NFPA 1964
Standard for Spray Nozzles (Shutoff and Tip)

1998 Edition

National Fire Protection Association, 1 Batterymarch Park, PO Box 9101, Quincy, MA 02269-9101
An International Codes and Standards Organization

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1998 Edition

This edition of NFPA 1964, *Standard for Spray Nozzles (Shutoff and Tip)*, was prepared by the Technical Committee on Fire Hose and acted on by the National Fire Protection Association, Inc., at its Fall Meeting held November 17–19, 1997, in Kansas City, MO. It was issued by the Standards Council on January 16, 1998, with an effective date of February 6, 1998, and supersedes all previous editions.

This edition of NFPA 1964 was approved as an American National Standard on February 6, 1998.

Origin and Development of NFPA 1964

The Committee on Fire Hose felt there was 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. The first edition of this standard was adopted in 1988.

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.

In this 1998 edition, requirements for marine nozzles were added to Chapter 2, and the testing process, methods, and procedures were clarified to improve the understanding of the compliance testing required in Chapter 5.

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This list represents the membership at the time the Committee was balloted on the text of this edition. Since that time, changes in membership may have occurred. A key to classifications is found at the back of this document.

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.

Contents

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NOTICE: An asterisk (*) following the number or letter designating a paragraph indicates that explanatory material on the paragraph can be found in Appendix A.

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

Chapter 1 Administration

1-1* Scope. This standard applies to new portable adjustable-pattern nozzles intended for general fire department use; for marine and offshore platform use; or for use with fire hoses affixed to standpipe systems. Unless otherwise specified, these requirements apply to the following:

(a) Basic spray, constant gallonage, and constant pressure spray nozzles

(a) Nozzles with trade sizes of $^3/_4$ in. (19 mm), 1 in. (25 mm), $1^1/_2$ in. (38 mm), and $2^1/_2$ in. (65 mm), or as determined by trade sizes of the coupling

(b) Nozzles for use on Class A and Class B fires

1-2 Purpose. The purpose of this standard is to provide minimum performance and reliability requirements for spray nozzles to ensure purchasers or authorities having jurisdiction that nozzles that comply with this standard are suitable for fire suppression use.

1-3 Definitions.

Authority Having Jurisdiction.* The organization, office, or individual responsible for approving equipment, an installation, or a procedure.

Basic Spray Nozzle. An adjustable-pattern spray nozzle in which the rated discharge is delivered at a designated nozzle pressure and nozzle setting. Due to its basic design, as the pattern changes from a straight stream to a wide spray pattern, the discharge (gpm) will vary. The nozzle pressure will also be affected. This is caused by changes in the orifice size to affect pattern adjustment.

Constant Gallonage Spray Nozzle. An adjustable-pattern nozzle in which the water is discharged at a designed nozzle pressure. At the rated pressure, the nozzle will deliver a constant gallonage from a straight stream to a wide spray pattern. This is accomplished by maintaining a constant orifice size during discharge pattern adjustment.

Constant Pressure (Automatic) Spray Nozzle. An adjustable-pattern nozzle in which the pressure remains constant through a range of discharge rates. The constant pressure provides the velocity for an effective stream reach at various discharge rates. This is accomplished by means of a pressure-activated self-adjusting orifice baffle.

Constant/Select Gallonage Feature. A nozzle feature that allows on-site, manual adjustment of the orifice to effect a predetermined discharge rate. The discharge rate remains constant throughout the range of pattern selection from straight stream to wide spray.

Flush. A nozzle feature that allows the orifice to be opened so that small debris that might otherwise be trapped in the nozzle, causing pattern disruptions and discharge variation, can pass through. When the flush feature is engaged, the nozzle pressure will drop and pattern will deteriorate. In fire fighting, caution must be exercised when the flush feature is engaged.

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

Lined Fire Hose. A hose having a nonpermeable lining of rubber, synthetic rubber, plastic, or latex-coated fabric.

Nozzle Pressure. The velocity pressure at which water is discharged from the nozzle. Pressure without discharge is known as static pressure. Gauge pressure is measured in pounds per square inch (psi) or kilopascals (kPa).

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

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

Shall. Indicates a mandatory requirement.

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

Spray Nozzle. A generic term applying to all nozzles covered by this standard.

Standpipe System. An arrangement of piping, valves, hose connectors, and allied equipment installed in a building or structure with the hose connections located in such a manner that water can be discharged in streams or spray patterns through attached hose and nozzles for the purpose of extinguishing a fire to protect the occupants. This is accomplished by connections to water supply systems or by pumps, tanks, and other equipment necessary to provide an adequate supply of water to the hose connectors.

1-4 Units of Measurement. 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, which is not part of but is recognized by SI, is commonly used in international fire protection. In this standard, values for measurements are followed by an equivalent in SI units. The U.S. value shall be regarded as the requirement, because the SI value can be approximate. Table 1-4 provides the conversion factors to be used where SI units are not provided in the text or where more precision is desired.

Table 1-4 Conversion Factors

1 gallon per minute (gpm)	= 3.785 liters per minute (L/min)
1 gallon per minute (gpm)	= 0.833 imperial gallons per minute
1 pound per square inch (psi)	= 6.895 kilopascals (kPa)
1 inch (in.)	= 25.40 millimeters (mm)
1 foot (ft)	= 0.305 meters (m)
1 cubic foot (ft^3)	= 0.0283 cubic meters (m^3)
1 square inch ($in.^2$)	= 645.2 square millimeters (mm^2)
1 pound force (lbf)	= 4.45 newtons (N)
1 horsepower (hp)	= 0.746 kilowatts (kW)

Chapter 2 Operational Design Requirements

2-1 Discharge Performance.

2-1.1* The nozzle discharge rating shall be expressed as a rated discharge at a rated pressure [e.g., 60 gpm at 100 psi (225 L/min at 690 kPa)]. The nozzle shall deliver its rated discharge at its rated pressure.

2-1.2 Basic spray nozzles shall discharge no less than the rated discharge at the rated pressure when tested in accordance with Section 4-1. The maximum discharge shall be no more than 10 percent above the rated discharge when measured at both the straight stream and full spray pattern settings.

2-1.3 Constant gallonage spray nozzles shall discharge 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 4-1.

2-1.4 Constant/select gallonage spray nozzles shall meet the requirements of 2-1.3 at each predetermined discharge rate.

2-1.5 Constant pressure (automatic) spray nozzles shall maintain their rated pressure, ±15 psi (±103 kPa), throughout the rated discharge range when tested in accordance with Section 4-1.

2-2 Discharge Pattern.

2-2.1 Spray nozzles shall be capable of developing discharge patterns varying from straight stream to at least 100 degrees spray angle.

2-2.2 The straight stream pattern setting shall provide a cohesive jet capable of delivering 90 percent of the rated discharge within a circle 12 in. (30.5 cm) in diameter at a distance of 10 ft (3.0 m) from the nozzle.

2-2.3* Spray pattern settings shall provide a full and uniform spray pattern.

2-3* Spray Nozzle Controls.

2-3.1 A spray nozzle designed to be used by fire department personnel 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.

2-3.2 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. Those 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.

2-3.3 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.

2-3.4 Trigger-type lever controls shall be in the "on" position when squeezed and the "off" position when released.

2-3.5 Lever-type controls shall require a force of no more than 16 lbf (71.2 N) of force and no less than 3 lbf (13.3 N) to open or close the shutoff or to adjust the stream pattern when tested in accordance with 4-3.1.

2-3.6 For rotational-type controls, the operational force required to change the pattern setting and discharge, as well as to just close (sans discharge), fully close, just open (leak), and fully open the valve, shall not exceed 40 lbf (178 N) and shall not be less than 3 lbf (13.3 N) when tested in accordance with 4-3.2 and 4-3.4.

2-3.7 The nozzle shall be subjected to a pressure of 300 psi (2070 kPa) or $1^1/_2$ times the maximum rated pressure, whichever is higher. After the pressure is removed, all functions — such as pattern selection, flush, discharge adjustments, and shutoff — shall be tested at maximum rated pressure to ensure that they function properly, with not greater than a 25 percent increase in force over the maximum allowed at 100 psi (690 kPa).

2-3.8 Nozzles equipped with a full-time swivel, which allows the nozzle to rotate once the swivel is tightened onto a coupling, shall require a minimum force of 10 lbf (44.5 N) to rotate the nozzle when tested in accordance with 4-3.3.

2-3.8.1 If the nozzle is equipped with rotational pattern controls as well as a full-time swivel, the force required to rotate the full-time swivel shall be at least 1 lbf (4.5 N) greater than the force required to rotate the pattern control, as outlined in 2-3.6.

2-4* Threads. All spray nozzles, shutoffs, and tips shall be manufactured with National Hose (NH) thread conforming to NFPA 1963, *Standard for Fire Hose Connections.*

Exception: Where the fire department hose threads do not conform to NFPA 1963, the authority having jurisdiction shall designate the hose threads that shall be used.

2-5 Flushing. All spray nozzles shall be designed to clear or flush the size of debris specified in Table 2-5 from the nozzle without shutting off the water to the hose. This can be accomplished either through the full open nozzle position or through a flush feature of the nozzle.

Table 2-5 Flushing Capability for Nozzles

Rated Discharge	Size of Steel Ball
Up to 60 gpm (230 L/min)	$^1/_8$ in. (3.18 mm)
60–150 gpm (230–570 L/min)	$^3/_{16}$ in. (4.76 mm)
Over 150 gpm (570 L/min)	$^1/_4$ in. (6.35 mm)

2-5.1 Nozzles shall be tested in accordance with Section 4-2 to verify compliance with Section 2-5.

2-5.2 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.

2-6 Leakage.

2-6.1 Nozzles equipped with a shutoff shall be pressurized to 800 psi (5516 kPa) or $1^1/_2$ times the rated pressure, whichever is higher, and the shutoff shall be fully opened and closed. After the shutoff has been closed, the leakage, if any, shall be measured. The maximum leakage allowed through the discharge orifice is 12 drops/min ($^1/_2$ ml/min). There shall be no leakage through any part of the nozzle other than the discharge orifice.

2-6.2 A nozzle with a twist shutoff shall be operated in accordance with 4-3.4. When it is returned to the fully closed position, the leakage shall not exceed that allowed in 2-6.1.

2-7 Rough Usage.

2-7.1 Spray nozzles shall be capable of continued operation after being subjected to the rough handling tests in Section 4-7.

2-7.2 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.

2-7.3 All functions such as pattern selection, flush, discharge adjustment, and shutoff shall operate properly as described in Section 2-3. The operating force shall not increase more than 10 percent from that determined before the test.

2-7.4 Following performance of the test in 2-7.3, samples shall again be subjected to the leakage test defined in Section 2-6. The leakage shall not increase by more than 10 percent from that determined before the test.

2-8 Handholds, Handgrips, and Ladder Hooks. Dual handholds, single handgrips, or ladder hooks provided on nozzles shall support a 300-lb (136-kg) nozzle reaction force when tested in accordance with Section 4-11. If more than one feature is provided on the same nozzle, each feature shall be tested separately. Test samples that distort or develop cracks or broken sections shall be considered as having failed to meet the test criteria.

2-9 Markings.

2-9.1 Each nozzle shall be permanently identified with the following information using figures and letters not less than $^{3}/_{16}$ in. (4.8 mm) in height:

(a) Name of manufacturer

(b) Unique product or model designation

(c) All other markings required by this standard

2-9.2 Each spray nozzle shall be marked with the rated pressure of the nozzle.

2-9.3 Each spray nozzle shall be marked with the flow rate at positions of straight stream and full spray. Select gallonage nozzles shall be marked to indicate the flow rate at each setting. Constant pressure (automatic) nozzles shall be marked with the minimum and maximum discharge as permitted in Section 2-1.

2-9.4 Nozzles equipped with a flush feature shall indicate the flush operating position with the word FLUSH.

2-9.5 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.

2-10 Nozzles for Use in Marine and Offshore Platform Applications.

2-10.1 Fire-fighting spray nozzles intended for use by personnel aboard ships, offshore platforms, and other marine applications shall meet the requirements of this section.

2-10.2 The nozzle shall comply with all of the requirements of this standard.

2-10.3 The nozzle shall be of the constant gallonage during pattern change type and shall use a lever-type shutoff.

2-10.4 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:

(a) Prolonged sunlight exposure

(b) Continuous salt air exposure

(c) Salt water residue

2-10.5 Nozzles shall be marked "Flush with fresh water after each use."

2-10.6 Salt Spray Resistance.

2-10.6.1 Nozzles on Vessels on Saltwater Routes.

2-10.6.1.1 When nozzles are tested for corrosion resistance in accordance with Sections 3-4 and 4-8, 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.

2-10.6.1.2 Nozzles shall be permanently marked "Marine."

2-10.6.2 Nozzles on Vessels with Routes Limited to Lakes and Other Bodies of Fresh Water. Nozzles shall be permanently marked "Marine — Fresh Water Only."

2-10.7* Nozzle Rating.

2-10.7.1 Each marine nozzle for use with $1^{1}/_{2}$-in. or $1^{3}/_{4}$-in. (38-mm or 44-mm) hose shall be permanently marked with the rated pressure or pressure range. The rated pressure shall be the minimum nozzle pressure necessary to separately accomplish all of the following:

(a) The spray pattern shall be adequately developed to meet the performance of 2-2.3.

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

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

2-10.7.2 Each marine nozzle for use with $2^{1}/_{2}$-in. (65-mm) hose shall be permanently marked with the rated pressure or pressure range. The rated pressure shall be the minimum nozzle pressure necessary to separately accomplish all of the following:

(a) The spray pattern shall be adequately developed to meet the performance of 2-2.3.

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

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

2-10.8* Marine nozzles shall be listed and marked to identify the listing organization.

Exception No. 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 authority having jurisdiction.

Exception No. 2: Nozzles manufactured under a quality control program approved by the authority having jurisdiction.

2-10.9 Each nozzle shall be tested by the manufacturer for flow calibration, pattern, and leakage to ensure compliance with the manufacturer's specifications.

Chapter 3 Construction Materials

3-1* Hydrostatic Strength. Nozzles shall be designed to withstand a hydrostatic pressure of 900 psi (6205 kPa) or three times the maximum rated pressure, whichever is higher. The hydrostatic strength shall be confirmed by testing in accordance with Section 4-4.

3-2 High-Temperature Exposure. The nozzle shall be capable of operation after storage in temperatures of 135°F (57°C). Test samples that develop cracks or broken sections, or that fail to meet the operational control requirements in Section 2-3 after being tested in accordance with Section 4-5, shall be considered as having failed to meet this requirement.

3-3 Low-Temperature Exposure. The dry nozzle shall be capable of operation in temperatures as low as –25°F (–32°C). Test samples that develop cracks or broken sections, or that fail to meet the operational control requirements in Section 2-3 after being tested in accordance with Section 4-6, shall be considered as having failed to meet this requirement.

3-4* Corrosion Exposure. All functions such as pattern selection, flush, discharge adjustments, and shutoff shall continue to function properly and to meet the requirements of Section 2-3 after the nozzle has been subjected to a salt spray test in accordance with Section 4-8. The nozzle shall then be tested for any leakage in accordance with Section 2-6.

3-5 Ultraviolet Light and Water Exposure of Nonmetallic Nozzle Components.

3-5.1 The test samples of nozzles with exposed nonmetallic parts shall be subjected to the ultraviolet light and water test as described in Section 4-9.

3-5.2 At the conclusion of the test, the nozzle shall be inspected for cracking or crazing. Cracking or crazing shall indicate failure of the test. All functions, such as pattern selection, flush, discharge adjustment, and shutoff, shall operate properly as described in Section 2-3.

3-6 Aging Exposure of Nonmetallic Nozzle Components.

3-6.1 The test samples of nozzles with nonmetallic components, other than rubber gaskets where a nozzle connects to a hose line, shall be subjected to the air-oven aging tests as described in Section 4-10.

3-6.2 The sample nozzles shall then be subjected to the rough usage test in accordance with Section 2-7.

3-6.3 At the conclusion of the test, the nozzle shall be inspected for cracking or crazing. Cracking or crazing shall indicate failure of the test.

3-7 Moist Ammonia–Air Stress Cracking Test.

3-7.1 Nozzles or components made from copper alloys containing more than 15 percent zinc shall withstand exposure to a moist ammonia-air mixture for 10 days without cracking.

3-7.2 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. Such stresses shall be applied to the sample prior to the test and maintained during the test. Each sample shall be connected to an appropriate male coupling and tightened to the minimum torque necessary to produce a leaktight assembly.

3-7.3 The samples shall be degreased, supported by an inert tray in a glass chamber with a glass cover 1.5 in. (38.1 mm) above an aqueous ammonia solution, and then continuously exposed for 10 days in a set position to a moist ammonia-air mixture. Approximately 0.16 gal (600 ml) of aqueous ammonia having a specific gravity of 0.94 shall be maintained in the glass chamber per cubic foot of container. The moist ammonia-air mixture in the chamber shall be maintained at atmospheric pressure and at a temperature of 93°F (34°C).

3-7.4 At the conclusion of the exposure, the samples shall show no evidence of cracking when examined using 25 × magnification.

3-8 Rubber Sealing Materials.

3-8.1 A rubber material or synthetic elastomer used to form a seal shall have the following properties in the as-received condition.

3-8.1.1 Silicone rubber (rubber having poly-organosiloxane as its characteristic constituent) shall have a tensile strength of not less than 500 psi (3.4 MPa) and at least 100 percent ultimate elongation, determined in accordance with Section 4-12.

3-8.1.2 Material other than silicone rubber in the as-received condition shall have a tensile strength of not less than 1500 psi (10.3 MPa) and at least 200 percent ultimate elongation.

3-8.1.3 A tensile set of the material in the as-received condition shall be not more than 19 percent, determined in accordance with 4-12.1.

3-8.1.4 A compression set of the material in the as-received condition shall be not more than 15 percent, determined in accordance with Section 4-13.

3-8.2 A rubber material or synthetic elastomer used to form a seal shall have not less than 80 percent of the as-received tensile strength and 50 percent of the as-received ultimate elongation after it has been through the accelerated aging test in accordance with Section 4-14.

Chapter 4 Test Methods

4-1 Discharge Test.

4-1.1 Test Equipment.

4-1.1.1 Pressure gauges connected to a piezometer ring shall be used to measure the water pressure at the nozzle inlet.

4-1.1.2 When testing nozzles equipped with a $1^1/_2$-in. (38-mm) connection at a discharge rate of 250 gpm (568 L/min) and higher, the pressure gauge shall be mounted on a $2^1/_2$-in. (65-mm) waterway. A tapered adaptor shall be used between the $2^1/_2$-in. (65-mm) waterway and the $1^1/_2$-in. (38-mm) inlet to the nozzle. The maximum included angle of the adaptor shall be 30 degrees.

4-1.1.3 Flowmeters used to establish the discharge referred to in this standard shall be calibrated volumetrically within 30 days prior to these tests to ensure their accuracy.

4-1.2 Test Procedure. The nozzle shall be mounted such that the discharge rate through the nozzle and pressure at the inlet to the nozzle can be measured. With the shutoff fully open, the inlet pressure shall be adjusted to the rated pressure, ±2 percent.

4-1.2.1 Basic spray nozzles shall be tested and discharge measurement taken in both straight stream and wide angle spray pattern settings. Nozzle pressure shall be adjusted as specified in 4-1.2 for each of the pattern settings.

4-1.2.2 Constant gallonage nozzles shall be tested and the discharge shall be monitored through the full range of pattern selection.

4-1.2.3 Constant/select gallonage nozzles shall be tested at each discrete discharge selection and monitored through the

entire range of pattern selection. The nozzle pressure shall be adjusted as specified in 4-1.2 for each discrete discharge selected.

4-1.2.4 Constant pressure (automatic) spray nozzles shall be tested on the same equipment specified in 4-1.1. The discharge shall be increased to the minimum rated discharge. The pressure at this discharge shall be recorded. The discharge and nozzle pressure shall be monitored through the entire range of pattern selection from straight stream to wide angle spray. Any deviation greater than 2 percent in discharge or pressure shall be recorded. Slowly increase the discharge to the maximum rated discharge while monitoring the pressure. Record the minimum and maximum pressures throughout the discharge range. At the maximum rated discharge, monitor the discharge and the pressure for the entire range of pattern selection.

4-2 Flush Test. Nozzles shall be held in the vertical position, discharge end down, with the nozzle in either the fully open or flush position. The appropriate size steel ball shall pass through the nozzle without changes in the control position. For discharges up to 60 gpm (230 L/min), a $^1/_8$-in. (3.18-mm) steel ball shall be used. For discharges of 60 gpm to 150 gpm (230 L/min to 570 L/min), a $^3/_{16}$-in. (4.76-mm) steel ball shall be used. For discharges greater than 150 gpm (570 L/min), a $^1/_4$-in. (6.35-mm) steel ball shall be used.

4-3 Control Tests.

4-3.1 Lever-Type Controls.

4-3.1.1 The nozzle shall be mounted in the closed position with an inlet pressure of 100 psi (690 kPa). A dynamometer, which records the maximum force reading, shall be attached to the lever or handle where it normally would be held during operation. 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. The maximum force shall be recorded. The inlet pressure shall be adjusted to 100 psi (690 kPa) while in the full discharge position. The dynamometer shall be used when moving the lever through the full range of positions and maximum force again measured and recorded. The maximum force required in both directions shall be recorded.

4-3.1.2 The nozzle shall be mounted without any pressure applied to it. The controlling lever shall be placed in the closed or full forward position. The lever shall be moved from the full forward position. The force required to move the lever shall be measured with the dynamometer. The force required to move the lever shall be recorded.

4-3.2 Rotational Pattern Control.

4-3.2.1 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 100 psi (690 kPa).

4-3.2.2 A length of twine or string, not to exceed $^3/_{32}$ in. (2.9 mm) in diameter, shall be wrapped around the nozzle at the point where the nozzle normally would be held while rotating the pattern sleeve. The string shall be of sufficient length to wrap around the nozzle at least six times. The first two turns shall overlap the starting end of the string, and the balance of the turns shall not overlap any other turn. A force gauge, which records the maximum force reading, shall be attached to a loop in the free end of the string.

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

The pattern sleeve shall be rotated from the straight stream position to the wide spray position or 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 or wide spray detent.

4-3.3 Full-Time Swivel.

4-3.3.1 Nozzles equipped with a full-time swivel shall be tested while water is discharging at 100 psi (690 kPa).

4-3.3.2 The nozzle shall have a hook or other device added so that a dynamometer, which records the maximum force reading, can be attached and force applied tangentially.

4-3.3.3 The pattern sleeve of the nozzle shall be rotated to the end of its travel in the wide spray direction. The force shall be applied tangentially with a dynamometer to determine the force required to rotate the nozzle. This force shall be recorded.

4-3.4 Twist Shutoff. A nozzle with a twist shutoff shall be mounted on a device equipped with a relief valve, or other means, to maintain 100 psi (690 kPa) in both the closed position and the fully open position while flowing the rated discharge. The test shall start with the nozzle in the closed position. The force gauge shall be used to twist the shutoff to the fully open position, following the method outlined in 4-3.2.2. The windings on the pattern sleeve shall be reversed and the force gauge used in the same manner as above to rotate the shutoff from the fully open to the fully closed position. In the fully closed position, any leakage shall be measured.

4-4 Hydrostatic Test. The nozzle shall be mounted in a closed position on a device capable of exerting a hydrostatic pressure of 900 psi (6205 kPa) or three times the maximum rated pressure, whichever is higher. All air shall be bled out of the system. The pressure shall be increased by 50-psi (345-kPa) increments and held for 30 seconds at each pressure up to the maximum pressure for which the nozzle is being tested. This maximum pressure shall be held for 1 minute without rupture of the nozzle. There shall be no leakage through any part of the nozzle other than the discharge orifice. Increase in leakage through the nozzle orifice shall be permitted beyond that allowed in Section 2-6.

4-5 High-Temperature Tests.

4-5.1 The nozzle shall be conditioned to 135°F (57°C) for 24 hours prior to the test.

4-5.2 Immediately after being removed from the heating chamber, the nozzle shall be tested for proper function of all adjustments and controls. There shall be no binding of any function, such as pattern selection, flush, discharge adjustment, or shutoff.

4-5.3 Within 3 minutes after being removed from the heating chamber, the nozzle shall be subjected to the rough usage tests in accordance with Section 4-7.

4-6 Low-Temperature Tests.

4-6.1 A dry nozzle shall be conditioned to –25°F (–32°C) for 24 hours prior to the test.

4-6.2 Immediately after being removed from the cooling chamber, the nozzle shall be tested for proper function of all adjustments and controls. There shall be no binding of any function such as pattern selection, flush, discharge adjustment, or shutoff.

4-6.3 Within 3 minutes after being removed from the cooling chamber, the nozzle shall be subjected to the rough usage tests identified in Section 4-7.

4-7 Rough Usage Test. Each nozzle shall be subject to all tests.

4-7.1 The nozzle shall be attached to a length of hose at least 10 ft (3 m) long. The hose shall not be charged. The nozzle shall be dropped from a height of 6 ft (2 m) onto a concrete surface so that it impacts directly or squarely on the discharge end.

4-7.2 The nozzle shall be attached to a length of hose at least 10 ft (3 m) long. The hose shall not be charged. The nozzle shall then be dropped twice from a height of 6 ft (2 m) onto a concrete surface such that the points of impact are on two different sides of the nozzle. 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.

4-7.3 The nozzle shall be attached to a length of hose at least 10 ft (3 m) long. With the nozzle shut off, the hose line shall be charged with water to a pressure of 100 psi (690 kPa). The nozzle shall be dropped twice from a height of 6 ft (2 m) onto a concrete surface such that the points of impact are on two different sides of the nozzle. 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.

4-8 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, *Standard Practice for Operating Salt Spray (Fog) Apparatus.*

4-9 Ultraviolet Light and Water Test.

4-9.1 Sample nozzles shall be exposed to ultraviolet light and water for 720 hours. They shall be inspected for cracking and crazing after 360 hours. If no cracking or crazing is apparent, the exposure shall continue for the full 720 hours.

4-9.2 Ultraviolet light shall be obtained from two stationary enclosed carbon-arc lamps. The arc of each lamp shall be formed between two vertical carbon electrodes, $^1/_2$ in. (12.7 mm) in diameter, located at the center of a revolvable vertical meter cylinder 31 in. (787 mm) in diameter and $17^3/_4$ in. (451 mm) in height. Each arc shall be enclosed with a number PX clear Pyrex™ glass globe. 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. A system of nozzles shall be provided so that each sample in turn is sprayed with water as the cylinder revolves. During each operating cycle, each sample shall be exposed to the light and water spray for 3 minutes and to only light for 17 minutes (total 20 minutes). The air temperature within the revolving cylinder of the apparatus during operations shall be 145°F ± 9°F (63°C ± 5°C).

4-10 Air–Oven Aging Tests. Samples of the nozzles shall be subjected to air–oven aging for 180 days at 158°F (70°C), and then allowed to cool at least 24 hours in air at 74°F (23°C) at 50 percent relative humidity.

4-11 Handholds, Handgrips, and Ladder Hooks.

4-11.1 The sample nozzle shall be mounted in a fixture to simulate intended use. A force of 300 lbf (1334 N) shall be applied to the nozzle for 5 minutes to simulate the nozzle reaction force.

4-11.2 Sample nozzles equipped with a handhold, handgrip, or ladder hook shall have one of the drops required in 4-7.2 and 4-7.3 include a point of impact on the handhold, handgrip, or ladder hook.

4-12 Tensile Strength, Ultimate Elongation, and Tensile Set Tests.

4-12.1 Tensile strength, ultimate elongation, and tensile set shall be determined in accordance with ASTM D 412, *Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers — Tension,* 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. The elongation of a specimen for a tensile set determination shall be such that the 1-in. (25-mm) spacing of the benchmarks increases to 3 in. (76 mm).

4-12.2 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. 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.

4-13 Compression Set Test. Type I specimens of the material shall be prepared and the test conducted in accordance with ASTM D 395, *Standard Test Methods for Rubber Property — Compression Set,* Method B. The specimens shall be exposed for 22 hours at 70°F ± 2°F (21°C ± 1°C).

4-14 Accelerated Aging Test. Specimens shall be prepared in the same manner as for tensile strength and ultimate elongation tests, except that benchmarks spaced 1 in. (25 mm) apart shall be stamped on the specimens after the test exposure. Specimens shall be tested at 212°F (100°C) for 70 hours in accordance with ASTM D 573, *Standard Test Method for Rubber - Deterioration in an Air Oven.*

Chapter 5 Compliance Testing

5-1* Certification. Ratings of nozzle designs shall be certified by a testing laboratory or by the manufacturer if suitable test facilities are available.

5-2* Sample Selection. A minimum of three representative nozzles shall pass each required test. The same nozzles used for the high-temperature exposure test *(see Section 3-2)* shall be used for the low-temperature exposure test. *(See Section 3-3.)*

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.

5-3 Test Equipment. All gauges used for testing pressures required by this standard shall have been calibrated within the previous 30 days with test equipment traceable to the National Institute of Science and Technology.

5-4 Test Results. The test results shall be kept on file by the manufacturer. Copies shall be provided when requested by the purchaser.

5-5 Design Changes. Any changes to the design of the nozzle or in the materials of construction shall be cause for retesting.

Chapter 6 Referenced Publications

6-1 The following documents or portions thereof are referenced within this standard as mandatory requirements and shall be considered part of the requirements of this standard. The edition indicated for each referenced mandatory document is the current edition as of the date of the NFPA issuance of this standard. Some of these mandatory documents might also be referenced in this standard for specific informational purposes and, therefore, are also listed in Appendix B.

6-1.1 NFPA Publication. National Fire Protection Association, 1 Batterymarch Park, P.O. Box 9101, Quincy, MA 02269-9101.

NFPA 1963, *Standard for Fire Hose Connections,* 1993 edition.

6-1.2 ASTM Publications. American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

ASTM B 117, *Standard Practice for Operating Salt Spray (Fog) Apparatus*, 1995.

ASTM D 395, *Standard Test Methods for Rubber Property — Compression Set*, 1989.

ASTM D 412, *Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers — Tension*, 1997.

ASTM D 573, *Standard Test Method for Rubber — Deterioration in an Air Oven*, 1988.

6-1.3 ISO Publications. International Standards Organization, 1 Rue de Varembé, Case postale 56, CH-1211 Genève 20, Switzerland.

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

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

Appendix A Explanatory Material

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

A-1-1 Purchasers should specify conformance testing to this specification. Any requirements for conformance testing or certification to this specification should be identified at the time of order.

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 testing of in-service nozzles is covered by NFPA 1962, *Standard for the Care, Use, and Service Testing of Fire Hose Including Couplings and Nozzles.*

A-1-3 Authority Having Jurisdiction. The phrase "authority having jurisdiction" 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-2-1.1 Spray nozzles have traditionally been rated at 100 psi (690 kPa). Lower rating pressures affect the stream's reach and the characteristics of spray patterns. The purchaser should ensure that the performance of the nozzle they intend to use meets their needs and expectations.

A-2-2.3 Nozzles should be tested and visually inspected for full and uniform wide spray patterns as follows:

With the nozzle discharging horizontally 3 ft (1 m) above grade level, it should be set to discharge at its rated pressure and the nozzle should be 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 circumference should be visually inspected around its entirety for continuously persistent weak or hollow areas. The spray sheet at the surface of the cone should not have hollow or weak areas larger than 1 in. (25 mm) wide as measured at a location 2 ft (0.61 m) 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 2 in. (51 mm) at a distance of 2 ft (0.61 m) 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 2 in. (51 mm) when measured at a location 2 ft (0.61 m) from the center of the nozzle along the spray sheet (measured along the spray angle from the axis of the nozzle).

A-2-3 In order for the fire fighter to be effective in combating fire with fire nozzles, the nozzle must be opened and shut off and adjustments made 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-2-4 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, there has been an effort in the United States to standardize hose threads. NFPA 1963, *Standard for Fire Hose Connections,* 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-2-10.7 This standard does not dictate the operating pressure of the nozzle. Marine fire main systems have traditionally been designed to provide a minimum 50 psi (345 kPa) nozzle pressure. However, vessel designers may design fire main systems for pressures in excess of 50 psi (345 kPa) depending on the type of vessel and the nature of the vessel's fire risks. Caution must 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 may have a rating of 100 psi (690 kPa) and not perform properly if installed on a dinner cruiser with a fire main pressure of 50 psi (345 kPa). 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 may 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-2-10.8 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-3-1 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-3-4 The purpose of the salt spray test is to ensure nozzles will perform under the 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 the nozzle is expected to be exposed to corrosive conditions on a long-term basis, or to be used where strong corrosives are present, then the purchaser should ensure the nozzle is designed for such exposure.

A-5-1 When acceptance tests are desired on delivery, they should include the following items:

(a) Nozzle discharge performance as defined in Section 2-1
(b) Discharge patterns as defined in Section 2-2
(c) Field evaluation of the controls only (Section 2-3)
(d) Confirmation of the threads (Section 2-4)
(e) Confirmation of markings as defined in Section 2-9

A-5-2 It is not the intent of this standard to restrict the testing to a single set of three nozzles that must pass all tests. Multiple sets of nozzles can be used to facilitate simultaneous testing as long as a set of three nozzles passes each sequence of tests.

Appendix B Referenced Publications

B-1 The following documents or portions thereof are referenced within this standard for informational purposes only and are thus not considered part of the requirements of this standard unless also listed in Chapter 6. The edition indicated here for each reference is the current edition as of the date of the NFPA issuance of this standard.

B-1.1 NFPA Publications. National Fire Protection Association, 1 Batterymarch Park, P.O. Box 9101, Quincy, MA 02269-9101.

NFPA 1962, *Standard for the Care, Use, and Service Testing of Fire Hose Including Couplings and Nozzles,* 1998 edition.

NFPA 1963, *Standard for Fire Hose Connections,* 1993 edition.

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