NFPA 1965

Standard for

Fire Hose Appliances

2003 Edition

This edition of NFPA 1965, *Standard for Fire Hose Appliances*, was prepared by the Technical Committee on Fire Hose and acted on by NFPA at its May Association Technical Meeting held May 18–21, 2003, in Dallas, TX. It was issued by the Standards Council on July 18, 2003, with an effective date of August 7, 2003.

This edition of NFPA 1965 was approved as an American National Standard on July 18, 2003.

Origin and Development of NFPA 1965

This is the first edition of NFPA 1965, *Standard for Fire Hose Appliances*. The Technical Committee on Fire Hose heard reports of hose-connected appliances failing in use, sometimes catastrophically, sometimes just by not working properly when needed. The committee developed this standard to provide some basic requirements that all hose-connected appliances must meet, in an effort to improve the usefulness and safety of appliances connected to fire hose. This standard completes a set of standards designed to provide consistent requirements for the whole fire hose system.

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

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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 Annex A.

A reference in brackets [ ] following a section or paragraph indicates material that has been extracted from another NFPA document. As an aid to the user, Annex B lists the complete title and edition of the source documents for both mandatory and nonmandatory extracts. Editorial changes to extracted material consist of revising references to an appropriate division in this document or the inclusion of the document number with the division number when the reference is to the original document. Requests for interpretations or revisions of extracted text shall be sent to the technical committee responsible for the source document.

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

Chapter 1 Administration

1.1* Scope.

This standard shall cover the requirements for fire hose appliances up to and including 150 mm (6 in.) nominal dimension designed for connection to fire hose, fire apparatus, and fire hydrants and intended for general fire service use in controlling or conveying water.

1.2 Purpose.

The purpose of this standard shall be to provide minimum performance and operational requirements for fire hose appliances and to specify the design verification tests for fire hose appliances.

1.3* Application.

This standard shall apply to fire hose appliances up to and including 150 mm (6 in.) manufactured after the effective date of this standard. Fire hose appliances shall include the following:

(1) Portable valves, including gate valves, ball valves, piston valves, butterfly valves, clappered valves, and pressure relief valves

(2) Portable monitors, ladder pipes, and break-apart monitors

(3) Miscellaneous hose appliances, including wyes, siameses, elbows, water curtains, water thieves, and manifolds

1.4 Equivalency.

Nothing in this standard is intended to 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.

1.5* Units of Measurement.

In this standard, values for measurement in SI units are followed by an equivalent in U.S. customary units. Either set of values can be used, but the same set of values (either SI or U.S. customary 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 Publication.

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

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, West Conshohocken, PA 19428-2959.

ASTM B 117, *Standard Practice for Operating Salt Spray (Fog) Apparatus*, 2002.

ASTM D 395, *Standard Test Methods for Rubber Property — Compression Set*, 2002.

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

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

ASTM D 2565, *Standard Practice for Xenon Arc Exposure of Plastics Intended for Outdoor Applications*, 1999.

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 included, common usage of the terms shall apply.

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.

3.3 General Definitions.

3.3.1 Break-Apart Monitor. A monitor that can be converted for use either in stationary mode on a fire apparatus or in portable mode on a separate ground base.

3.3.2 Fire Hose Appliance. A piece of hardware (excluding nozzles) generally intended for connection to fire hose to control or convey water.

3.3.3 Ladder Pipe. A monitor that is fed by a hose and that holds and directs a nozzle while attached to the rungs of a vehicle-mounted aerial ladder.

3.3.4 Maximum Operating Pressure. The maximum pressure at which the device is designed to be operated.

3.3.5 Monitor. A device designed to be fed by one or more hose lines or to be fed by rigid piping and to hold and direct a nozzle.

3.3.6* **Nozzle.** A constricting appliance attached to the end of a fire hose or monitor to increase the water velocity and form a stream.

3.3.7 Portable Monitor. A monitor that can be lifted from a vehicle-mounted bracket and moved to an operating position on the ground by not more than two people.

3.3.8 Portable Valve. A fire hose appliance that includes at least one valve and has fire hose connections on both inlet(s) and outlet(s).

3.3.9* **Shutoff Valve.** A valve whose primary function is to operate in either a fully shutoff or a fully open condition.

3.3.10 Slow-Operating Valve. A valve that has a mechanism to prevent movement of the flow-regulating element from the fully closed position to the fully opened position or vice versa in less than 3 seconds. [**1901:**3.3]

Chapter 4 Operational Design Requirements for All Fire Hose Appliances

4.1* Maximum Operating Pressure.

The maximum operating pressure shall be a minimum of 13.8 bar (200 psi).

4.2 Appliance Connectors.

4.2.1 All fire hose couplings on the appliance shall meet the requirements of NFPA 1963, *Standard for Fire Hose Connections*.

4.2.2* All fire hose connectors on an appliance shall conform to NFPA 1963, *Standard for Fire Hose Connections*. If the hose threads or connectors used by the fire department do not conform to NFPA 1963, the authority having jurisdiction shall be permitted to designate the hose threads or connectors that shall be used.

4.2.3 If the hose connector(s) on the appliance is equipped with a full-time swivel, the force required to rotate the swivel shall not exceed 133.4 N (30 lb_f) when tested in accordance with Section 6.1.

4.3 Shutoff Valves.

4.3.1 Shutoff valves or appliances equipped with a lever-operated handle shall indicate the closed position when the handle is perpendicular to the hose line it is controlling.

4.3.2 If an appliance has more than two valves with lever-operated handles, the two outside handles shall indicate their closed position as described in 4.3.1.

4.3.2.1 If the design of the appliance does not permit the intervening handle(s) to indicate the closed position perpendicular to the hose, it shall be permitted to indicate the closed position when the handle(s) is at the 2 o'clock position when viewed from the single hose connection side.

4.3.2.2 Any valve arranged as permitted in 4.3.2.1 shall be permanently marked to indicate the open and closed positions.

4.3.3 Shutoff valves equipped with a U-shaped handle shall indicate the closed position when the handle is closer to the discharge end of the valve.

4.3.4 Operating a shutoff valve shall require a force of no more than 180 N (40 lb_f) and no less than 13 N (3 lb_f) to open or close the valve when tested in accordance with Section 6.2.

4.3.5 Any 76 mm (3 in.) or larger shutoff valve on an appliance shall be a slow-operating valve.

4.4* Relief Valves.

If the appliance has a relief valve, the relief valve shall meet the requirements of this section.

4.4.1 The relief valve shall be on the intake side of the shutoff valve.

4.4.2 The relief valve shall relieve to atmosphere.

4.4.3 The relief valve shall be field adjustable.

4.4.4 The manufacturer shall mark the range of pressure adjustment on the relief valve.

4.5 Leakage.

4.5.1 If the appliance is equipped with a shutoff valve on the discharge side of the appliance, the appliance shall not develop in excess of ½ ml/min (12 drops/min) through the discharge orifice of the valve when tested in accordance with Section 6.3.

4.5.2 There shall be no leakage through any part of the appliance other than the discharge orifice of a shutoff valve on the discharge side of the appliance when tested in accordance with Section 6.3.

4.6 Rough Usage.

4.6.1 Section 4.6 shall not apply to portable monitors.

4.6.2 The appliance shall be capable of operation after being subjected to the rough usage tests in Section 6.4.

4.6.3 Any operating force shall not increase more than 10 percent from that allowed before the test.

4.6.4 Following performance of the test to confirm compliance with 4.6.3, the test sample shall again be subjected to the leakage test defined in Section 6.3.

4.6.5 The leakage shall not increase by more than 10 percent from that allowed before the test.

4.7 Requirements for Portable Monitors.

4.7.1* A portable monitor, except a portable ladder pipe, shall have an attachment for at least one tiedown.

4.7.2 Portable ladder pipes shall have rung attachment mechanisms with multiple motion-locking devices.

4.7.3 The monitor shall be provided with stops to prevent it from being lowered to an angle of discharge or rotated to a point where the monitor becomes unstable.

4.7.4 A locking method(s) shall be provided that will hold the elevation of the monitor in any position allowed by the manufacturer.

4.7.5 A locking method shall be provided that will hold the rotation of the monitor in any position allowed by the manufacturer.

4.7.6 Any shutoff valves incorporated in a monitor shall meet the requirements of Section 4.3.

4.7.7 All swivel hose connections 90 mm (3½ in.) or larger shall have a full-time swivel.

4.7.8 Force to Operate.

4.7.8.1 The force to rotate a monitor shall be not less than 13 N (3 lb_f) nor more than 180 N (40 lb_f) when measured as defined in Section 6.5.

4.7.8.2 The force to elevate the stream of a monitor shall be not more than 180 N (40 lb_f) when measured as defined in Section 6.6.

4.7.9 The monitor shall be capable of operation through all positions of elevation and rotation allowed by the manufacturer without any movement of the monitor's feet when tested in accordance with Section 6.7.

4.7.10 Rough Usage.

4.7.10.1 The monitor shall remain operational and not leak or come apart after being subjected to the rough usage test described in Section 6.8.

4.7.10.2 Any operating force shall not increase by more than 10 percent from that allowed before the test.

4.7.10.3 Following performance of the test to confirm compliance with 4.7.10.2, the test sample shall again be subjected to the leakage test described in Section 6.3. The leakage shall not increase by more than 10 percent from that allowed before the test.

4.7.11 The rated flow of the monitor shall be permanently identified on the monitor in conformance with 4.8.1 and near the marking of the maximum operating pressure.

4.8 Markings.

4.8.1 Each fire hose appliance shall be permanently identified with the following information using numerals and letters not less than 4.8 mm ($\frac{3}{16}$ in.) in height:

(1) Name of manufacturer

(2) Unique product or model designation

(3) Maximum operating pressure

4.8.2 The information on the maximum operating pressure shall be visible to the operator when the appliance is in its normal operating position.

Chapter 5 Construction Materials

5.1 Hydrostatic Strength.

5.1.1 The appliance shall withstand a hydrostatic gauge pressure of 62.1 bar (900 psi) or three times the maximum operating pressure, whichever is higher, when tested in accordance with Section 6.9.

5.1.2 Following the test, no part of the appliance shall be cracked or ruptured, and the appliance shall be fully capable of operation.

5.1.3 Operating forces and leakage shall not increase by more than 10 percent from that allowed before the test.

5.2 High and Low Temperature Exposure.

The appliance shall be capable of operation and there shall be no cracks or broken sections after it has been tested to a high temperature of 57°C (135°F) and then to a low temperature of -32°C (-25°F) in accordance with Section 6.10.

5.3 Corrosion Exposure.

5.3.1* All appliances shall be capable of operation after they have been subjected to a salt spray test in accordance with Section 6.11.

5.3.2 If the appliance has a valve(s), operating forces and leakage shall not increase by more than 10 percent from that allowed before the test.

5.4 Ultraviolet Light and Water Exposure of Nonmetallic Appliance Components.

5.4.1 An appliance with exposed nonmetallic parts shall have those components subjected to the ultraviolet light and water test as described in Section 6.12.

5.4.2 Cracking or crazing of the nonmetallic components shall indicate failure of the test.

5.5 Aging Exposure of Nonmetallic Appliance Components.

5.5.1 An appliance with nonmetallic components other than rubber gaskets where an appliance connects to a hose line shall be subjected to the air-oven aging test as described in Section 6.13.

5.5.2 The appliance shall then be subjected to a rough usage test in accordance with Section 6.4 if the appliance is not a portable monitor or in accordance with Section 6.8 if the appliance is a portable monitor.

5.5.3 At the conclusion of the test, the appliance shall be inspected for cracking or crazing.

5.5.4 Cracking or crazing shall indicate failure of the test.

5.6 Moist Ammonia–Air Stress Cracking.

5.6.1 Appliances or components made from copper alloys containing more than 15 percent zinc shall be tested in accordance with Section 6.14.

5.6.2 The appliance or component shall show no evidence of cracking when examined using 25X magnification following exposure to the moist ammonia–air mixture.

5.7 Rubber Sealing Materials.

5.7.1 A rubber material or synthetic elastomer used to form a seal shall have the properties described in 5.7.1.1 through 5.7.1.4 in the as-received condition.

5.7.1.1 Silicone rubber (rubber having polyorganosiloxane as its characteristic constituent) shall have a tensile strength of not less than 3.45 MPa (500 psi) and at least 100 percent ultimate elongation, determined in accordance with Section 6.15.

5.7.1.2 Material other than silicone rubber shall have a tensile strength of not less than 10.34 MPa (1500 psi) and at least 200 percent ultimate elongation.

5.7.1.3 A tensile set of the material shall not be more than 19 percent, determined in accordance with Section 6.16.

5.7.1.4 A compression set of the material shall not be more than 25 percent, determined in accordance with Section 6.17.

5.7.2 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 6.18.

Chapter 6 Test Methods

6.1 Full-Time Swivel Test.

6.1.1 An appliance equipped with a full-time swivel on the hose connection shall be tested while it is dry.

6.1.2 The appliance shall be mounted in a device capable of holding the appliance stationary.

6.1.3 The coupling shall have a hook or other device added in a manner that will allow an attached dynamometer to apply force tangentially.

6.1.4 The force required to rotate the coupling shall be applied tangentially with a dynamometer, which records the maximum force reading.

6.1.5 The force shall be recorded.

6.2 Test of Lever-Operated Shutoff Valves.

6.2.1 The appliance or the valve used with the appliance shall be mounted in a device capable of holding the appliance or valve stationary.

6.2.2 A dynamometer, which records the maximum force reading, shall be attached to the outermost point of the actuating device.

6.2.3 With the valve in the closed position, an inlet gauge pressure of 6.9 bar (100 psi) shall be applied to the valve.

6.2.4 The dynamometer shall be used to measure the force to move the lever from the fully closed position to the fully open position, and the maximum force shall be recorded.

6.2.5 The inlet pressure shall be adjusted to a gauge pressure of 6.9 bar (100 psi) while the valve is in the fully open position.

6.2.5.1 If the outlet to the valve is 25.4 mm (1 in.) or less, the flow shall be whatever discharge rate is achieved with the inlet pressure at 6.9 bar (100 psi).

6.2.5.2 If the outlet to the valve is greater than 25.4 mm (1 in.), the flow shall be at least 946 L/min (250 gpm) with the inlet pressure at 6.9 bar (100 psi). A nozzle or restricting orifice shall be permitted to be used downstream of the valve discharge to regulate the flow.

6.2.6 The dynamometer shall be used to measure the force to move the lever from the fully open position to the fully closed position, then back to the fully open position.

6.2.7 The maximum force measured in both directions shall be recorded.

6.2.8 The valve shall be fully closed without any inlet pressure on the valve.

6.2.9 The dynamometer shall be used to measure the force to move the lever from the fully closed position to the fully open position.

6.2.10 The maximum force measured in both directions shall be recorded.

6.3 Leakage Test.

6.3.1 The appliance shall be connected to a source of water.

6.3.2 If the appliance is equipped with a shutoff valve on the discharge side of the appliance, the valve shall be closed and all the air bled out.

6.3.3 If the appliance is not equipped with a shutoff valve on the discharge side of the appliance, the discharge side of the appliance shall be capped and all the air bled out.

6.3.4 The appliance shall be slowly pressurized to a gauge pressure of 5516 kPa (800 psi) or 1½ times the maximum operating pressure, whichever is higher.

6.3.5 The leakage, if any, shall be measured.

6.4 Rough Usage Test.

6.4.1 A cap shall be attached to each male threaded connection on the appliance to protect the exposed threads.

6.4.2 If the appliance weighs less than 4.54 kg (10 lb), the appliance shall be dropped from a height of 2 m (6 ft) onto a concrete surface so that it impacts directly or squarely on each side and on the top and the bottom (a minimum of six drops).

6.4.3 If the appliance weighs 4.54 kg (10 lb) or more, the appliance shall be dropped from a height of 1 m (3 ft) onto a concrete surface so that it impacts directly or squarely on each side and on the top and the bottom (a minimum of six drops).

6.5 Force to Rotate Test.

6.5.1 The monitor shall be mounted in a device capable of holding its base stationary. A dynamometer, which records the maximum force reading, shall be attached to the monitor where a person would normally grab the monitor to rotate it.

6.5.2 The monitor shall be flowing water at its maximum rate of flow at 690 kPa (100 psi) through a smooth bore tip.

6.5.3 The dynamometer shall be used to measure the force when the monitor is rotated first in one direction and then in the other direction. The maximum force in both directions shall be recorded.

6.6 Force to Elevate Test.

6.6.1 The monitor shall be mounted in a device capable of holding its base stationary. A dynamometer shall be attached to the monitor where a person would normally grab the monitor to elevate it.

6.6.2 The monitor shall be flowing water at its maximum flow rate at 690 kPa (100 psi) through a smooth bore tip.

6.6.3 The dynamometer shall be used to measure the force when the monitor is elevated from its lowest position to its maximum elevation. The maximum force shall be recorded.

6.7 Stability Test for Portable Monitors.

6.7.1 Test Setup.

6.7.1.1 The monitor shall be set up in accordance with the manufacturer's instructions on a concrete surface with a broom finish.

6.7.1.2 The position of the feet shall be marked on the surface so that any movement can be detected.

6.7.1.3 The monitor shall be attached to a secure tiedown point with an attachment that has approximately 150 mm (6 in.) of slack.

6.7.1.4 The attachment shall have a rated strength of at least twice the maximum test reaction force.

6.7.1.5 The hose supplying the monitor shall be charged and any slack removed from the hose.

6.7.1.6 The monitor shall be equipped with a smooth bore nozzle that is capable of flowing the rated flow of the monitor at 690 kPa (100 psi) pitot pressure.

6.7.1.7 The monitor shall be positioned to discharge the stream at the maximum elevation position.

6.7.2 Test Procedure.

6.7.2.1 A water flow shall be established at a nozzle discharge pitot pressure of 1034 kPa (150 psi).

6.7.2.2 The monitor shall then be operated through all positions of elevation and rotation allowed by the manufacturer.

6.7.2.3 The monitor shall be operated for a minimum of 3 minutes.

6.7.2.4* Any movement of the monitor feet relative to the concrete surface of more than 38 mm (1½ in.) shall constitute failure of this test, and the water supply shall be immediately shut down and the test discontinued.

6.8 Rough Usage Test for Portable Monitors.

6.8.1 The assembled monitor shall have caps and plugs installed to protect any threaded

connection.

6.8.2 The legs shall be extended and the monitor shall be dropped from a height of 1 m (3 ft) onto a concrete surface so that it impacts directly on a support leg.

6.8.3 The monitor shall continue to be dropped from a height of 1 m (3 ft) onto a concrete surface until it has been dropped on each supporting leg.

6.8.4 The monitor shall then be dropped from the same height onto the discharge end and the intake end of the appliance.

6.8.5 If the monitor is of a break-apart design, it shall be disassembled and each piece dropped on the break-apart point.

6.8.6 Following these drops, the monitor shall be inspected to be sure that it will still rotate and elevate and that all components are still attached and operational as designed by the manufacturer.

6.8.7 The monitor shall be flow tested and shall remain operational and not leak or come apart.

6.9 Hydrostatic Test.

6.9.1 The appliance shall be connected to a hydrostatic test pump capable of exerting a gauge pressure of 6205 kPa (900 psi) or three times the maximum operating pressure, whichever is higher.

6.9.2 Test caps capable of withstanding the required hydrostatic pressure shall be attached to the appliance openings, and all valves shall be placed in the fully open position.

6.9.3 All air shall be bled out of the system.

6.9.4 The gauge pressure shall be increased by 345 kPa (50 psi) increments and held for 30 seconds at each pressure up to the maximum pressure for which the appliance is being tested.

6.9.5 This maximum pressure shall be held for 1 minute.

6.10 High and Low Temperature Test.

6.10.1 The appliance shall be conditioned in a heating chamber to 57°C (135°F) for 24 hours.

6.10.2 Immediately after being removed from the heating chamber, all adjustments and controls on the appliance shall be operated.

6.10.3 There shall be no binding of any adjustment or control.

6.10.4 The appliance shall then be conditioned in a cooling chamber to -32°C (-25°F) for 24 hours.

6.10.5 Immediately after being removed from the cooling chamber, all adjustments and controls on the appliance shall be operated.

6.10.6 There shall be no binding of any adjustment or control.

6.10.7 Within 3 minutes after being removed from the cooling chamber, the appliance shall be subjected to the rough usage test.

6.10.7.1 All appliances other than portable monitors shall be tested in accordance with Section 6.4.

6.10.7.2 Portable monitors shall be tested in accordance with Section 6.8.

6.10.8 The appliance shall then be hydrostatically tested in accordance with Section 6.9.

6.11 Salt Spray Test.

A test sample 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.*

6.12 Ultraviolet Light and Water Test.

6.12.1 The test components shall be exposed to ultraviolet light and water for 720 hours using the process described in either 6.12.2 or 6.12.3.

6.12.1.1 The test components shall be inspected for cracking and crazing after 360 hours.

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

6.12.2 Carbon-Arc Lamp Source.

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

6.12.2.2 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 revolving vertical metal cylinder 787 mm (31 in.) in diameter and 451 mm (17¾ in.) in height.

6.12.2.3 Each arc shall be enclosed with a number 9200 PX clear Pyrex™ glass globe.

6.12.2.4 The test components shall be mounted vertically on the inside of the metal cylinder and revolved continuously around the stationary arcing lamps at 1 rpm.

6.12.2.5 A system of nozzles shall be provided so that, during each operating cycle, the samples shall be exposed to the light and to water spray for 3 minutes and to only the light for 17 minutes (total 20 minutes).

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

6.12.3 Xenon-Arc Lamp Source.

6.12.3.1 The ultraviolet light exposure shall be obtained in accordance with ASTM D 2565, *Standard Practice for Xenon Arc Exposure of Plastics Intended for Outdoor Applications*.

6.12.3.2 The source of radiation shall be a 6500 W, water-cooled xenon-arc lamp with borosilicate inner and outer optical filters.

6.12.3.3 The wattage to the lamp shall be controlled automatically to provide spectral irradiance of 0.35 W/m^2 (0.0325 W/ft^2) at 340 nm (0.000014 in.).

6.12.3.4 The samples shall be mounted vertically on the inside of a 97 cm (38 in.) diameter cylinder, facing the arc, and the cylinder shall be rotated about the arc at 1 rpm.

6.12.3.5 During each operating cycle of 120 minutes, each sample shall be exposed to light for 102 minutes and to light and water spray for 18 minutes.

6.12.3.6 The black-panel temperature during the dry portion of the light-on cycle shall be regulated to 63°C ± 5°C (145°F ± 9°F).

6.12.4 At the conclusion of the test, the components shall be inspected for cracking or crazing.

6.13 Air-Oven Aging Test.

A sample appliance(s) shall be subjected to air-oven aging for 180 days at 100°C (212°F) and then allowed to cool at least 24 hours in air at 23°C (74°F) at 50 percent relative humidity.

6.14 Moist Ammonia–Air Stress Cracking Test.

6.14.1 A sample appliance shall be subjected to the physical stresses normally imposed on or within the appliance as the result of assembly with other components or a coupling.

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

6.14.1.2 The sample shall be connected to a mating coupling and tightened to the minimum torque necessary to produce a leaktight assembly.

6.14.2 The sample shall be degreased, supported by an inert tray in a glass chamber with a glass cover 38 mm (1½ in.) above an aqueous ammonia solution, and then continuously exposed for 240 hours in a set position to a moist ammonia–air mixture.

6.14.2.1 Approximately 600 ml (0.16 gal) of aqueous ammonia having a specific gravity of 0.94 shall be maintained in the glass chamber per cubic foot of container volume.

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

6.15 Tensile Strength and Ultimate Elongation Tests.

6.15.1 Tensile strength and ultimate elongation shall be determined in accordance with ASTM D 412, *Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers — Tension,* Method A.

6.15.2 If a specimen breaks outside the benchmarks, or if either the measured tensile strength or the ultimate elongation of the specimen is less than the required value, an additional specimen shall be tested, and those results shall be final.

6.15.3 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.

6.16 Tensile Set Test.

6.16.1 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 the elongation shall be maintained for only 3 minutes, and the tensile set shall be measured 3 minutes after release of the specimen.

6.16.2 The elongation of the specimen for a tensile set determination shall be such that the 25.4 mm (1 in.) spacing of the benchmarks increases to 76.2 mm (3 in.).

6.17 Compression Set Test.

6.17.1 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.

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

6.18 Accelerated Aging Test.

6.18.1 Specimens shall be prepared in the same manner as for tensile strength and ultimate elongation tests, except that benchmarks spaced 25.4 mm (1 in.) apart shall be stamped on the specimens after the test exposure.

6.18.2 Specimens shall be tested at 100°C (212°F) for 70 hours in accordance with ASTM D 573, *Standard Test Method for Rubber — Deterioration in an Air Oven*.

Chapter 7 Compliance Testing

7.1* Certification.

Performance of the appliance 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 completely assembled appliance shall pass each required test.

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

7.2.2.1 The same appliance that is initially used to evaluate the requirements of Section 4.3 shall be used for the rough usage evaluation *(see Section 4.6 and 4.7.10)*.

7.2.2.2 The same appliance that is used to test the high temperature exposure shall be used to test the low temperature exposure following the procedures defined in Section 6.10.

7.2.3 Any appliance or appliance 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 manufacturer shall keep the test results on file.

7.3.2 Copies shall be provided to the purchaser when requested by the purchaser.

7.4 Design Changes.

Any changes to the design of the appliance 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 The purchasers should specify any desired conformance testing or required certification to this standard at the time they order the appliance.

A.1.3 Adapters, reducers, caps, and plugs are covered by NFPA 1963, *Standard for Fire Hose Connections*. Spray nozzles with built-in shutoff valves, spray nozzle tips, and spray nozzles with break-apart shutoff valves are covered by NFPA 1964, *Standard for Spray Nozzles*. Foam-making equipment, such as eductors, nozzles, and foam aspiration equipment, is covered by UL 162, *Standard for Foam Equipment and Liquid Concentrates.*

A.1.5 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) lists the abbreviations used in Table A.1.5(a).

Table A.1.5(a)
Conversion Factors

SI Units to U.S. Customary Units	U.S. Customary Units to SI Units
1 kPa = 0.145 psi	1 psi = 6.895 kPa
1 bar = 14.50 psi	1 psi = 0.069 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 = 0.264 gal	1 gal = 3.785 L

Table A.1.5(a)
Conversion Factors

SI Units to U.S. Customary Units	U.S. Customary Units to SI Units
1 N = 0.225 lb_f	1 lb_f = 4.45 N

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

ft = foot	lb = pound
gal = gallon	lb_f = pound force
in. = inch	m = meter
kg = kilogram	mm = millimeter
kPa = kilopascal	N = newton
L = liter	psi = pound per square inch

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 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.3.3.6 Nozzle. A nozzle can be equipped with a shutoff and can be designed to produce a

straight stream, a spray pattern, or both.

A.3.3.9 Shutoff Valve. Some shutoff valves have a secondary capability to operate and hold their position between the fully open and fully closed positions. The purchaser should specify that the valve be designed with that capability if it is required for operations.

A.4.1 The appliance and the hose with which it is used should be carefully matched. All components of the system need to be rated at or above the maximum operating pressure. The use of appliances rated for use with a lower service test pressure hose could result in catastrophic failure.

The friction loss through the appliance can vary, depending on the design of the appliance and the amount of water flowing through the appliance. It is suggested that the manufacturer or the authority having jurisdiction conduct tests to determine what the friction loss is through the appliance at various flows so the pump operator can account for that loss when determining the pump pressure required.

A.4.2.2 The Committee recognizes that different types of hose connections and hose threads might be used in different countries. It is extremely important for fireground operations involving multiple jurisdictions to use a common type of thread or hose connection. 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 to develop uniformity of fire hose coupling threads and to achieve interconnectability of fire hose.

A.4.4 Users of hose-connected appliances should always be careful to avoid situations that create water hammer. Training should stress the need to open and close valves slowly. Relief valves will not operate in time to avoid damage to an appliance from a water hammer.

A.4.7.1 It is important that portable monitors be tied down during use. The nozzle reaction on a portable monitor is directly opposite the direction of the stream. The nozzle reaction from a 51 mm (2 in.) smooth bore tip at a nozzle pressure of 690 kPa (100 psi) is 2670 N (600 lb_f).

A.5.3.1 The purpose of the salt spray test is to ensure that the appliance 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. When the appliance 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 that the appliance is designed for such exposure.

A.6.7.2.4 It is extremely important that, as the monitor is operated through all its positions, any change in stream direction be done slowly so that there are not sudden changes in force on the monitor.

A.7.1 The tests defined in this standard are manufacturer's verification tests and are not designed to be conducted in the field. When acceptance tests are desired on delivery, they should ensure the following:

(1) That the valves open and close smoothly

(2) That the threads are correct and hose will easily thread onto and off the connection

(3) If the appliance has a relief valve, that it will operate at the correct pressure

(4) That the appliance does not leak when subjected to its maximum operating pressure

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

Annex B Informational References

B.1 Referenced Publications.

The following documents or portions thereof are referenced within this standard for informational purposes only and are thus not part of the requirements of this document unless also listed in Chapter 2.

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

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

NFPA 1964, *Standard for Spray Nozzles*, 2003 edition.

B.1.2 Other Publications.

B.1.2.1 UL Publication. Underwriters Laboratories Inc., 333 Pfingsten Road, Northbrook, IL 60062.

UL 162, *Standard for Foam Equipment and Liquid Concentrates*, 1994.

B.2 Informational References. (Reserved)

B.3 References for Extracts.

The following documents are listed here to provide reference information, including title and edition, for extracts given throughout this standard as indicated by a reference in brackets [ ] following a section or paragraph. These documents are not a part of the requirements of this document unless also listed in Chapter 2 for other reasons.

NFPA 1901, *Standard for Automotive Fire Apparatus*, 2003 edition.