.1.2.6 Constant pressure (automatic) spray nozzles shall be tested on the same equipment specified in 6.1.1.

6.1.2.6.1 The discharge shall be increased to the minimum rated discharge and the pressure at this discharge shall be recorded.

6.1.2.6.2 The discharge and nozzle pressure shall be monitored through the entire range of pattern selection from straight stream to wide angle spray, and any deviation greater than 2 percent in discharge or pressure shall be recorded.

6.1.2.6.3 The discharge rate shall continue to be slowly increased to the maximum rated discharge and the minimum and maximum pressures throughout the discharge range shall be recorded.

6.1.2.6.4 At the maximum discharge rate, the discharge and the pressure shall be monitored through the entire range of pattern selection from straight stream to wide angle spray and any deviation greater than 2 percent in discharge or pressure shall be recorded.

6.2 Flush Test.

6.2.1 Nozzles shall be held in the vertical position, discharge end down, with the nozzle in either the fully open or flush position.

6.2.2 The appropriate size steel ball shall pass through the nozzle without changes in the control position.

(A) For nozzles with discharge rates up to 230 L/min (60 gpm), a 3.18 mm (⅛ in.) steel ball shall be used.

(B) For nozzles with discharge rates of 230 L/min to 570 L/min (60 gpm to 150 gpm), a 4.76 mm (3⁄16 in.) steel ball shall be used.

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(C) For nozzles with discharge rates greater than 570 L/min (150 gpm), a 6.35 mm (¼ in.) steel ball shall be used.

6.3 Control Tests.

6.3.1 Lever-Type Controls.

6.3.1.1 The nozzle shall be mounted in the closed position with an inlet pressure of 6.9 bar (100 psi).

6.3.1.1.1 A dynamometer, which records the maximum force reading, shall be attached to the lever or handle where it is designed to be held during operation.

6.3.1.1.2 The shutoff or pattern selection lever or handle shall be moved from the fully closed to fully open position for the full range of pattern adjustment and the maximum force recorded.

6.3.1.1.3 The inlet pressure shall be adjusted to 6.9 bar (100 psi) while in the full discharge position.

6.3.1.1.4 The dynamometer shall be used to measure the maximum force to move the lever through the full range of positions.

6.3.1.1.5 The maximum force required in both directions shall be recorded.

6.3.1.2 The nozzle shall be mounted without any pressure applied to it and the controlling lever shall be placed in the closed or full forward position.

6.3.1.2.1 The dynamometer shall be used to measure the force required to move the lever from the full forward position.

6.3.1.2.2 The force required to move the lever shall be recorded.

6.3.2 Rotational Pattern Control.

6.3.2.1 Nozzles equipped with rotational pattern control shall be mounted on a rigid device, and the force required to rotate the pattern sleeve shall be measured while water is discharging at 6.9 bar (100 psi).

6.3.2.2 A length of twine or string, not to exceed 2.9 mm (3⁄32 in.) in diameter, shall be wrapped around the nozzle at the point where the nozzle normally would be held while rotating the pattern sleeve.

6.3.2.2.1 The string shall be of sufficient length to wrap around the nozzle at least six times.

6.3.2.2.2 The first two turns shall overlap the starting end of the string, and the balance of the turns shall not overlap any other turn.

6.3.2.3 A force gauge, which records the maximum force reading, shall be attached to a loop in the free end of the string.

6.3.2.4 The pattern sleeve shall be rotated by pulling the force gauge perpendicular to the center axis of the nozzle such that, as the pattern sleeve rotates, the string will unwind so that the force always remains tangential to the pattern sleeve.

6.3.2.5 The pattern sleeve shall be rotated from the straight stream position to the wide spray position, and vice versa. If the nozzle is equipped with detents for the pattern settings, this test shall commence with the pattern sleeve in the straight stream and wide spray detent.

6.3.3 Full-Time Swivel.

6.3.3.1 Nozzles equipped with a full-time swivel shall be tested while water is discharging at the rated pressure of the nozzle.

6.3.3.2 A length of twine or string, not to exceed 2.9 mm (3⁄32 in.) in diameter, shall be wrapped around the nozzle at the point where the nozzle normally would be held while rotating the pattern sleeve.

6.3.3.3 The pattern sleeve of the nozzle shall be rotated to the end of its travel in the wide spray direction.

6.3.3.4 The force shall be applied tangentially with a dynamometer to determine the force required to rotate the nozzle, and this force shall be recorded.

6.3.4 Twist Shutoff.

6.3.4.1 A nozzle with a twist shutoff shall be mounted on a device equipped with a relief valve, or other means, to maintain 6.9 bar (100 psi) in both the closed position and the fully open position while flowing the rated discharge.

6.3.4.2 The test shall start with the nozzle in the closed position.

6.3.4.3 The force gauge shall be used to twist the shutoff to the fully open position, following the method outlined in 6.3.2.2 through 6.3.2.4.

6.3.4.4 The windings on the pattern sleeve shall be reversed, and the force gauge used as described in 6.3.2.4 to rotate the shutoff from the fully open to the fully closed position.

6.3.4.5 In the fully closed position, any leakage shall be measured and shall not exceed that allowed by 4.6.2.

6.4 Hydrostatic Test.

6.4.1 The nozzle shall be mounted in a closed position on a device capable of exerting a hydrostatic pressure of 62 bar (900 psi) or three times the maximum rated pressure, whichever is higher.

6.4.2 All air shall be bled out of the system.

6.4.3 The pressure shall be increased by 3.5 bar (50 psi) increments and held for 30 seconds at each pressure up to the maximum pressure for which the nozzle is being tested.

6.4.4 This maximum pressure shall be held for 1 minute without rupture of the nozzle.

6.4.5 Leakage shall not be permitted through any part of the nozzle other than the discharge orifice.

6.4.6 Increase in leakage through the discharge orifice shall be permitted beyond that allowed in Section 4.6.

6.5 High-Temperature Tests.

6.5.1 The nozzle shall be conditioned to 57°C (135°F) for 24 hours prior to the test.

6.5.2 Immediately after being removed from the heating chamber, the nozzle shall be tested for proper function of all adjustments and controls. Binding of any function, such as pattern selection, flush, discharge adjustment, or shutoff, shall not be permitted.

6.6 Low-Temperature Tests.

6.6.1 A dry nozzle shall be conditioned to –32°C (–25°F) for 24 hours prior to the test.

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6.6.2 Immediately after being removed from the cooling chamber, the nozzle shall be tested for proper function of all adjustments and controls. Binding of any function, such as pattern selection, flush, discharge adjustment, or shutoff, shall not be permitted.

6.6.3 Within 3 minutes after being removed from the cooling chamber, the nozzle shall be subjected to the rough-handling tests identified in Section 6.7 for handline nozzles or Section 6.8 for master stream nozzles.

6.7 Rough-Handling Tests for Handline Nozzles. Each nozzle shall be subject to the three tests in 6.7.1 through 6.7.3.

6.7.1 Test One.

6.7.1.1 The nozzle shall be attached to a length of hose at least 3 m (10 ft) long.

6.7.1.2 With the hose uncharged, the nozzle shall be dropped from a height of 2 m (6 ft) onto a concrete surface so that it impacts directly or squarely on the discharge end.

6.7.2 Test Two.

6.7.2.1 The nozzle shall be attached to a length of hose at least 3 m (10 ft) long.

6.7.2.2 With the hose uncharged, the nozzle shall be dropped twice from a height of 2 m (6 ft) onto a concrete surface so that the points of impact are on two different sides of the nozzle.

6.7.2.2.1 For nozzles equipped with a shutoff handle or lever, one of the points of impact shall be directly on that handle or lever while in the closed position.

6.7.2.2.2 For nozzles equipped with a handhold, handgrip, or ladder hook, one of the points of impact shall be on the handhold, handgrip, or ladder hook.

6.7.3 Test Three.

6.7.3.1 The nozzle shall be attached to a length of hose at least 3 m (10 ft) long.

6.7.3.2 With the nozzle shut off and the hose line charged with water to a pressure of 6.9 bar (100 psi), the nozzle shall be dropped twice from a height of 2 m (6 ft) onto a concrete surface so that the points of impact are on two different sides of the nozzle.

6.7.3.2.1 For nozzles equipped with a shutoff handle or lever, one of the points of impact shall be directly on that handle or lever while in the closed position.

6.7.3.2.2 For nozzles equipped with a handhold, handgrip, or ladder hook, one of the points of impact shall be on the handhold, handgrip, or ladder hook.

6.8 Rough-Handling Test for Master Stream Nozzles.

6.8.1 A plug shall be attached to the nozzle's threaded connection to protect the threads.

6.8.2 If the nozzle weighs less than 4.54 kg (10 lb), it shall be dropped four times from a height of 2 m (6 ft) onto a concrete surface so that it impacts directly or squarely once on its discharge end, at least once on each of two sides, and once on the plugged end.

6.8.3 If the nozzle weighs 4.54 kg (10 lb) or more, it shall be dropped four times from a height of 1 m (3 ft) onto a concrete surface so that it impacts directly or squarely once on its discharge end, at least once on each of two sides, and once on the plugged end.

6.9 Salt Spray Test. Test samples shall be supported vertically and exposed to salt spray (fog) for 120 hours, following the procedures specified by ASTM B 117.

6.10 Ultraviolet Light and Water Test.

6.10.1 Sample nozzles shall be exposed to ultraviolet light and water for 720 hours.

6.10.1.1 They shall be inspected for cracking and crazing after 360 hours.

6.10.1.2 If no cracking or crazing is apparent, the exposure shall continue for the full 720 hours.

6.10.2 Ultraviolet light shall be obtained from two stationary enclosed carbon-arc lamps.

6.10.2.1 The arc of each lamp shall be formed between two vertical carbon electrodes, 12.7 mm (½ in.) in diameter, located at the center of a revolvable vertical metal cylinder 787 mm (31 in.) in diameter and 451 mm (17¾ in.) in height.

6.10.2.2 Each arc shall be enclosed with a number PX clear Pyrex™ glass globe.

6.10.3 The samples shall be mounted vertically on the inside of the revolvable cylinder, arcing the lamps, and the cylinder shall revolve continuously around the stationary lamps at 1 rpm.

6.10.4 A system of nozzles shall be provided so that each sample in turn is sprayed with water as the cylinder revolves.

6.10.5 During each operating cycle, each sample shall be exposed to both the light and water spray for 3 minutes and to only the light for an additional 17 minutes (for a total 20 minutes).

6.10.6 The air temperature within the revolving cylinder of the apparatus during operations shall be 63°C ± 5°C (145°F ± 9°F).

6.11 Air-Oven Aging Tests. Samples of the nozzles shall be subjected to air-oven aging for 180 days at 70°C (158°F) and then allowed to cool at least 24 hours in air at 23°C (74°F) at 50 percent relative humidity.

6.12 Handholds, Handgrips, and Ladder Hooks. The sample nozzle shall be mounted in a fixture to simulate intended use and a force of 1335 N (300 lbf) shall be applied to the nozzle for 5 minutes to simulate the nozzle reaction force.

6.13 Moist Ammonia–Air Stress Cracking Test.

6.13.1 Each test sample shall be subjected to the physical stresses normally imposed on or within the sample as the result of assembly with other components or a coupling.

6.13.1.1 Such stresses shall be applied to the sample prior to the test and maintained during the test.

6.13.1.2 Each sample shall be connected to an appropriate male coupling and tightened to the minimum torque necessary to produce a leaktight assembly.

6.13.2 The sample shall be degreased and supported by an inert tray in a glass chamber with a glass cover 38.1 mm (1.5 in.) above an aqueous ammonia solution.

6.13.2.1 An aqueous ammonia solution having a specific gravity of 0.94 shall be maintained in the glass chamber at a volume of approximately 21.2 L/m^3 (0.16 gal/ft^3) of chamber capacity.

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6.13.2.2 The moist ammonia–air mixture in the chamber shall be maintained at atmospheric pressure and at a temperature of 34°C (93°F).

6.13.2.3 The sample shall be left in its set position and continuously exposed to the moist ammonia–air mixture for 10 days.

6.13.3 At the conclusion of the exposure, the sample shall show no evidence of cracking when examined using 25× magnification.

6.14 Tensile Strength, Ultimate Elongation, and Tensile Set Tests.

6.14.1 Tensile strength, ultimate elongation, and tensile set shall be determined in accordance with ASTM D 412, Method A, except that, for tensile set determinations, the elongation shall be maintained for only 3 minutes, and the tensile set shall be measured 3 minutes after release of the specimen.

6.14.2 The elongation of a specimen for a tensile set determination shall be such that the 25 mm (1 in.) spacing of the benchmarks increases to 76 mm (3 in.).

6.14.3 If a specimen breaks outside the benchmarks, 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.

6.14.4 Results of tests for specimens that break in the curved portion just outside the benchmarks shall be permitted to be accepted if the measured strength and elongation values are within the minimum requirements.

6.15 Compression Set Test.

6.15.1 Type I specimens of the material shall be prepared and the test conducted in accordance with ASTM D 395, Method B.

6.15.2 The specimens shall be exposed for 22 hours at 21°C ± 1°C (70°F ± 2°F).

6.16 Accelerated Aging Test.

6.16.1 Specimens shall be prepared in the same manner as for tensile strength and ultimate elongation tests, except that benchmarks spaced 25 mm (1 in.) apart shall be stamped on the specimens after the test exposure.

6.16.2 Specimens shall be tested at 100°C (212°F) for 70 hours in accordance with ASTM D 573.

Chapter 7 Compliance Testing

7.1* Certification. Performance of the nozzle to the requirements of this standard shall be certified by a testing laboratory or by the manufacturer.

7.2 Sample Selection.

7.2.1 A minimum of one nozzle shall pass each required test.

7.2.2* Multiple nozzles shall be permitted to be used during the testing process.

7.2.2.1 The same nozzle that is initially used to evaluate the requirements of Section 4.3 shall be used for the rough-handling evaluation *(see Section 4.7 and Section 4.8).*

7.2.2.2 The same nozzle that is used to test the high-temperature exposure *(see Section 5.2)* shall be used to test the low-temperature exposure *(see Section 5.3)* with the high-temperature exposure evaluation done first.

7.2.3 Any nozzle or nozzle components that have been subjected to the destructive tests to prove compliance with the requirements of this standard shall be considered unsuitable for in-service use.

7.3 Test Results.

7.3.1 The test results shall be kept on file by the manufacturer.

7.3.2 Copies shall be provided when requested by the purchaser.

7.4 Design Changes. Any changes to the design of the nozzle or in the materials of construction shall be cause for retesting.

Annex A Explanatory Material

Annex A is not a part of the requirements of this NFPA document but is included for informational purposes only. This annex contains explanatory material, numbered to correspond with the applicable text paragraphs.

A.1.1 While nozzles meeting the requirements of this standard are designed to be used in fire suppression, including hose lines on standpipe systems, the nozzles cannot be expected to provide satisfactory performance if adequate water pressure and volume are not available. Pressures available in standpipe systems are often controlled by pressure-reducing devices. Fire departments planning to use spray nozzles with standpipe systems should ensure the standpipe system can supply the necessary pressure and volume.

The inspection and care of in-service nozzles is covered by NFPA 1962.

A.1.5 Metric units of measurement in this standard are in accordance with the modernized metric system known as the International System of Units (SI). The liter unit is outside of, but recognized by, SI and commonly is used in international fire protection. Table A.1.5(a) provides the conversion factors that can be used where more precision is desired. Table A.1.5(b) provides a list of abbreviations for units of measure.

A.3.2.1 Approved. The National Fire Protection Association does not approve, inspect, or certify any installations, procedures, equipment, or materials; nor does it approve or evaluate testing laboratories. In determining the acceptability of installations, procedures, equipment, or materials, the authority having jurisdiction may base acceptance on compliance with NFPA or other appropriate standards. In the absence of

Table A.1.5(a) Conversion Factors

SI to U.S.	U.S. to SI
1 kPa = 0.145 psi	1 psi = 6.895 kPa
1 bar = 14.492 psi	1 psi = 0.0690 bar
1 kg = 2.205 lb	1 lb = 0.454 kg
1 mm = 0.039 in.	1 in. = 25.40 mm
1 m = 3.281 ft	1 ft = 0.305 m
1 L = 0.2642 gal	1 gal = 3.785 L
1 N = 0.2248 lbf	1 lbf = 4.45 N
1 MPa = 145 psi	1 psi = 0.006 MPa

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Table A.1.5(b) Abbreviations for Units of Measure

Abbreviation	Unit
ft	foot/feet
ft^2	square foot/feet
ft^3	cubic foot/feet
in.	inch(es)
kg	kilogram(s)
kPa	kilopascal(s)
lb	pound(s)
MPa	megapascal(s)
m	meter(s)
mm	millimeter(s)
m^2	square meter(s)
m^3	cubic meter(s)
psi	pound(s) per square inch

such standards, said authority may require evidence of proper installation, procedure, or use. The authority having jurisdiction may also refer to the listings or labeling practices of an organization that is concerned with product evaluations and is thus in a position to determine compliance with appropriate standards for the current production of listed items.

A.3.2.2 Authority Having Jurisdiction (AHJ). The phrase "authority having jurisdiction," or its acronym AHJ, is used in NFPA documents in a broad manner, since jurisdictions and approval agencies vary, as do their responsibilities. Where public safety is primary, the authority having jurisdiction may be a federal, state, local, or other regional department or individual such as a fire chief; fire marshal; chief of a fire prevention bureau, labor department, or health department; building official; electrical inspector; or others having statutory authority. For insurance purposes, an insurance inspection department, rating bureau, or other insurance company representative may be the authority having jurisdiction. In many circumstances, the property owner or his or her designated agent assumes the role of the authority having jurisdiction; at government installations, the commanding officer or departmental official may be the authority having jurisdiction.

A.3.3.2 Flush. When the flush feature is engaged, the nozzle pressure will drop and pattern will deteriorate. In fire fighting, caution should be exercised when the flush feature is engaged.

A.3.3.4 Handline Nozzle. Handline nozzles are normally used on hose lines that can be advanced and maneuvered by firefighting personnel while the nozzles are flowing.

A.3.3.5 Master Stream Nozzle. Master stream nozzles are normally used with monitors that can be supplied by either hose lines or fixed piping.

A.3.3.6.1 Normal Pressure. Normal pressure is measured with a ring gauge or piezometer ring attached to the base of a nozzle.

A.3.3.6.2 Nozzle Pressure. Pressure without discharge is known as static pressure. Pressure is measured in bars or pounds per square inch (psi).

A.3.3.8.1 Basic Spray Nozzle. Due to its basic design, as the pattern changes from straight stream to wide spray, the discharge rate will vary. The nozzle pressure will also be affected. These variations are caused by changes in the orifice size to affect pattern adjustment.

A.3.3.8.2 Constant Gallonage Spray Nozzle. Constant gallonage is accomplished by maintaining a constant orifice size during discharge pattern adjustment.

A.3.3.8.3 Constant Pressure (Automatic) Spray Nozzle. The constant pressure provides the velocity for an effective stream reach at various discharge rates. This constant pressure is accomplished by means of a pressure-activated self-adjusting orifice baffle.

A.3.3.8.4 Constant/Select Gallonage Spray Nozzle. Because these are constant gallonage nozzles, the discharge rate remains constant throughout the range of pattern selection from straight stream to wide spray.

A.4.1.1 Spray nozzles have traditionally been rated at 6.9 bar (100 psi). Lower rating pressures affect the stream's reach and the characteristics of spray patterns. The purchaser should ensure that the performance of a nozzle meets his or her needs and expectations.

A.4.2.3 Nozzles should be tested and visually inspected for full and uniform wide spray patterns as follows.

With the nozzle discharging horizontally 1 m (3 ft) above grade level, it should be set to discharge at its rated pressure and adjusted to the setting where it creates the largest-diameter pattern. The spray issuing from the nozzle should be conically or parabolically enlarging (referred to as the cone), and the center should be permitted to be either hollow or filled with spray.

The circumference of the spray should appear full and uniform. The entire circumference should be visually inspected for persistently weak or hollow areas. The spray sheet at the surface of the cone should not have hollow or weak areas larger than 25 mm (1 in.) wide as measured at a location 0.61 m (2 ft) from the center of the nozzle along the spray sheet (measured along the spray angle from the axis of the nozzle).

The thickness of the sheet of spray at the surface of the cone should be inspected by hand around its entire circumference. The sheet thickness should be at least 51 mm (2 in.) at a distance of 0.61 m (2 ft) from the center of the nozzle along the spray sheet (measured along the spray angle from the axis of the nozzle).

The cone should be visually inspected for flat spots, lobes, or spray ejected outside the general shape of the cone. Discontinuities of the cone shape should not exceed 51 mm (2 in.) when measured at a location 0.61 m (2 ft) from the center of the nozzle along the spray sheet (measured along the spray angle from the axis of the nozzle).

A.4.3 In order for a fire fighter to be effective in combating a fire, the fire fighter should be able to open and shut off the nozzle and make adjustments to the discharge and pattern without excessive exertion. Conversely, the controls should not be so loose as to be accidentally altered in normal handling.

This section is not intended to limit intentional self-operated or limiting control features, such as discharge-limiting "dead man" controls designed to reduce or shut off the water discharge when force is released from the control, or to limit pattern overtravel or limiting twist controls incorporated by design for special purposes.

A.4.3.8 If a master stream nozzle is equipped with a shutoff, it should be of a slow-operating type (i.e., it has a mechanism to prevent movement of the flow-regulating element from the

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fully closed position to the fully opened position or vice versa in less than 3 seconds).

A.4.4 The Committee recognizes that not all countries use the same type of hose threads. It is believed to be extremely important for fireground operations involving multiple jurisdictions to use a common type of thread. Each country should make an effort to standardize thread types. Since 1905, an effort has been made in the United States to standardize hose threads. NFPA 1963, provides criteria for the American National Fire Connection Screw Thread. The goal of NFPA 1963 is uniformity and interchangeability of fire hose coupling threads.

A.4.11.6 This standard does not dictate the operating pressure of the nozzle. Marine fire main systems have traditionally been designed to provide a minimum 3.45 bar (50 psi) nozzle pressure. However, vessel designers could design fire main systems for pressures in excess of 3.45 bar (50 psi) depending on the type of vessel and the nature of the vessel's fire risks. Caution should be exercised to ensure a match between the minimum nozzle rating and the actual fire main system performance. It is possible for two virtually identical marine nozzles to have operating pressures that are vastly different. For example, a marine nozzle for a tank ship could have a rating of 6.9 bar (100 psi) and not perform properly if installed on a dinner cruiser with a fire main pressure of 3.45 bar (50 psi). Nozzles should be rated for a pressure equal to or less than the actual pressure available when required streams are flowing. It is recognized that a nozzle could have a good pattern over a wide range of pressures and thus an allowance is made for the nozzle to have a rated pressure range rather than a single rated pressure.

A.4.11.7.2 While control of the initial quality of a nozzle can be reasonably assured through the manufacturing process, in-service readiness of any nozzle is primarily the responsibility of the owner. Nozzles should be inspected, tested, and maintained in accordance with NFPA 1962.

A.5.1 The nozzle and the hose with which it is used should be carefully matched. The pressure rating on the nozzle should be at least five times the service test pressure of the corresponding hose so that the hose will fail before the nozzle does.

A.5.4 The purpose of the salt spray test is to ensure nozzles will perform under normal exposure to mild corrosive conditions such as those found in the atmosphere near oceans or caused by chemicals used to treat road surfaces in icy conditions. If a nozzle is expected to be exposed to corrosive conditions on a long-term basis, or to be used where strong corrosives are present, the purchaser should ensure the nozzle is designed for such exposure.

A.5.8.1.1 Silicone rubber is rubber having poly-organosiloxane as its characteristic constituent.

A.7.1 When acceptance tests are desired on delivery, they should include the following items:

(1) Nozzle discharge performance as defined in Section 4.1
(2) Discharge patterns as defined in Section 4.2
(3) Field evaluation of the controls only as defined in Section 4.3
(4) Confirmation of the threads as defined in Section 4.4
(5) Confirmation of markings as defined in Section 4.10

A.7.2.2 It is not the intent of this standard to restrict the testing to a single nozzle that has to pass all tests. Multiple nozzles can be used to facilitate simultaneous testing.

Annex B Informational References

B.1 Referenced Publications. The documents or portions thereof listed in this annex are referenced within the informational sections of this standard and are not part of the requirements of this document unless also listed in Chapter 2 for other reasons.

B.1.1 NFPA Publications. National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02169-7471.

NFPA 1962, *Standard for the Inspection, Care, and Use of Fire Hose, Couplings, and Nozzles and the Service Testing of Fire Hose*, 2008 edition.

NFPA 1963, *Standard for Fire Hose Connections*, 2003 edition.

B.1.2 Other Publications. (Reserved)

B.2 Informational References. (Reserved)

B.3 References for Extracts in Informational Sections. (Reserved)

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Revise definition of effective ground-fault current path to read:

3.3.78 Effective Ground-Fault Current Path. An intentionally constructed, permanent, low impedance electrically conductive path designed and intended to carry ~~underground~~ electric fault current ~~conditions~~ from the point of a ground fault on a wiring system to the electrical supply source.

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