FM Approvals®

Member of the FM Global Group

Examination Standard for Firefighting Nozzles for Use with Hose, Monitor Assemblies and Other Firefighting Equipment

Class Number 5511

December 2021

Foreword

This standard is intended to verify that the products and services described will meet stated conditions of performance, safety and quality useful to the ends of property conservation. The purpose of this standard is to present the criteria for examination of various types of products and services.

Examination in accordance with this standard shall demonstrate compliance and verify that quality control in manufacturing shall ensure a consistent and reliable product.

TABLE OF CONTENTS

1 INTRODUCTION

1.1 Purpose

1.1.1 This standard states testing and certification requirements for portable adjustable-pattern water spray nozzles for use with residential and industrial fire hose and fixed monitor assemblies. Depending on their design and performance, these nozzles are suitable for use on fires in combustible commodities, flammable liquids and/or electrical equipment.

1.1.2 Testing and certification criteria may include, but are not limited to, performance requirements, marking requirements, examination of manufacturing facility(ies), audit of quality assurance procedures, and a surveillance program.

1.2 Scope

1.2.1 This standard applies to basic spray, constant gallonage, constant/select gallonage, and constant pressure portable spray nozzles in nominal inlet sizes of 3/4" or larger for use with residential and industrial fire hose and fixed monitor assemblies for their intended application for use on combustible commodities, flammable liquid, and/or electrical fires. In cases where metric sized portable nozzles are to be examined for certification, test criteria comparable to the equivalent or nearest nominal inch size shall be used.

1.2.2 Nozzles certified by this standard are intended to be inspected, maintained, and used in accordance with the requirements in NFPA 1962, *Standard for the Care, Use, Inspection, Service Testing, and Replacement of Fire Hose, Coupling, Nozzles, and Fire Hose Appliances.*

1.2.3 This standard does not apply to underwriters playpipes.

1.2.4 Other types of portable nozzles may be certified if they meet the requirements and intent of this standard. Portable nozzles of unusual design may be subjected to special tests to determine their suitability.

1.3 Basis for Requirements

1.3.1 The requirements of this standard are based on experience, research and testing, and/or the standards of other organizations. The advice of manufacturers, users, trade associations, jurisdictions and/or loss control specialists was also considered.

1.3.2 The requirements of this standard reflect tests and practices used to examine characteristics of portable the nozzles for the purpose of obtaining certification. Portable nozzles having characteristics not anticipatedby this standard may be certified if performance equal, or superior, to that required by this standard is demonstrated.

1.4 Basis for Certification

Certification is based upon satisfactory evaluation of the product and the manufacturer in the following major areas:

1.4.1 Examination and tests on production samples shall be performed to evaluate:

- the suitability of the product;
- the performance of the product as specified by the manufacturer and required for certification; and as far as practical,
- the durability and reliability of the product.

1.4.2 An examination of the manufacturing facilities and audit of quality control procedures is made to evaluate the manufacturer's ability to consistently produce the product which is examined and tested,

1.5 Basis for Continued Certification

The basis for continual certification may include, but is not limited to, the following based upon certification scheme and requirements of the certification agency:

- production or availability of the product as currently certified;
- the continued use of acceptable quality assurance procedures;
- satisfactory field experience;
- compliance with the terms stipulated in the by the certification;
- satisfactory re-examination of production samples for continued conformity to requirements; and,
- satisfactory surveillance audits conducted as part of the certification agency's product surveillance program.

1.6 Effective Date

The effective date of this certification standard mandates that all products tested for certification after the effective date shall satisfy the requirements of this standard.

The effective date of this standard is eighteen (18) months after the publication date of the standard for compliance with all requirements.

1.7 System of Units

Units of measurement used in this Standard are United States (U.S.) customary units. These are followed by their arithmetic equivalents in International System (SI) units, enclosed in parentheses. The first value stated shall be regarded as the requirement. The converted equivalent value may be approximate. Conversion of U.S. customary units is in accordance with ANSI/IEEE/ASTM SI 10.

Two units of measurement (liter and bar), outside of, but recognized by SI, are commonly used in international fire protection and are used in this standard

1.8 Normative References

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the cited edition applies.

American National Standards Institute

ANSI/IEEE/ASTM SI 10, *American National Standard for Metric Practice*

ANSI/NEMA 250, *Enclosures for Electrical Equipment (1000 Volts Maximum)*

ASTM International

ASTM B117, *Standard Practice for Operating Salt Spray (Fog) Apparatus*

ASTM D395, *Standard Test Methods for Rubber Property - Compression Set*

ASTM D412, *Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension*

ASTM D573, *Standard Test Method for Rubber - Deterioration in an Air Oven*

ASTM G155, *Standard Practice for Operating Xenon Arc Light Apparatus for Exposure of Non-Metallic Materials*

FM Approvals LLC

FM 3600, *Examination Standard for Electrical Equipment for Use in Hazardous (Classified) Locations – General Requirements*

FM 3611, *Examination Standard for Nonincendive Electrical Equipment for Use in Class I and II, Division 2 and Class III, Divisions 1 and 2 Hazardous (Classified) Locations*

FM 3615, *Examination Standard for Explosionproof Electrical Equipment General Requirements*

FM 3810, *Examination Standard for Electrical and Electronic Test, Measuring and Process Control Equipment*

FM 5130, *Examination Standard for Foam Extinguishing Systems*

National Fire Protection Association

NFPA 1962, *Standard for the Care, Use, Inspection, Service Testing, and Replacement of Fire Hose, Couplings, Nozzles, and Fire Hose Appliances*

NFPA 1963, *Standard for Fire Hose Connections*

Underwriters Laboratories

UL508, Standard for Safety, *Industrial Control Equipment*

UL508A, Standard for Safety, *Industrial Control Panels*

UL 1004 (series), Standard for Safety, *Rotating Electrical Machines*

1.9 Terms and Definitions

For purposes of this standard, the following terms apply:

Accepted
This term refers to installations acceptable to the authority enforcing the applicable installation rules. Acceptance is based upon an overall evaluation of the installation. Factors other than the use of certified equipment impact upon the decision to accept, or not to accept the product. Acceptance is not a characteristic of a product, it is installation specific, and a product accepted for one installation may not be accepted elsewhere.

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

Constant Gallonage Spray Nozzle
A constant gallonage spray nozzle is an adjustable-pattern nozzle in which the nozzle will deliver a constant discharge flow throughout all spray patterns from straight stream to wide angle spray at its rated pressure. This is accomplished by maintaining a constant orifice size during discharge pattern adjustment.

Constant Pressure (Automatic) Spray Nozzle
A constant pressure (automatic) spray nozzle is an adjustable-pattern nozzle in which the pressure remains constant through a range of discharge rates. This is accomplished by means of a pressure-activated self-adjusting orifice baffle.

Constant/Select Gallonage Spray Nozzle
A constant/select gallonage spray nozzle is a constant-gallonage nozzle that allows on-site manual adjustment of the orifice to choose between multiple options of rated discharge flow at a given rated pressure. The discharge rate remains constant throughout the range of pattern selection from straight stream to wide spray.

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

Flammable Liquid
Any liquid that has a flash point below 100ºF (38ºC).

Full-Time Swivel
A swivel coupling connection at the inlet of a spray nozzle designed to rotate independently from the nozzle.

Handline Nozzle
A portable handheld spray nozzle designed to be affixed to an industrial fire hose, or other water hose.

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

Master Stream Nozzle
A spray nozzle designed to be affixed to a firefighting monitor assembly. Also known as monitor nozzles.

Maximum Rated Operating Pressure
The maximum pressure, measured at the nozzle inlet, at which a nozzle is rated to operate as intended.

Narrow Angle Spray
A spray pattern between straight stream and wide angle spray patterns.

Combustible Commodities
Ordinary combustible materials, such as wood, cloth, paper, rubber, and many plastics. Also known as Class A fire applications.

Rated Flow
The rated flow rate of the nozzle achieved while flowing at the specified rated inlet pressure. Also known as rated discharge.

Rated Inlet Pressure
The inlet pressure at which a nozzle is designed to operate to produce the rated discharge. Also known as rated pressure.

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

Spray Angle
The angle at which the nozzle's spray radiates outward from the nozzle outlet. Also known as the discharge cone angle.

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

Straight Stream
The most dense type of spray pattern in an adjustable spray nozzle to achieve the maximum reach.

Trigger-Type Lever Controls
A control that is activated by a squeezing or pinching movement and features a spring-operated automatic return to the closed position.

Wide Angle Spray
The spray pattern resulting in the widest possible spray angle.

2 GENERAL INFORMATION

2.1 Product Information

2.1.1 This standard applies to portable adjustable-pattern nozzles intended for general fire department and industry use, for use with fire hoses affixed to standpipe systems, or for use with fixed monitor assemblies. Depending on their design and performance, these nozzles are suitable for use on fires in combustible commodities, flammable liquids, and/or electrical equipment. Nozzles may be either basic spray, constant gallonage, constant/select gallonage, or constant pressure (automatic) types. Nozzles are typically supplied with rotational-type pattern controls that are used to control and adjust the spray pattern of the discharge from straight stream to wide angle spray. Nozzles may also be supplied with a shutoff valve, or have twist shutoff capabilities, to provide on/off control of water flow. Nozzles will provide their rated flow at the rated pressure.

2.1.2 In order to meet the intent of this standard, nozzles must be examined on a model-by-model, type-by-type, manufacturer-by-manufacturer, and plant-by-plant basis. This is predicated on the basis that identical designs, fabricated in identical materials by different manufacturers or, even by different plants of the same manufacturer, have been seen to perform differently in testing. Sample nozzles, selected in conformance to this criterion, shall satisfy all of the requirements of this standard,

2.2 Certification Application Requirements

The manufacturer shall provide the following preliminary information with any request for certification consideration:

- A complete list of all models, types, sizes, and options for the products or services being submitted for certification consideration.
- General assembly drawings, one complete set of manufacturing drawings, materials list(s), anticipated marking format, brochures, sales literature, specification sheets, installation, operation and maintenance procedures; and,
- The number and location(s) of the manufacturing facilities.

All documents shall identify the manufacturer's name, document number or other form of reference, title, date of last revision, and revision level. All foreign language documents shall be provided with English translation.

2.3 Requirement for Samples for Examination

2.3.1 Following authorization of a certification examination, the manufacturer shall submit samples for examination and testing based on the sample requirements determined by the certification agency.

2.3.2 Requirements for samples may vary depending on design features, results of prior or similar testing, and results of any foregoing tests.

2.3.3 The manufacturer shall submit samples representative of production. Any decision to use data generated using prototypes is at the discretion of the certification agency.

2.3.4 It is the manufacturer's responsibility to provide any necessary test fixtures, such as those which may be required to evaluate the nozzles.

3 GENERAL REQUIREMENTS

3.1 Review of Documentation

During the initial investigation and prior to physical testing, the manufacturer's specifications, technical data sheets, and design details shall be reviewed to assess the ease and practicality of installation and use.

3.2 Physical or Structural Features

3.2.1 Portable nozzles shall be designed for a maximum rated operating pressure of at least 175 psi (12.1 bar). Portable nozzles shall be designed for a rated inlet pressure of not less than 50 psi (3.4 bar) and not more than 150 psi (10.3 bar). Nozzles with higher rated inlet pressures shall be evaluated on a case-by-case basis.

3.2.2 Nozzle discharge rating shall be expressed as a rated discharge at a rated pressure [e.g., 60 gal/min at 100 psi (225 L/min at 6.9 bar)].

3.2.3 Typical inlet end connections shall be female only with national fire hose thread (NH) end connections, as specified in NFPA 1963, *Standard for Fire Hose Connections*, or connection types conforming to other nationally or internationally recognized standards and accepted by the Authority Having Jurisdiction (AHJ). Other types of end connections shall be evaluated on a case-by-case basis. End connections with threaded end connections shall be provided with a section to serve as a hand/wrench grip. If a special wrench is required, it shall be supplied with the nozzle.

3.2.4 Portable nozzles submitted for testing shall be production samples and shall be free of sharp edges, burrs, or other imperfections that might injure the installer or interfere with proper installation of the unit or with full water flow.

3.2.5 Nozzles having fixed water passages or orifices with dimensions smaller than 1/8 in. (3 mm) shall be provided with a screen at the inlet. The diameter of the holes in this screen shall be less than the smallest dimension of the water passages. The aggregate area of the holes in the screen shall be at least ten times the total outlet area. The screen shall be placed so that it may be easily cleaned.

3.2.6 Handline nozzles shall be of reasonable weight. The following is a guide for weight limitations:

1-1/2 in. nominal size nozzle	10 lb. (4.5) kg maximum
2-1/2 in. nominal size nozzle	15 lb. (6.8 kg) maximum

3.2.7 A handline spray 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.

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

3.2.9 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.

3.2.10 Nozzles equipped with a flush feature, shall have a separate setting or detent or require increased force to indicate when the flush feature is engaged.

3.2.11 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.

3.2.12 Nozzles equipped with a trigger-type shutoff control shall be in the open position when squeezed and the closed position when released.

3.2.13 Nozzles designed for use in Class C fire applications shall have a minimum discharge angle of not less than 30 degrees.

3.3 Electrically Operated Nozzles

Master stream nozzles for use on monitor assemblies may be equipped with an electrical motor to allow for adjustment of the spray pattern control from remote locations.

3.3.1 For nozzles equipped with an option for electrical operation, the High Temperature Exposure (Section 4.7) and Weatherability – Low Temperature Exposure (Section 4.8) tests shall be conducted on a nozzle assembly equipped with the appropriate electrical motor and auxiliary components. After each of these tests, the nozzle shall operate freely as intended over its entire range of motion when using the electrical operation method. All other tests may be completed with a standard manually operated nozzle assembly.

3.3.2 The electric motor and its related components (i.e. junction box, wiring, control panel) shall be subject to additional electrical evaluation. Electrical components shall be 3rd party certified and/or tested to the applicable standards listed below. Depending on component design and requested ratings, examination to other applicable standards which are not referenced below may also be required at the discretion of the certification agency.

FM 3810, Electrical and Electronic Test, Measuring and Process Control Equipment

ANSI/NEMA 250, Enclosures for Electrical Equipment (1000 Volts Maximum)

UL 508, Industrial Control Equipment

UL 508A, Industrial Control Panels

UL 1004 series, Rotating Electrical Machines

*FM 3600, Electrical Equipment for Use in Hazardous (Classified) Locations – General Requirements

*FM 3611, Nonincendive Electrical Equipment for Use in Class I and II, Division 2 and Class III, Divisions 1 and 2 Hazardous (Classified) Locations

*FM 3615, Explosionproof Electrical Equipment General Requirements

*If HAZLOC or explosion proof rating is desired

3.4 Nozzles Designed for Foam Applications

Nozzles designed for foam applications equipped with ports for dip tubes for metering foam concentrate into the water stream shall be subject to the appropriate requirements in the following standard. Certification shall not be granted for nozzles designed for foam applications unless these requirements have been met.

FM 5130, Examination Standard for Foam Extinguishing Systems

3.5 Materials

All materials used in these nozzles shall be suitable for the intended application. Nozzles shall be constructed of corrosion resistant materials. When unusual materials are used, special tests may be necessary to verify their suitability.

3.6 Markings

3.6.1 Each nozzle shall be permanently stamped or embossed and identified with the following information using figures and letters not less than 3/16 in. (4.8 mm) in height:

- Name or logo of manufacturer
- Unique product or model designation
- The rated inlet pressure of the nozzle
- 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 flow.
- Nozzles equipped with a flush feature shall indicate the flush operating position with the word FLUSH
- 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 (Open and Close)
- All other markings required by this standard

3.6.2 The model or type identification shall correspond with the manufacturer's catalog designation and shall uniquely identify the certification agency's mark of conformity.

3.6.3 The certification agency's mark of conformity shall be displayed visibly and permanently on the product and/or packaging as appropriate and in accordance with the requirements of the certification agency. The manufacturer shall exercise control of this mark as specified by the certification agency and the certification scheme.

3.6.4 All markings shall be legible and durable.

3.7 Manufacturer's Installation and Operation Instructions

The manufacturer shall:

- prepare instructions for the installation, maintenance, and operation of the product;
- provide facilities for repair of the product and supply replacement parts, if applicable; and
- provide services to ensure proper installation, inspection, or maintenance for products of such nature that it would not be reasonable to expect the average user to be able to provide such installation, inspection, or maintenance.

3.8 Calibration

3.8.1 Each piece of equipment used to verify the test parameters shall be calibrated within an interval determined on the basis of stability, purpose, and usage. A copy of the calibration certificate for each piece of test equipment is required. The certificate shall indicate that the calibration was performed

against working standards whose calibration is certified and traceable to an acceptable reference standard and certified by an ISO/IEC 17025 accredited calibration laboratory. The test equipment shall be clearly identified by label or sticker showing the last date of the calibration and the next due date. A copy of the service provider's accreditation certificate as an ISO/IEC 17025 accredited calibration laboratory should be available.

3.8.2 When the inspection equipment and/or environment is not suitable for labels or stickers, other methods such as etching of control numbers on the measuring device are allowed, provided documentation is maintained on the calibration status of thus equipment.

4 PERFORMANCE REQUIREMENTS

4.1 Examination

4.1.1 Requirements

The nozzles shall conform to the manufacturer's drawings and specifications and to the requirements stated in Section 3 - General Requirements.

4.1.2 Test/Verification

A sample shall be examined and compared to drawings and specifications. It shall be verified that the sample conforms to the physical and structural requirements described in Section 3, General Requirements.

4.2 Discharge Performance Tests

4.2.1 Requirements

The nozzle shall deliver its rated discharge at its rated pressure within the limits stated below.

4.2.1.1 Basic spray nozzles shall not discharge 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 4.2.2.1.

4.2.1.2 Constant gallonage spray nozzles shall not discharge 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 4.2.2.2.

4.2.1.3 Constant/select gallonage spray nozzles shall not discharge less than the rated discharge at the rated pressure and no more than 10 percent over the rated discharge at each rated discharge setting when tested in accordance with Section 4.2.2.3.

4.2.1.4 Constant pressure (automatic) spray nozzles shall maintain their rated pressure, ±15 psi (±1.0 bar), throughout the rated discharge range when tested in accordance with Section 4.2.2.4.

4.2.2 Test/Verification

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

4.2.2.1 Basic spray nozzles shall be tested and discharge measurements taken in both straight stream and wide angle spray pattern settings. Each measurement shall be taken with the inlet pressure adjusted to the rated pressure, ±2 percent.

4.2.2.2 Constant gallonage nozzles shall be tested and discharge measurements taken throughout the entire range of pattern selection. Measurements shall be made at straight stream, narrow angle, and wide angle spray pattern settings, at a minimum. Each measurement shall be taken with the inlet pressure adjusted to the rated pressure, ±2 percent.

4.2.2.3 Constant/select gallonage nozzles shall be tested and discharge measurements taken throughout the entire range of pattern selection at each rated discharge setting. At each discharge setting, measurements shall be made at straight stream, narrow angle, and wide

angle spray pattern settings, at a minimum. Each measurement shall be taken with the inlet pressure adjusted to the rated pressure, ±2 percent.

4.2.2.4 Constant pressure (automatic) spray nozzle discharge shall be set at the minimum rated discharge ±2 percent. The inlet pressure at this flow shall be recorded throughout the entire range of pattern selection. Measurements shall be made at straight stream, narrow angle, and wide angle spray pattern settings, at a minimum. The discharge shall slowly be increased to the maximum rated discharge while monitoring the pressure. The minimum and maximum pressures throughout the discharge range shall be recorded. At the maximum rated flow, the inlet pressure shall be recorded throughout the entire range of pattern selection. Measurements shall be made at straight stream, narrow angle, and wide angle spray pattern settings, at a minimum.

4.3 Spray Character, Reach, and Discharge Angle

4.3.1 Requirements

Spray nozzles shall be capable of developing discharge patterns varying from straight stream to at least 100 degrees spray angle. Spray pattern settings shall provide a full and uniform spray pattern. The straight stream reach and discharge angle of each distinct pattern selection observed in testing shall be used to verify the manufacturer's published reach and discharge angle for each rating and flow condition.

Spray nozzles designed for Class C fire applications shall be exempt from the straight stream pattern requirement. Instead, the minimum discharge angle shall not be less than 30 degrees.

4.3.1.1 Wide Angle Spray – With the nozzle discharging horizontally at the rated pressure, the wide angle spray shall produce a uniform circular 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 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 surface of the spray sheet. Discontinuities of the cone shape should not exceed 2 in. (51 mm) above or below the basic cone surface when measured at a distance of 2 ft (0.61 m) from the edge of the nozzle along the surface of the spray sheet. On a vertical plane 4 ft (1.2 m) from the nozzle tip, at least 90 percent of the total discharge shall fall within a 12 ft (3.7 m) diameter circle for nozzles up to 1.5" nominal inlet size. For nozzles greater than 1.5" nominal inlet size, at least 90 percent of the total discharge shall fall within a 15 ft (4.6 m) diameter circle. Exceptions may apply for nozzles designed for special applications requiring higher maximum spray angles. In all cases, the spray cone diameter at a distance of 4 ft. (1.2 m) from the nozzle shall be a minimum of 9.5 ft. (2.9 m) to satisfy the minimum 100 degree spray angle requirement.

4.3.1.2 Narrow Angle Spray – With the nozzle discharging horizontally at the rated pressure, the spray discharge shall be reasonably uniform within the discharge pattern. 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 surface of the spray sheet. Discontinuities of the cone shape should not exceed 2 in. (51 mm) above or below the basic cone surface when measured at a distance of 2 ft (0.61 m) from the edge of the nozzle along the surface of the spray sheet.

4.3.1.3 Straight Stream – With the nozzle discharging horizontally at the rated pressure, 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 if the nozzle's rated discharge is less than 350 gpm (1325 L/min), and within a circle 15 in. (38.1 cm) in diameter at a distance of 10 ft. (3.0 m) if

the nozzle's rated discharge is 350 gpm (1325 L/min) or greater. There shall be little or no spray evident at the nozzle during the solid stream discharge. Reach figures shall also be obtained with the nozzle discharging at an angle of 32 degrees above the horizontal.

4.3.2 Test/Verification

With the nozzle discharging horizontally at the rated pressure and at each distinct pattern selection, the requirements of Sections 4.3.1.1, 4.3.1.2, & 4.3.1.3 shall be verified. The cone shall be visually inspected for flat spots, lobes, or spray ejected outside the general shape of the cone. Any hollow or weak areas or discontinuities of the cone shape shall be measured. For narrow angle spray and wide angle spray settings, discharge cone diameter shall be measured and recorded at a distance of 4 ft. (1.22m) from the edge of the nozzle. This data shall be used to calculate discharge angles. The calculated discharge angles shall be used to verify the manufacturer's published angles.

Discharge angle (θ) shall be calculated by the formula:

$$\theta = 2 \bullet \tan^{-1} (d/8),$$

where d is the diameter of the cone in feet, or

$$\theta = 2 \bullet \tan^{-1} (d/2.44),$$

where d is the diameter of the cone in meters.

Straight stream reach shall also be measured with the nozzle discharging at an angle of 32 degrees above the horizontal. Straight stream reach measurements shall be used to verify the manufacturer's published reach figure

4.4 Flush Test

4.4.1 Requirements

All spray nozzles shall be designed to clear or flush the size of debris specified in Table 4.4.1 from the nozzle without shutting off the water to the hose, either through the full open nozzle position or through a flush feature of the nozzle.

Table 4.4.1 *Flushing Capability for Nozzles*

Rated Discharge		***Size of Steel Ball***	
gal/min	***L/min***	***in.***	***mm***
Up to 60	(Up to 230)	1/8	(3.18)
60-150	(230-570)	3/16	(4.76)
Over 150	(Over 570)	1/4	(6.35)

4.4.2 Test/Verification

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 be dropped into the inlet and pass through the nozzle without changes in the control position.

4.5 Control Tests

4.5.1 Lever-Type Controls

4.5.1.1 Requirements

Nozzles equipped with lever-type shutoff or pattern selection controls shall require a force of no more than 16 lb_f (71.2 N) and no less than 3 lb_f (13.3 N) to operate when tested in accordance with 4.5.1.2.

For nozzles equipped with a shutoff, operational force shall not increase by more than 25% after the nozzle is subjected to a hydrostatic pressure of 300 psi (20.7 bar) or 1-1/2 times the maximum rated operating pressure, whichever is greater.

4.5.1.2 Test/Verification

The nozzle shall be mounted without any pressure applied to it. The controlling lever shall be placed in the fully closed or full forward position. 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 lever or handle shall be moved from the fully closed to fully open position. The maximum force required to move the lever shall be measured with the dynamometer and recorded.

The controlling lever shall be placed in the fully closed or full forward position and nozzle supplied with an inlet pressure of 100 psi (6.9 bar). The shutoff or pattern selection lever or handle shall be moved from the fully closed to fully open position and the maximum force recorded. The inlet pressure shall then be adjusted to 100 psi (6.9 bar) while in the full discharge position. The lever or handle shall be moved from the fully open to fully closed position and, again, the maximum force recorded.

For nozzles equipped with a lever-type shutoff, with the controlling lever in the fully closed position, the nozzle shall be subjected to a hydrostatic pressure of 300 psi (20.7 bar) or 1-1/2 times the maximum rated operating pressure, whichever is greater, for 5 minutes. The pressure shall then be released and the aforementioned force measurements repeated. Results shall be compared to those recorded prior to subjecting the nozzle to the hydrostatic pressure.

4.5.2 Rotational-Type Controls

4.5.2.1 Requirements

For rotational-type controls, the operational force required to change the pattern or flow setting shall not exceed 40 lbf (178 N) and shall not be less than 3 lbf (13 N) when tested in accordance with 4.4.2.2. Twist shutoffs shall also meet these requirements when used to just open or just close the nozzle.

For nozzles equipped with a rotational-type twist shutoff, operational force shall not increase by more than 25% after the nozzle is subjected to a hydrostatic pressure of 300 psi (20.7 bar) or 1-1/2 times the maximum rated operating pressure, whichever is greater.

4.5.2.2 Test/Verification

Nozzles equipped with a rotational pattern or flow control shall be mounted on a rigid device and 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.

With the nozzle in the open position, water shall be discharged and the inlet pressure be adjusted to 100 psi (6.9 bar). The pattern or flow sleeve shall then be rotated by pulling the force gauge perpendicular to the center axis of the nozzle. As the sleeve rotates, the string will unwind so that the force always remains tangential to the sleeve. The pattern or flow sleeve shall be rotated throughout its full range. If the nozzle is equipped with detents for the pattern or flow settings, this test shall commence with the pattern or flow sleeve in the detent.

For nozzles equipped with a twist shutoff, in addition to the above, the force shall be measured to just close the shutoff under 100 psi (6.9 bar) flowing conditions and to just open the shutoff under 100 psi (6.9 bar) hydrostatic pressure. Subsequently, with the shutoff in the closed position, the nozzle shall be subjected to a hydrostatic pressure of 300 psi (20.7 bar) or 1-1/2 times the maximum rated operating pressure, whichever is greater, for 5 minutes. The pressure shall then be released and all force measurements repeated. Results shall be compared to those recorded prior to subjecting the nozzle to the hydrostatic pressure.

4.5.3 Full-Time Swivel

4.5.3.1 Requirements

Nozzles equipped with a full-time swivel shall require a minimum force of 10 lbf (44.5 N) to rotate the nozzle against the swivel when tested in accordance with 4.5.3.2. If the nozzle is equipped with rotational pattern or flow 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 or flow control, as outlined in Section 4.5.2.

4.5.3.2 Test/Verification

Nozzles equipped with a full-time swivel shall be tested while water is discharging at 100 psi (6.9 bar). A length of twine or string not to exceed 3/32 in. (2.9 mm) in diameter shall be wrapped around the rotational pattern or flow control sleeve as described in Section 4.5.2.2. A force gauge, which records the maximum force reading, shall be attached to a loop in the free end of the string. The pattern or flow control sleeve shall be rotated to the end of its travel. Force shall continue to be applied tangentially until the full-time swivel connection rotates. The maximum force required to rotate the full-time swivel shall be recorded.

4.6 Hydrostatic Pressure Tests

4.6.1 Leakage Test

4.6.1.1 Requirements

Nozzles equipped with a shutoff shall remain sufficiently leak tight when in the shutoff position and hydrostatically pressurized to 800 psi (55.2 bar). The maximum leakage allowed through the shutoff is 12 drops/min (0.8 ml/min). There shall be no leakage through any other part of the nozzle.

4.6.1.2 Test/Verification

With the shutoff in the fully closed position, the nozzle shall be hydrostatically pressurized to 800 psi (55.2 bar) then fully opened and closed. After the shutoff has been

closed again, the test pressure shall be maintained for a period of 5 minutes. Any leakage through the shutoff shall be collected and measured. Observations of any leakage through any other part of the nozzle shall be made.

4.6.2 Hydrostatic Strength Test

4.6.2.1 Requirements

Nozzles equipped with a shutoff shall be capable of withstanding a hydrostatic pressure of 1000 psi (68.9 bar) or four times the maximum rated operating pressure, whichever is greater, without suffering any cracking or permanent distortion. There shall be no leakage through any part of the nozzle other than the discharge orifice.

4.6.2.2 Test/Verification

The nozzle shutoff shall be hydrostatically pressurized to 1000 psi (68.9 bar), or four times the maximum rated operating pressure, whichever is greater, for a period of 1 minute. Observations of a cracking or permanent distortion of the nozzle body as well as any leakage through any part of the nozzle other than the discharge orifice shall be made.

4.7 High Temperature Exposure

4.7.1 Requirements

A dry nozzle assembly shall operate freely, with no binding, and shall show no significant deformation, blistering, or fracture following exposure to a high temperature of 135°F (57°C) for a period of 24 hours. Immediately following the conditioning period, the sample shall be subjected to the drop tests described in Section 4.9.2.1 without the attached fire hose.

After completion of the high temperature exposure and rough usage tests, if deemed necessary by visual inspection, deterioration of the performance characteristics shall be evaluated, including the use of any or all of the tests detailed in Section 4.3 (Spray Character, Reach, and Discharge Angle), 4.5 (Control Tests), and/or Section 4.6 (Hydrostatic Pressure Tests).

4.7.2 Test/Verification

The nozzle assembly shall be conditioned in an oven or furnace set at 135°F (57°C) for a period of 24 hours. Immediately upon removal from the conditioning chamber, the unpressurized nozzle assembly shall be tested for proper function of the adjustments and controls. Within three minutes after being removed from the heating chamber, the nozzle shall be subjected to the drop tests described in Section 4.9.2.1 without the attached fire hose. The nozzle assembly shall then be visually examined and, if deemed necessary, the nozzle assembly shall be subjected to the post-tests as detailed in Section 4.7.1.

4.8 Weatherability - Low Temperature Exposure

4.8.1 Requirements

The same nozzle sample used for the high-temperature exposure test (Section 4.7) shall be used for the low-temperature exposure test.

The nozzle assembly shall operate freely, with no binding, and shall show no significant deformation, blistering, or fracture, following exposure to simulated wet and freezing conditions with a low temperature of -40°F (-40°C) for a period of 24 hours. Immediately following the conditioning period, the nozzle shall be subjected to the drop tests described in Section 4.9.2.1 without the attached fire hose.

After completion of the low temperature exposure and rough usage tests, if deemed necessary by visual inspection, deterioration of the performance characteristics shall be evaluated, including the use of any or all of the tests detailed in Section 4.3 (Spray Character, Reach, and Discharge Angle), 4.5 (Control Tests), and/or Section 4.6 (Hydrostatic Pressure Tests). Failure to operate as a result of freezing shall be deemed a failure.

4.8.2 Test/Verification

The same nozzle sample used for the high-temperature exposure test (Section 4.7) shall be subjected to a water spray at an approximate rate of 0.6 in./min (15mm/min) for an elapsed time of 5 minutes. This is to simulate exposure to condensation, moisture, or rain. The nozzle assembly shall then be conditioned in a freezer set at -40°F (-40°C) for a period of 24 hours. Immediately upon removal from the conditioning chamber, the unpressurized nozzle assembly shall be tested for proper function of the adjustments and controls. Within three minutes after being removed from the conditioning chamber, the nozzle shall be subjected to the drop tests described in Section 4.9.2.1 without the attached fire hose. The nozzle assembly shall then be visually examined and, if deemed necessary, the nozzle assembly shall be subjected to the post-tests as detailed in Section 4.8.1.

4.9 Rough Usage Test – Handline Nozzles

4.9.1 Requirements

Handline nozzle assemblies shall operate freely and shall show no significant deformation, blistering, or fracture, following rough usage. All functions such as pattern selection, flush, discharge adjustment, and shutoff shall remain fully functional and operate as intended. This test does not apply to master stream nozzles.

After completion of the rough usage test, if deemed necessary by visual inspection, deterioration of the performance characteristics shall be evaluated, including the use of any or all of the tests detailed in Section 4.2 (Discharge Performance Test) and Section 4.4 (Flush Test). The control tests as part of Section 4.5 (Control Tests) shall be repeated. The operating force of all control mechanisms shall not increase by more than 10 percent from that determined before the test. In addition, nozzles equipped with a shutoff shall again be subjected to the leakage test defined in Section 4.6.1.

4.9.2 Test/Verification

The nozzle shall be attached to a length of hose at least 10 ft. (3 m) long, and subjected to each of the following:

4.9.2.1 The hose shall not be charged. The shutoff handle or lever, if available, shall be in the closed position. The nozzle shall be dropped three times from a height of 6 ft (2 m) onto a concrete surface. The nozzle shall be dropped once so that it impacts directly or squarely on the discharge end, and twice so that the points of impact are on two different sides of the nozzle. For nozzles with a shutoff handle or lever, one point of impact shall be directly on the handle or lever. For nozzles with a handhold, handgrip, or ladder hook, one point of impact shall be directly on the handhold, handgrip, or ladder hook.

4.9.2.2 The hose shall be pressurized to 100 psi (6.9 bar). The shutoff handle or lever, if available, shall be in the closed position. The nozzle shall be dropped twice from a height of 6 ft (2 m) onto a concrete surface. The points of impact shall be on two different sides of the nozzle.For nozzles with a shutoff handle or lever, one point of impact shall be directly on the handle or lever. For nozzles with a handhold, handgrip, or ladder hook, one point of impact shall be directly on the handhold, handgrip, or ladder hook.

Following the drop tests, the nozzle shall be examined for signs of significant deformation, blistering, or fracture. All functions such as pattern selection, flush, discharge adjustment, and shutoff shall be tested for proper functioning. The control tests detailed in Section 4.5 shall be repeated. For nozzles equipped with a shutoff, the hydrostatic leakage test detailed in Section 4.6.1 shall be repeated.

4.10 Corrosion - Salt Spray / Process Residue

4.10.1 Requirements

In order to evaluate the resistance to corrosion, such as might be experienced by dissimilar materials in contact over long periods of time, the nozzle assembly shall withstand a timed exposure to a salt spray atmosphere.

When tested as detailed in Section 4.10.2, visual evidence of severe deterioration or impending failure of any component shall constitute failure. Following exposure, all functions such as pattern selection, flush, discharge adjustment, and shutoff shall operate properly. If deemed necessary, deterioration of performance characteristics shall be evaluated, including the use of any or all of the tests detailed in Section 4.2 (Discharge Performance Tests), Section 4.4 (Flush Test), Section 4.5 (Control Tests), and Section 4.6 (Hydrostatic Pressure Tests).

4.10.2 Test/Verification

The nozzle assembly, with provision for sealing the inlet and outlet connections, shall be exposed to salt spray (fog) as specified by the latest version of the Standard for ASTM B117, Salt Spray (Fog) Testing. The salt solution shall consist of 20 percent by weight of common salt (sodium chloride) dissolved in demineralized water.

The samples shall be exposed to a salt spray (fog) for a continuous period of 10 days. Each nozzle assembly shall be mounted in its intended installation position.

Following the exposure to the salt fog, the samples shall be removed from the test chamber and permitted to air dry for a two - to four - day drying period. Following exposure, samples shall be tested for proper operation of all control mechanisms. If deemed necessary, the samples shall be subjected to the post tests detailed in Section 4.10.1.

4.11 Moist Ammonia-Air Stress Cracking Test

4.11.1 Requirements

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. 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.

4.11.2 Test/Verification

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 leak tight assembly.

The samples shall be degreased, supported by an inert tray in a glass chamber with a glass cover 1.5 in. (38 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).

At the conclusion of the exposure, the samples shall show no evidence of cracking when examined using "25 times" magnification.

4.12 Ultraviolet Light and Water Test

4.12.1 Requirements

Nozzles or exposed components manufactured of non-metallic materials shall be exposed to ultraviolet light and water for 720 hours in accordance with Table X3.1, Condition 1, of ASTM G155, Standard Practice for Operating Xenon Arc Light Apparatus for Exposure of Non-Metallic Materials. At the conclusion of the test, there shall be no cracking or crazing of the nozzle. Following exposure, all functions such as pattern selection, flush, discharge adjustment, and shutoff shall operate properly. Subsequently, the nozzle shall be subjected to the drop tests described in Section 4.9.2.1 without the attached fire hose.

4.12.2 Test/Verification

A sample nozzle or component shall be exposed to ultraviolet light and water for 720 hours. The nozzle shall be inspected for cracking and crazing after 360 hours. If no cracking or crazing is apparent, the exposureshall continue for the full 720 hours.

During each operating cycle, each sample shall be exposed to light and water spray for 18 minutes and to only light for 102 minutes (total 120 minutes). The air temperature within the apparatus during operations shall be 109 +/- 4.5ºF (43 +/- 2.5ºC) and the relative humidity 30 +/- 5 percent.

Following exposure, the nozzle shall be subjected to the drop tests described in Section 4.9.2.1 without the attached fire hose.

4.13 Air-Oven Aging Tests of Nonmetallic Nozzle Components

4.13.1 Requirements

Nozzles or components manufactured of non-metallic materials, other than rubber gaskets, shall be subjected to air-oven aging at 158°F (70°C) for 180 days. There shall be no cracking or crazing as a result of this test. Following exposure, the nozzle shall be subjected to the drop tests described in Section 4.9.2.1 without the attached fire hose.

4.13.2 Test/Verification

Sample nozzles shall be placed in a conditioning chamber at 158°F (70°C) for a period of 180 days, and then allowed to cool at least 24 hours in air at 74°F (23°C) at 50 percent relative humidity. Following the conditioning period, the nozzle shall be inspected for any cracking or crazing. The sample nozzles shall then be subjected to the drop tests described in Section 4.9.2.1 without the attached fire hose.

4.14 Handholds, Handgrips, and Ladder Hooks

4.14.1 Requirements

Dual handholds, single handgrips, or ladder hooks provided on nozzles shall support a 300 lb. (136 kg) nozzle reaction force. If more than one feature is provided on the same nozzle, each feature shall be tested separately. There shall be no distortion, cracks or broken sections as a result of this test.

4.14.2 Test/Verification

A sample nozzle shall be mounted in a fixture in its intended position for use. A force of 300 lbf (1334N) shall be applied to the nozzle for 5 minutes. The nozzle shall then be examined for distortion, cracks, and/or broken sections.

4.15 Tensile Strength, Ultimate Elongation, and Tensile Set Tests

4.15.1 Requirements

Elastomeric gasket or o-ring materials shall have a tensile strength of not less than 500 psi (3.45 MPa), an ultimate elongation of not less than 100 percent, and a tensile set of not more than 19 percent. Tensile strength, ultimate elongation, and tensile set shall be determined in accordance with ASTM D412, Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers – Tension, Method A with exceptions as stated in Section 4.15.2.

4.15.2 Test/Verification

Tensile strength, ultimate elongation, and tensile set shall be determined in accordance with ASTM D412, Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension, Method A, with the exception that, for tensile set determinations, the elongation shall be maintained for 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). 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.

4.16 Compression Set Test

4.16.1 Requirements

Elastomeric gasket or o-ring materials shall have a compression set of not more than 15 percent, as determined according to Section 4.17.2.

4.16.2 Test/Verification

Testing shall be conducted in accordance with ASTM D395, Standard Test Methods for Rubber Property – Compression Set, Method B. Type I specimens of the material shall be prepared and then exposed for 22 hours at 70°F ± 2°F (21°C ± 1°C).

4.17 Accelerated Aging Test

4.17.1 Requirements

Elastomeric gasket or o-ring materials shall be subjected to an accelerated aging test. Following the test, the material shall not have less than 80 percent of the as-received tensile strength and 50 percent of the as-received ultimate elongation.

4.17.2 Test/Verification

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 D573, Standard Test Method for Rubber - Deterioration in an Air Oven.

4.18 Additional Tests

Additional tests may be required, depending on design features, results of any tests, material application, or to verify the integrity and reliability of the nozzles, at the discretion of the certification agency.

Unexplainable failures shall not be permitted. A re-test shall only be acceptable at the discretion the certification agency and with adequate technical justification of the conditions and reasons for failure.

5 OPERATIONS REQUIREMENTS

5.1 Demonstrated Quality Control Program

5.1.1 A quality assurance program is required to assure that subsequent products produced by the manufacturer shall present the same quality and reliability as the specific products examined. Design quality, conformance to design, and performance are the areas of primary concern.

- Design quality is determined during the examination and tests and may be documented in the certification report.
- Continued conformance to this standard is verified by the certifier's surveillance program.
- Quality of performance is determined by field performance and by periodic re-examination and testing.

5.1.2 The manufacturer shall demonstrate a quality assurance program which specifies controls for at least the following areas:

- Existence of corporate quality assurance guidelines;
- Incoming quality assurance, including testing;
- In-process quality assurance, including testing;
- Final inspection and tests;
- Equipment calibration;
- Drawing and change control;
- Packaging and shipping; and,
- Handling and disposition of non-conformance materials.

In order to assure adequate traceability of materials and products, the manufacturer shall maintain records of all quality control tests performed and shall maintain these records for a minimum period of two years from the date of manufacture.

5.1.3 Documentation Manual

There shall exist an authoritative collection of procedures and policies. Such documentation shall provide an accurate description of the quality management system while serving as a permanent reference for implementation and maintenance of that system. The system should require that sufficient records are maintained to demonstrate achievement of the required quality and verify operation of the quality system.

5.1.4 Records

To assure adequate traceability of materials and products, the manufacturer shall maintain a record of all quality assurance tests performed, for a minimum period of two years from the date of manufacture.

5.1.5 Drawing and Change Control

- The manufacturer shall establish a system of product configuration control that shall allow no unauthorized changes to the product. Changes to critical documents, identified in the certification report, may be required to be reported to, and authorized by the certification agency prior to implementation for production.

- Records of all revisions to all certified products shall be maintained.

5.2 Surveillance Audit

5.2.1 An audit of the manufacturing facility may be part of the certification agency's surveillance requirements to verify implementation of the quality assurance program. Its purpose is to determine that the manufacturer's equipment, procedures, and quality program are maintained to ensure a uniform product consistent with that which was tested and certified.

5.2.2 Certified products or services shall be produced or provided at the location(s) disclosed as part of the certification examination. Manufacture of products bearing a certification mark is not permitted at any other location prior to disclosure to the certification agency.

5.3 Manufacturer's Responsibilities

The manufacturer shall notify the certification agency of changes in product construction, design, components, raw materials, physical characteristics, coatings, component formulation, or quality assurance procedures prior to implementation of such changes.

5.4 Manufacturing and Production Tests

5.4.1 *Test Requirement No. 1 - Hydrostatic Strength & Leakage*

The manufacturer shall test 100 percent of production nozzle assemblies for body leakage at two times the rated pressure. The pressure shall be held for a minimum of 15 seconds with no ruptures, leakage or noticeable distortions.

6 BIBLIOGRPAHY

ISO/IEC 17025, *General Requirements for the Competence of Testing and Calibration Laboratories*.

ISO 9001, *Quality Management Systems – Requirements*

ISO/TS 9002*, Quality Management Systems – Guidelines for the Application of ISO 9001*

MIL-N-24408E, *Nozzles, Fire Hose, Combination Aqueous Film Forming Foam, Water Spray, Adjustable Pattern (Shipboard Use)*

NFPA 1964, *Standard for Spray Nozzles*

UL 401, *Standard for Safety – Portable Spray Nozzles for Fire-Protection Service*