NFPA 750
Standard on Water Mist Fire Protection Systems

1996 Edition

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

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NFPA 750

Standard on

Water Mist Fire Protection Systems

1996 Edition

This edition of NFPA 750, *Standard on Water Mist Protection Systems*, was prepared by the Technical Committee on Water Mist Fire Suppression Systems and acted on by the National Fire Protection Association, Inc., at its Annual Meeting held May 20–23, 1996, in Boston, MA. It was issued by the Standards Council on July 18, 1996, with an effective date of August 9, 1996.

This edition of NFPA 750 was approved as an American National Standard on July 26, 1996.

Origin and Development of NFPA 750

In 1993, representatives from the research and engineering communities, water mist system manufacturers, the insurance industry, enforcement authorities, and industrial users met and organized the NFPA Technical Committee on Water Mist Fire Suppression Systems. The committee started work on developing a new NFPA document that would begin to standardize water mist technology and provide for reliable design and installation of these systems.

Water mist systems were introduced in the 1940s and were utilized for specific applications such as on passenger ferries. The renewed interest in water systems is due partially to the phasing out of Halon and their potential as a fire safety system for spaces where the amount of water that can be stored or that can be discharged is limited. In addition, their application and effectiveness for residential occupancies, flammable liquids storage facilities, and electrical equipment spaces continues to be investigated with encouraging results.

NFPA 750 will contain elements which are similar to other types of fire protection systems such as automatic sprinklers, fixed water spray, carbon dioxide, and Halon. In many ways, water mist can be thought of as a hybrid of these systems. Overall, water mist systems utilize water as the extinguishing, suppression, or control medium, but do so in a nontraditional manner. In developing this new standard, the committee addressed system components and hardware, system types, installation requirements, design objectives, hazard classifications, calculations, water supplies, atomizing media, plans, documentation, acceptance criteria, and maintenance considerations.

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Committee Scope: This Committee shall have primary responsibility for documents on the design, installation, and maintenance of systems which use a water mist for the control, suppression, or extinguishment of fire.

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

Information on referenced publications can be found in Chapter 12 and Appendix C.

Chapter 1 General Information

1-1* Scope. This standard contains the minimum requirements for the design, installation, maintenance, and testing of water mist fire protection systems. This standard does not provide definitive fire performance criteria nor does it offer specific guidance on how to design a system to control, suppress, or extinguish a fire. Reliance is placed on the procurement and installation of listed water mist equipment or systems which have demonstrated performance in fire tests as part of a listing process.

1-2 Purpose. The purpose of this standard is to provide a reasonable degree of protection for life and property from fire through the standardization of design, installation, maintenance, and testing requirements for water-based fire suppression systems that use a specific spray (mist) that absorbs heat, displaces oxygen, or blocks radiant heat to control, suppress, or extinguish fires as required by the application. This standard endeavors to establish minimum requirements for water mist technology based on sound engineering principles, test data, and field experience. Nothing in this standard is intended to restrict new technologies or alternate arrangements, provided the level of safety prescribed by this standard is not lowered. Materials or devices not specifically designated by this standard shall be utilized in accordance with all conditions, requirements, and limitations of their listings.

NOTE 1: Water mist systems are specialized fire protection systems. Design and installation of these systems necessitates specialized training, knowledge, and experience.

NOTE 2: Water mist systems offer potential benefits for many specialized applications, particularly where available water supplies are limited or where the application of water needs to be restricted. Potential benefits also might exist for applications previously protected by gaseous and other fire suppressant agents.

1-3 Retroactivity Clause. The provisions of this document are considered necessary to provide a reasonable level of protection from loss of life and property from fire. They reflect situations and the state of the art at the time the standard was issued.

Unless otherwise noted, it is not intended that the provisions of this document be applied to facilities, equipment, structures, or installations that were existing or approved for construction or installation prior to the effective date of this document.

Exception: In those cases where it is determined by the authority having jurisdiction that the existing situation involves a distinct hazard to life or property, this standard shall apply.

1-4 Definitions and Units.

1-4.1 Definitions.

Approved.* Acceptable to the authority having jurisdiction.

Atomizing Media. Compressed air or other gases that produce water mist by mechanical mixing with water.

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

Deluge System. A water mist system using open nozzles attached to a piping system which is connected to a water supply through a valve that is opened by means of a detection system installed in the same area as the mist nozzles. When the valve opens, water flows into the piping system and discharges through all nozzles attached to the system.

Dry Pipe System. A water mist system using automatic nozzles attached to a piping system containing air, nitrogen, or inert gas under pressure, the release of which (as from an opening of an automatic nozzle) allows the water pressure to open a dry pipe valve. The water then flows into the piping system and out through any open nozzles.

Dv_f. A drop diameter such that the cumulative volume, from zero diameter to this respective diameter, is the fraction, f, of the corresponding sum of the total distribution.

NOTE: $Dv_{0.50}$ is the volume median diameter; that is, 50 percent of the total volume of liquid is in drops of smaller diameter and 50 percent is in drops of larger diameter.

Enclosure. The case, housing, partition, or walls that will substantially contain water mist in the vicinity of the hazard for a sufficient length of time to achieve the fire protection objectives.

Engineered Systems. Those systems that need individual calculation and design to determine the flow rates, nozzle pressures, pipe size, area, or volume protected by each nozzle, discharge density of water mist, the number and types of nozzles, and the nozzle placement in a specific system.

Fire Control. The limitation of the growth of a fire by prewetting adjacent combustibles and controlling ceiling gas temperatures to prevent structural damage.

Fire Extinguishment. The complete suppression of a fire until there are no burning combustibles.

Fire Suppression. The sharp reduction of the rate of heat release of a fire and the prevention of regrowth.

High Pressure System. A water mist system where the distribution system piping is exposed to pressures of 500 psi (34.5 bars) or greater.

Intermediate Pressure System. A water mist system where the distribution system piping is exposed to pressures greater than 175 psi (12.1 bars) but less than 500 psi (34.5 bars).

Listed.* Equipment, materials, or services included in a list published by an organization acceptable to the authority having jurisdiction and concerned with evaluation of products or services that maintains periodic inspection of production of listed equipment or materials or periodic evaluation of services and whose listing states either that the equipment, material, or service meets identified standards or has been tested and found suitable for a specified purpose.

Local Application System. A water mist system arranged to discharge directly on an object or hazard in an enclosed, unenclosed, or open outdoor condition.

Low Pressure System. A water mist system where the distribution piping is exposed to pressures of 175 psi (12.1 bars) or less.

Preaction System. A water mist system using automatic nozzles attached to a piping system containing air that might or might not be under pressure, with a supplemental detection system installed in the same areas as the mist nozzles. The actuation of the detection system opens a valve that allows water to flow into the piping system and discharges through all opened nozzles in the system.

Pre-engineered Systems. Those systems having predetermined flow rates, nozzle pressures, and volumes and spray flux densities of water mist. These systems have the specific pipe size, maximum and minimum pipe lengths, flexible hose specifications, number of fittings, and number and types of nozzles prescribed by a testing laboratory. Systems are provided with either a self-contained or external water supply. Based on actual test fires, the hazards protected by these systems are specifically limited as to type and size by a testing laboratory. Limitations on hazards that are allowed to be protected by these systems are contained in the manufacturer's installation manual, which is referenced as part of the listing.

Shall. Indicates a mandatory requirement.

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

Single Fluid System. A water mist system utilizing a single piping system to supply each nozzle.

Standard. A document, the main text of which contains only mandatory provisions using the word "shall" to indicate requirements, which is in a form generally suitable for mandatory reference by another standard or code or for adoption into law. Nonmandatory provisions shall be located in an Appendix, footnote, or fine-print note and are not to be considered a part of the requirements of a standard.

Total Compartment Application System. A system designed to discharge water mist to protect all hazards in an enclosure.

Twin Fluid System. A water mist system in which water and atomizing media are separately supplied to and mixed at the water mist nozzle.

Valves.

Automatic (Activation) Valve. The valve controlling water flow into the mist system, including the alarm, dry pipe, deluge, zone, and group valves.

Control Valve. Any automatic or manually operated valve that controls the flow of water or air to any part of the system in the air or water supply. Control valves include gate and ball valves.

Ventilation-limited. An enclosure in which, under normal operating conditions, all doors, hatches, and service openings in the enclosure are closed and in which activation of the water mist system automatically stops the ventilation system supplying or exhausting air from the enclosure.

Water Mist.* A water spray for which the $Dv_{0.99}$, as measured at the coarsest part of the spray in a plane 3.3 ft (1 m) from the nozzle, at its minimum design operating pressure, is less than 1000 microns.

Water Mist Nozzle. A special purpose device containing one or more orifices designed to produce and deliver water mist.

Automatic Nozzles. Automatic nozzles shall operate independently of other nozzles by means of a detection/activation device built into the nozzle.

Nonautomatic Nozzles (Open). Nonautomatic nozzles shall operate as an entire system or grouping of nozzles. These nozzles contain open orifices and the water flow to the nozzles shall be activated by an independent detection system.

Hybrid Nozzles. A hybrid nozzle shall operate using a combination of the two methods described previously (automatic or nonautomatic means, or both). These nozzles contain a built-in detection/activation device that also can be activated by an independent detection system.

Water Mist System. A distribution system connected to a water supply or water and atomizing media supplies and equipped with one or more nozzles capable of delivering water mist intended to control, suppress, or extinguish fires and that has been demonstrated to meet the performance requirements of its listing and this standard.

Wet Pipe System. A water mist system using automatic nozzles attached to a piping system containing water and connected to a water supply so that water discharges immediately from nozzles operated by the heat from a fire.

Zoned Application System. A system designed to protect hazards in a predetermined portion of an enclosure.

1-4.2 Units.

1-4.2.1 Metric units of measurement in this standard are in accordance with the modernized metric system known as the International System of Units (SI). Liter and bar units are outside of but recognized by SI and are commonly used in international fire protection. These units are provided with their conversion factors in Table 1-4.2.2.

1-4.2.2 If a value for a measurement provided in this standard is followed by an equivalent value in other units, the first stated value shall be regarded as the requirement. A given equivalent value shall be considered an approximate value.

1-5* General.

1-5.1 A water mist system is a fire protection system using very fine water sprays (i.e., water mist). The very small water droplets allow the water mist to control or extinguish fires by cooling of the flame and fire plume, oxygen displacement by water vapor, and radiant heat attenuation.

1-5.2 Use and Limitations.

1-5.2.1 Water mist systems are used for a wide range of performance objectives, including the following:

(a) Fire extinguishment;

(b) Fire suppression;

(c) Fire control;

(d) Temperature control; and

(e) Exposure protection.

Table 1-4.2.2 Metric Conversion Factors

Name of Unit	Unit Symbol	Conversion Factor
Millimeter	mm	1 in. = 25.4 mm
Square meter	m^2	1 ft^2 = 0.0929 m^2
Liter	L	1 gal = 3.785 L
Cubic decimeter	dm^3	1 gal = 3.785 dm^3
Cubic meter	m^3	1 ft^3 = 0.028317 m^3
Kilogram	kg	1 lb = 0.4536 kg
Kilograms per cubic meter	kg/m^3	1 lb/ft^3 = 16.0183 kg/m^3
Pascal	Pa	1 psi = 6895 Pa
Bar	bar	1 psi = 0.0689 bars
Bar	bar	1 bar = 10^5 Pa
Liter per minute per square meter	$L/min/m^2$	1 gpm = 40.746 $L/min/m^2$
Micron	μ	1 mm = 1000μ (1000 microns)

NOTE 1: For additional conversions and information, see ASTM E 380, *Standard Practice for Use of the International System of Units (SI) (the Modernized Metric System).*
NOTE 2: In Canada, refer to CSA CAN3-A234.1, *Canadian Metric Practice Guide.*
NOTE 3: The abbreviation "gal" indicates the U.S. gallon measure.

1-5.2.2* Water mist systems shall not be used for direct application to materials that react with water to produce violent reactions or significant amounts of hazardous products. These materials include:

(a) Reactive metals, such as lithium, sodium, potassium, magnesium, titanium, zirconium, uranium and plutonium;

(b) Metal alkoxides, such as sodium methoxide;

(c) Metal amides, such as sodium amide;

(d) Carbides, such as calcium carbide;

(e) Halides, such as benzoyl chloride and aluminum chloride;

(f) Hydrides, such as lithium aluminum hydride;

(g) Oxyhalides, such as phosphorus oxybromide;

(h) Silanes, such as trichloromethylsilane;

(i) Sulfides, such as phosphorus pentasulfide; and

(j) Cyanates, such as methylisocyanate.

1-5.2.3 Water mist systems shall not be used for direct application to liquefied gases at cryogenic temperatures (such as liquefied natural gas), which boil violently when heated by water.

1-6 Safety.

1-6.1* Hazards to Personnel. For fire situations, suitable safeguards shall be provided to ensure prompt evacuation of and to prevent entry into hazardous atmospheres and also to provide means for prompt rescue of any trapped personnel. Safety items such as personnel training, warning signs, discharge alarms, self-contained breathing apparatus, evacuation plans, and fire drills shall be considered.

1-6.2 Electrical Clearances.

NOTE: As used in this standard, "clearance" is the air distance between water mist system equipment, including piping and nozzles, and unenclosed or uninsulated live electrical components at other than ground potential. The minimum clearances provided are for the purpose of electrical clearance under normal conditions; they are not intended for use as "safe" distances during water mist system operation.

1-6.2.1* All system components shall be located to maintain minimum clearances from unenclosed and uninsulated energized electrical components in accordance with NFPA 70, *National Electrical Code®*.

1-6.2.2 Where the design basic insulation level (BIL) is not available and where nominal voltage is used for the design criteria, the highest minimum clearance specified for this group shall be used.

1-6.2.3 The selected clearance to ground shall satisfy the greater of the switching surges or BIL duty, rather than being based on nominal voltage.

1-6.2.4 The clearance between uninsulated energized parts of the electrical system equipment and any portion of the water mist system shall not be less than the minimum clearance provided elsewhere for electrical system insulation on any individual component.

1-7 Environmental Factors. When selecting water mist to protect a hazard area, the effects of water runoff on the environment shall be considered. Particular attention shall be given to any water additives or any chemicals that can be carried out of the hazard area by the water.

Chapter 2 System Components and Hardware

2-1 General. This chapter provides requirements for the correct use of water mist system components.

2-1.1 All components shall be listed for their intended use.

Exception No. 1: Where approval of system components is specifically permitted to be substituted for listing.

Exception No. 2: Where components are part of a listed, pre-engineered system.

2-1.2 System components shall be rated for the maximum working pressure to which they are exposed but not less than 175 psi (12.1 bar).

Exception: Where components are part of a listed, pre-engineered system with a self-contained water supply.

2-1.3 Corrosion Resistance. Where components are subjected to severe corrosive atmospheres, corrosion protection such as special corrosion-resistive materials or coating shall be required.

2-2 Gas and Water Containers.

2-2.1 Capacity. Gas and water containers, if provided, shall be sized to supply quantities of gas and water as required by Chapter 7.

2-2.2 Design.

2-2.2.1* Gas and water containers shall be designed for secure installation according to the manufacturer's installation manual, including provision for attachment of seismic restraint.

2-2.2.2* Gas and water containers shall be designed to meet the requirements of the U.S. Department of Transportation or of Transport Canada, if used as shipping containers. If not shipping containers, they shall be designed, fabricated, inspected, certified, and stamped in accordance with Section VIII of the ASME *Boiler and Pressure Vessel Code*. The design pressure shall be suitable for the maximum pressure developed by the water mist system at 130°F (54°C).

2-2.2.3 Each pressurized container shall be provided with a safety device to release excess pressure.

2-2.2.4 Each water container shall have a permanent nameplate or other permanent marking specifying the liquid held in the container (including additives) and the nominal water volume and pressurization level (where applicable) of the container.

Exception: Marking shall not be required on each water container if the information is provided on a nameplate or placard permanently installed on the system at a location convenient for servicing or content measuring.

2-2.2.5 External sight glasses on water containers shall be protected against mechanical damage.

2-2.2.6 Each gas container shall have a permanent nameplate or other permanent marking specifying the type of gas, weight of gas, weight of container, nominal gas volume, and pressurization level of the container.

Exception: Marking shall not be required on each gas container if the information is provided on a nameplate or placard permanently installed on the system at a location convenient for servicing or content measuring.

2-2.2.7 A reliable means shall be provided to indicate the pressure in refillable, pressurized gas containers.

2-2.3 Multiple Container Systems. All containers supplying the same manifold outlet shall be interchangeable and of the same size and charge.

2-3 Piping and Tube.

2-3.1* All piping from the system strainer to the nozzle shall have corrosion resistance at least equivalent to piping specified in Table 2-3.3.1. Wherever the word "pipe" is used, it shall be understood also to mean "tube."

2-3.2 Other types of pipe or tube investigated for suitability in water mist system installations and listed for this service shall be permitted where installed in accordance with their listing limitations, including installation instructions. Bending of the pipe shall be permitted as provided by the listing. Pipe or tube shall not be listed for portions of an occupancy classification.

2-3.3 Low Pressure Systems.

2-3.3.1 Pipe or tube used in low pressure water mist systems shall meet or exceed one of the standards in Table 2-3.3.1 or shall be in accordance with 2-3.2. The chemical properties, physical properties, and dimensions of the materials given in Table 2-3.3.1 shall conform at a minimum to the standards cited in the table. Pipe and tube used in water mist systems shall be designed to withstand a working pressure of not less than 175 psi (12.1 bar).

Table 2-3.3.1 Pipe or Tube Standards

Materials and Dimensions	Standard
Copper Tube (Drawn, Seamless)	
Standard Specification for Solder Metal [95-5 (Tin-Antimony-Grade 95TA)]	ASTM B 32
Standard Specification for Seamless Copper Tube[1]	ASTM B 75
Standard Specification for Seamless Copper Water Tube[1]	ASTM B 88
Standard Specification for General Requirements for Wrought Seamless Copper and Copper-Alloy Tube	ASTM B 251
Standard Specification for Liquid and Paste Fluxes for Soldering Applications of Copper and Copper-Alloy Tube	ASTM B 813
Specification for Filler Metals for Brazing and Braze Welding (Classification BCuP-3 or BCuP-4)	AWS A5.8
Stainless Steel	
Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service	ASTM A 269
Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing (Small-Diameter) for General Service	ASTM A 632
Standard Specification for Welded, Unannealed Austenitic Stainless Steel Tubular Products	ASTM A 778
Standard Specification for Seamless and Welded Ferritic/Austenitic Stainless Steel Tubing for General Service	ASTM A 789/A 789M

[1]Denotes pipe or tube suitable for bending (*see 2-3.6*) according to ASTM standards.

2-3.3.2 Copper tube as specified in the standards referenced in Table 2-3.3.1 shall have a wall thickness of Type K, L, or M where used in water mist systems.

2-3.4 Intermediate and High Pressure Systems.

2-3.4.1 Pipe or tube shall be of noncombustible material having physical and chemical characteristics such that its deterioration under stress can be predicted with reliability. The piping shall be in accordance with ANSI B31.1, *Power Piping Code*. The internal pressure used for calculation of pipe wall thickness shall be the maximum operating pressure of the water mist systems at a pipe temperature of 130°F (54°C).

2-3.4.2* Flexible piping, tubing, or hoses (including connections) shall be listed for their intended use.

2-3.5 Pipe or Tube Identification.

2-3.5.1 All pipe or tube, including specially listed pipe or tube, shall be marked continuously along its length by the manufacturer in such a way as to identify the type of pipe or tube properly. This identification shall include the manufacturer's name, model designation, or schedule.

2-3.5.2 Pipe or tube marking shall not be painted, concealed, or removed prior to approval by the authority having jurisdiction.

2-3.6 Pipe or Tube Bending. Bending of Type K and Type L copper tube shall be permitted where bends are made with no kinks, ripples, distortions, reductions in diameter, or any noticeable deviations from a round shape. The minimum radius of a bend shall be six pipe diameters for pipe sizes of 2 in. (51 mm) and smaller and five pipe diameters for pipe sizes larger than 2 in. (51 mm).

2-4 Fittings.

2-4.1* General. All fittings used on piping described in 2-3.1 shall have a corrosion resistance at least equivalent to wrought copper fittings conforming to ANSI B16.22, *Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.*

2-4.2 Low Pressure Systems.

2-4.2.1 Fittings used in water mist systems shall meet or exceed the standards in Table 2-4.2.1 or shall be in accordance with 2-4.2.2.

Table 2-4.2.1 Fitting Standards

Materials and Dimensions	Standard
Copper	
Cast Copper Alloy Solder Joint Pressure Fittings	ANSI B16.18
Wrought Copper and Copper Alloy Solder Joint Pressure Fittings	ANSI B16.22
Stainless Steel	
Standard Specification for Castings, Austeitic, Austenitic-Ferritic (Duplex) for Presure-Containing Parts	ASTM A 351/A 351M
Standard Specification for Wrought Austenitic Stainless Steel Piping Fittings	ASTM A 403/A 403M
Standard Specification for As-Welded Wrought Austenitic Stainless Steel Fittings for General Corrosive Service at Low and Modeate Temperatures	ASTM A 774/A 774M
Standard Specification for Wrought Feitic, Ferritic/Austenitic, and Martensitic Stainless Steel Piping Fittings	ASTM A 815/A 815M

2-4.2.2* Other types of fittings investigated for suitability in water mist installations and listed for this service shall be permitted where installed in accordance with their listing limitations, including installation instructions.

2-4.2.3 Screwed unions shall not be used on pipe larger than 2 in. (51 mm). Couplings and unions of other than the screwed type shall be listed for the intended use.

2-4.2.4 A one-piece reducing fitting shall be used wherever a change is made in the size of pipe.

Exception: Hexagonal or face bushings shall be permitted in reducing the size of openings of fittings where standard fittings of the required size are not available.

2-4.2.5 All threads used in joints and fittings shall conform to ANSI B1.20.1, *Pipe Threads, General Purpose (Inch).* Joint compound, tape, or thread lubricant shall be applied only to the male threads of the joint.

2-4.2.6 Soldering fluxes shall be in accordance with Table 2-3.3.1. Brazing fluxes, if used, shall not be of a highly corrosive type.

2-4.2.7 Welding shall be performed in accordance with AWS D10.9, *Specification for Qualification of Welding Procedures and Welders for Piping and Tubing,* Level AR-3.

2-4.3 Intermediate and High Pressure Systems.

2-4.3.1 Fittings shall have a minimum-rated working pressure equal to or greater than the maximum operating pressure of the water mist systems at 130°F (54°C). For systems that employ the use of a pressure regulating device in the distribution piping, the fittings downstream of the device shall have a minimum-rated working pressure equal to or greater than the maximum anticipated pressure in the downstream piping.

2-4.3.2 All threads used in joints and fittings shall conform to ANSI B1.20.1, *Pipe Threads, General Purpose (Inch).* Joint compound, tape, or thread lubricant shall be applied only to the male threads of the joint.

2-4.3.3 Welding and brazing alloys shall have a melting point above 1000°F (538°C).

2-4.3.4 Welding and brazing shall be performed in accordance with Section IX of the ASME *Boiler and Pressure Vessel Code.*

2-4.3.5 Where copper, stainless steel, or other suitable tubing is joined with compression-type fittings, the manufacturer's pressure temperature ratings for the fitting shall not be exceeded.

2-5 Hangers.

2-5.1 Hangers shall be listed for use with the pipe or tube involved.

Exception: Hangers certified by a registered professional engineer to include the following shall be permitted where:

(a) Hangers are designed to support five times the weight of the pipe or tube when filled with gas or water, as appropriate, plus 250 lb (114 kg) at each point of piping support;

(b) These points of support are adequate to support the water mist system; and

(c) Hanger components are ferrous.

Detailed calculations shall be submitted, where required by the authority having jurisdiction, showing the stresses developed both in the hangers and the piping and the safety factors provided.

2-5.2 Hanger components shall be ferrous.

Exception: Nonferrous components that have been proven by fire tests to be adequate for the hazard application, that are listed for this purpose, and that are in compliance with the other requirements of this section shall be permitted.

2-5.3 The components of hanger assemblies that attach directly to the pipe or to the building structure shall be listed. Threaded portions of hangers shall not be bent.

Exception: Mild steel rods that connect pipe and building attachment components shall be permitted to be of an approved type.

2-5.4 The use of listed inserts set in concrete to support hangers shall be permitted.

2-5.5 Power-driven fasteners shall not be used to attach hangers to the building structure where systems are required to be protected against earthquakes.

Exception: Power-driven fasteners shall be permitted where they are specifically listed for service in seismic areas.

Table 2-6.6 Temperature Ratings, Classifications, and Color Coding of Individual, Thermally Activated Nozzles

Maximum Ambient Temperature		Nozzle Temperature Rating				
(°F)	(°C)	(°F)	(°C)	Temperature Classification	Color Code	Glass Bulb Colors
100	38	135 to 170	57 to 77	Ordinary	Uncolored or black	Orange or red
150	66	175 to 225	79 to 107	Intermediate	White	Yellow or green
225	107	250 to 300	121 to 149	High	Blue	Blue
300	149	325 to 375	163 to 191	Extra high	Red	Purple
375	191	400 to 475	204 to 246	Very extra high	Green	Black
475	246	500 to 575	260 to 302	Ultra high	Orange	Black
625	329	650	343	Ultra high	Orange	Black

2-6 Nozzles.

2-6.1* Nozzles shall be listed either individually or as a part of a pre-engineered system. Listing information shall include:

(a) Specific hazards and protection objectives;

(b) Volumetric flow rate characteristics of water discharge for each nozzle;

(c) Maximum height of protected space;

(d) Minimum distance between nozzle tip or diffuser, as applicable, and plane of protection;

(e) Maximum spacing between nozzles;

(f) Maximum coverage area per nozzle;

(g) Minimum spacing between nozzles;

(h) Maximum height between ceiling and nozzle diffuser or tip, as applicable;

(i) Nozzle obstruction spacing criteria;

(j) Maximum spacing of nozzles from walls;

(k) Minimum- and maximum-rated operating pressures of nozzles;

(l) Allowable range of nozzle orientation angle from vertically down;

(m) Classification of automatic nozzle thermal response characteristics as fast, special, or standard response;

(n) Maximum compartment volume, if applicable; and

(o) The maximum time delay for water mist delivery to the most remote nozzle.

2-6.2 Only new nozzles shall be installed in water mist systems.

2-6.3 Nozzles shall be permanently marked to identify the manufacturer, type, and size of the orifice(s) or part number.

2-6.4 Additional corrosion protection, such as special corrosion-resistant materials or coatings, shall be required in severely corrosive atmospheres. Where protective coatings are used to meet the requirements of 2-1.3, the coatings shall be applied by the nozzle manufacturer and the coated nozzle shall be listed.

2-6.5 Where clogging by external, foreign materials is likely, discharge nozzles shall be provided with frangible discs, blow-off caps, or other suitable devices. These devices shall provide an unobstructed opening upon system operation and shall be located so they cannot injure personnel.

2-6.6 The standard temperature ratings of individual, thermally activated nozzles are shown in Table 2-6.6. Individual, thermally activated nozzles shall be colored in accordance with the color code designated in Table 2-6.6.

2-6.7 The stock of spare, individual, thermally activated nozzles shall include all types and ratings installed and shall be as follows:

(a) For systems having fewer than 50 nozzles, not fewer than 3 nozzles;

(b) For systems having 50 to 300 nozzles, not fewer than 6 nozzles;

(c) For systems having 301 to 1000 nozzles, not fewer than 12 nozzles; and

(d) For systems having over 1000 nozzles, not fewer than 24 nozzles.

2-7 Valves.

2-7.1 All valves shall be listed for their intended use.

Exception: Valves used only for drains or test connections shall be permitted to be approved.

2-7.2 All gaskets, O-rings, sealants, and other valve components shall be constructed of materials that are compatible with the gas or water and any additives contained in the water.

2-7.3 Identification of Valves. All control, drain, and test connection valves shall be provided with permanently marked, weatherproof, metal or rigid plastic identification signs. The sign shall be secured with corrosion-resistant wire, chain or other approved means.

2-8 Strainers and Filters.

2-8.1 Pipeline strainers and filters shall be listed for use in water supply connections.

2-8.2 The strainer or filter shall be capable of continued operation without serious increase in head loss for a period that is estimated to be ample, taking into account the type of protection provided, the condition of the water, and similar local circumstances.

2-8.3 Pipeline strainer and filter designs shall incorporate a flush-out connection.

2-8.4 Pipeline strainers and filters shall be sized in accordance with 7-5.1.2 and 7-5.1.4.

2-8.5 Individual strainers or filters for water mist nozzles, where required by the manufacturer, shall be listed as a part of a nozzle.

2-8.6 A stock of spare pipeline and individual nozzle strainers and filters for water mist nozzles shall be provided and shall include all types and sizes installed. Sufficient spare strainers and filters shall be provided to service the nozzles for the largest single hazard or group of hazards to be protected simultaneously.

2-9 Pumps.

2-9.1 Materials.

2-9.1.1 Pumps shall be designed with capacities in accordance with 7-5.2.

2-9.1.2 Pumps capable of overpressurizing the system shall be provided with adequate means of pressure relief from the discharge to the supply side of the pump to prevent excessive pressure and temperature. Overpressure shall not exceed the working pressure of the piping system.

2-9.1.3 Pumps shall start automatically upon system actuation.

2-9.1.4 Provisions shall be made for automatic shutoff of the pump after the water supply is exhausted.

2-9.1.5 Pumps shall not take suction under a static lift condition.

2-9.2 Power Supply.

2-9.2.1 The power supply for pump drivers shall be installed in accordance with NFPA 20, *Standard for the Installation of Centrifugal Fire Pumps*, and NFPA 70, *National Electrical Code*.

Exception: Power supplies shall not be required to be fed by an independent service feed.

2-9.2.2 Power supplies shall be arranged so that disconnecting power to the protected facility during a fire shall not disconnect the power supply to the pump feeder circuit.

2-9.3 Controllers.

2-9.3.1 Controllers for pumps shall be listed as follows:

(a) Electric drive pumps greater than 30 horsepower, use listed fire pump controller;

(b) Electric drive pumps greater than 15 horsepower but not exceeding 30 horsepower, use listed fire pump controller or use listed limited service controller;

(c) Electric drive pumps less than 15 horsepower, use listed limited service controller; and

(d) Diesel engine drive pumps, use listed fire pump controller.

2-9.3.2 A service-disconnecting means in the feeder circuit to limited service controllers shall be permitted where acceptable to the authority having jurisdiction, provided the disconnecting means is supervised for the proper position. Supervision for proper position shall be by one of the following methods:

(a) Central station, proprietary, or remote station signaling electrical supervision service; or

(b) Local electrical supervision through use of a signaling service that causes the sounding of an audible signal at a constantly attended location; or

(c) Locking of the disconnecting means in the proper position, with monthly recorded inspections.

2-10 Detection, Actuation, Alarm, and Control Systems.

2-10.1 General.

2-10.1.1 Detection, actuation, alarm, and control systems shall be installed, tested, and maintained in accordance with appropriate, protective, signaling systems standards as follows:

NFPA 70, *National Electrical Code* ;
NFPA 72, *National Fire Alarm Code* ;
CAN/ULC S524-M86, *Standard for the Installation of Fire Alarm Systems (in Canada)*; and
CAN/ULC S529-M87, *Smoke Detectors for Fire Alarm Systems (in Canada)*.

2-10.1.2 Where a detection system is used to actuate the water mist system, detection and actuation shall be automatic.

Exception: Manual-only actuation shall be permitted if approved by the authority having jurisdiction.

2-10.2 Automatic Detection.

2-10.2.1* Automatic detection shall be by listed equipment installed in accordance with NFPA 72, *National Fire Alarm Code*.

2-10.2.2 Adequate and reliable primary and 24-hour minimum standby sources of energy shall be used to provide for operation of the detection, signaling, control, and actuation requirements of the systems.

2-10.2.3 If an existing detection system is used in a new water mist system, the detection system shall comply with the requirements of this standard.

2-10.3 Operating Devices.

2-10.3.1 Operating devices shall include water mist releasing devices or valves, discharge controls, and shutdown equipment necessary for successful performance of the system.

2-10.3.2 Operation shall be by listed mechanical, electrical, or pneumatic equipment. An adequate and reliable source of energy shall be used.

2-10.3.3 Devices shall be designed for the service they are to encounter and shall not readily be rendered inoperative or susceptible to accidental operation. Devices shall be designed to function properly from — 20°F to 130°F (—29°C to 54°C) or shall be marked to indicate temperature limitations.

2-10.3.4 An emergency release of the system that can be achieved by a single manual operation shall be provided. This shall be accomplished by a mechanical manual release or by an electrical, manual release when the control equipment that monitors the battery voltage level of the standby battery supply indicates a low battery signal. The release shall cause simultaneous operation of automatically operated valves that control agent release and distribution. The battery shall be sized to accomplish all functions.

Exception: Dry and wet pipe systems utilizing individual, thermally activated nozzles.

2-10.3.5 The normal manual control(s) for actuation shall be located for easy accessibility at all times, including at the time of a fire. The manual control(s) shall be of distinct appearance and clearly recognizable for the purpose intended. Operation of any manual control shall cause the complete system to operate in its normal fashion.

2-10.3.6 Manual controls shall not require a force of more than 40 lbf (178 N) nor a movement of more than 14 in. (356 mm) to secure operation. At least one manual control for activation shall be located not more that 4 ft (1.2 m) above the floor.

2-10.3.7 All devices for shutting down supplementary equipment shall be considered integral parts of the system and shall function with the system in operation.

2-10.3.8 All manual devices shall be identified as to the hazard they protect.

2-10.4 Control Equipment.

2-10.4.1 Electrical Control Equipment. Automatic control equipment shall be listed and installed in accordance with NFPA 72, *National Fire Alarm Code*.

2-10.4.2 The control unit shall be listed for release device service.

2-10.4.3 Pneumatic Control Equipment.

2-10.4.3.1 Pneumatic control lines shall be protected against crimping and mechanical damage. Where installations could be exposed to conditions that could lead to loss of integrity of the pneumatic lines, special precautions shall be taken to ensure that no loss of integrity occurs. Pneumatic control lines used as part of the system actuation shall be supervised.

Exception No. 1: Pneumatically operated control lines immediately adjacent to the pressurizing source are not required to be supervised.

Exception No. 2: Pneumatic control lines from master to slave cylinders which are located in close proximity to one another are not required to be supervised.

2-10.4.3.2 The control equipment shall be specifically listed for the number and type of actuating devices utilized, and their compatibility shall have been listed.

2-11 Unwanted System Operation. Care shall be taken to thoroughly evaluate and correct any factors that could result in unwanted system discharge.

2-12 Compatibility. All components of pneumatic, hydraulic, or electrical systems shall be compatible.

Chapter 3 System Requirements

3-1 General. Water mist systems shall be described by the following four parameters:

(a) System application;

(b) Nozzle type;

(c) System operation method; and

(d) System media type.

3-2 System Applications. System applications shall consist of the following three categories:

(a) Local application systems;

(b) Total compartment application systems; or

(c) Zoned application systems.

3-2.1 Local Application Systems. Local application systems are designed and installed to provide complete distribution of mist around the hazard or object to be protected.

3-2.1.1 Local application systems shall be designed to protect an object or a hazard in an enclosed, unenclosed, or open outdoor condition.

3-2.1.2 Local application systems shall be actuated by automatic nozzles or by an independent detection system.

3-2.2 Total Compartment Application Systems. Total compartment application systems are designed and installed to provide complete protection of an enclosure or space.

3-2.2.1* The complete protection of an enclosure or space shall be achieved by the simultaneous operation of all nozzles in the space by manual or automatic means.

3-2.3 Zoned Application Systems. Zoned application systems are a subset of the compartment system and are designed to protect a predetermined portion of the compartment by the activation of a selected group of nozzles.

3-2.3.1 Zoned application systems shall be designed and installed to provide complete mist distribution throughout a predetermined portion of an enclosure or space. This shall be achieved by simultaneous operation of a selected group of nozzles in a predetermined portion of the space by manual or automatic means.

3-2.3.2 Zoned application systems shall be actuated by automatic nozzles or by an independent detection system.

3-3 Nozzle Types. Water mist nozzles shall be classified as one of the following three types:

(a) Automatic;

(b) Nonautomatic; and

(c) Hybrid.

3-4 System Operation Methods. Water mist systems shall operate by means of one of the following methods:

(a) Deluge;

(b) Wet pipe;

(c) Preaction; and

(d) Dry pipe.

3-4.1 Deluge Systems. Deluge systems shall employ nonautomatic nozzles (open) attached to a piping network connected to the fluid supply(ies) through a valve controlled by an independent detection system installed in the same area as the mist nozzles. When the valve(s) is activated, the fluid shall flow into the piping network and discharge from all nozzles attached thereto.

3-4.2 Wet Pipe Systems. Wet pipe systems shall employ automatic nozzles attached to a piping network pressurized with water up to the nozzles.

3-4.3 Preaction Systems. Preaction systems shall employ automatic nozzles attached to a piping network containing a pressurized gas with a supplemental, independent detection system installed in the same area as the nozzles. Operation of the detection system shall actuate a tripping device that opens the valve, pressurizing the pipe network with water to the nozzles.

3-4.4 Dry Pipe Systems. Dry pipe systems shall employ automatic nozzles attached to a piping network containing a pressurized gas. The loss of pressure in the piping network shall activate a control valve, which causes water to flow into the piping network and out through the activated nozzles.

3-5* Media System Types. Water mist systems shall be classified by two media system types:

(a) Single fluid; or

(b) Twin fluid.

3-5.1 Twin fluid media systems produce water mist (droplet production) by exposing a slow-moving liquid to a higher velocity atomizing fluid stream. The process shall occur in or near the discharge nozzle.

Chapter 4 Installation Requirements

4-1 General. This chapter provides requirements for the correct installation of water mist system components.

4-1.1 All listed materials and devices shall be installed in accordance with their listing. All other materials and devices shall be installed in accordance with the system design manual. Systems installed in corrosive environments shall comply with 2-1.3.

4-1.2 System components shall be located, installed, or suitably protected so they are not subject to mechanical, chemical, or other damage that could render them inoperative.

4-2 Nozzles.

4-2.1 General. Nozzles shall be installed in accordance with the manufacturer's listing.

4-2.2 Nozzle Height Limitations. The minimum and maximum heights shall be in accordance with the manufacturer's listing.

4-2.3 Nozzle Spacing Limitations. The minimum and maximum distances between nozzles shall be in accordance with the manufacturer's listing.

4-2.4 Distance from Walls. The minimum and maximum distance from nozzles to walls or partitions shall be in accordance with the manufacturer's listing.

4-2.5 Obstructions to Nozzle Discharge. The location of nozzles with respect to obstructions shall be in accordance with the manufacturer's listing.

4-2.6 Distance Below Ceilings. The distance between the nozzle and the ceiling shall be in accordance with the range (minimum and maximum) identified in the manufacturer's listing.

4-2.7 Spacing under Pitched or Curved Surfaces. The distance between nozzles in or under a pitched or curved surface shall be in accordance with the manufacturer's listing.

4-2.8 Nozzle Protection. Nozzles subject to mechanical damage shall be protected with listed guards. Guards shall not significantly reduce the effectiveness of the nozzle.

4-2.9 Escutcheon Plates.

4-2.9.1 Escutcheon plates used in a recessed or flush-type nozzle installation shall be a part of a listed nozzle assembly.

4-2.9.2 Nonmetallic escutcheon plates shall be listed.

4-2.10 Thermally Activated Nozzle Temperature Ratings.

4-2.10.1 Ordinary temperature-rated nozzles shall be used unless otherwise specified.

4-2.10.2 The following practices shall be observed where providing automatic nozzles of other than ordinary temperature classification unless other temperatures are determined or unless high temperature nozzles are used throughout.

(a) Automatic and hybrid nozzles installed in a heater zone shall be of the high temperature classification, and nozzles in the danger zone shall be of the intermediate temperature classification.

(b) Automatic and hybrid nozzles located within 12 in. (305 mm) to one side of or 30 in. (762 mm) above an uncovered steam main, heating coil, or radiator shall be of the intermediate temperature classification.

(c) Automatic and hybrid nozzles within 7 ft (2.1 m) of a low pressure blow-off valve that discharges freely in a larger room shall be of the high temperature classification.

(d) Automatic and hybrid nozzles installed under glass or plastic skylights exposed to the direct rays of the sun shall be of the intermediate temperature classification.

(e) Automatic and hybrid nozzles installed in an unventilated, concealed space, under an insulated roof, or in an unventilated attic shall be of the intermediate temperature classification.

(f) Automatic and hybrid nozzles installed in unventilated areas having high-powered electric lights near the ceiling shall be of the intermediate temperature classification.

(g) Automatic and hybrid nozzles protecting commercial-type cooking equipment and ventilation systems shall be of the high or extra-high temperature classification as determined by use of a temperature measuring device.

4-3 Pipe and Tubing.

4-3.1 Piping and tubing for water mist systems shall be installed in accordance with the manufacturer's installation manual.

4-3.1.1 All water and atomizing media piping and tubing for water mist systems shall be installed in accordance with ANSI B31.1, *Power Piping Code.*

Exception No. 1: Piping in low pressure systems installed in accordance with NFPA 13, Standard for the Installation of Sprinkler Systems. This exception does not apply to piping conveying atomizing media.

Exception No. 2: Piping installed in accordance with a water mist system listing where the listing provides installation criteria different from ANSI B31.1, Power Piping Code.

4-3.1.2 All system piping, tubing, and hoses shall be rated for the maximum working pressure to which they are exposed.

4-3.1.3 Any flexible piping, tubing, hoses, or combination thereof shall be constructed and installed in accordance with the manufacturer's listing.

4-3.2 The system piping shall be supported by structural elements that are independent of the ceiling sheathing to prevent lateral and horizontal movement upon system actuation.

4-3.3 All system piping and fittings shall be installed so that the entire system can be drained.

4-3.4 Location of Hangers and Supports. Hangers and supports shall be located in accordance with the system's design manual.

Exception: For low pressure and intermediate systems, steel pipe and copper tubing shall be supported in accordance with NFPA 13, Standard for the Installation of Sprinkler Systems.

4-3.4.1 The length of an unsupported arm over to a nozzle shall not exceed 2 ft (0.6 m) for steel pipe or 1 ft (0.3 m) for steel tubing.

4-3.5 Protection of System Components against Damage where Subject to Earthquakes. Water mist systems shall be protected to prevent pipe breakage where subject to earthquakes in accordance with 4-14.4.3 of NFPA 13, *Standard for the Installation of Sprinkler Systems.*

4-4 Fittings.

4-4.1 All system fittings shall be installed in accordance with the manufacturer's listing.

Exception: All fittings installed in low pressure water mist systems shall conform to NFPA 13, Standard for the Installation of Sprinkler Systems.

4-4.2 All fittings shall be rated for the maximum working pressure to which they are exposed.

4-5 Gas and Water Storage Containers.

4-5.1 Storage containers shall be installed, mounted, and braced in accordance with the manufacturer's listing.

4-5.2 Storage containers and accessories shall be installed so that inspection, testing, recharging, and other maintenance are facilitated and interruption to protection is held to a minimum.

4-5.3* Storage containers shall be located as close as possible to the hazard or within the hazards they protect, and shall not be exposed to fire or mechanical damage in a manner to affect performance.

4-5.4 Storage containers shall be protected from severe weather conditions and from mechanical, chemical, or other damage.

4-5.4.1 Where excessive climatic or mechanical exposures are expected, guards or enclosures shall be provided.

4-5.5 High Pressure Storage Containers.

4-5.5.1 High pressure containers or cylinders shall be constructed, tested, and marked in accordance with recognized, international standards, such as the U.S. Department of Transportation, Title 49, *Code of Federal Regulations*, Parts 171 to 190, Sections 178.36 and 178.37, specifications (in effect upon date of manufacture and test) for DOT-3A, 3AA-1800, or higher, seamless steel cylinders. Charged cylinders shall be tested for tightness before shipment in accordance with an approved procedure.

4-5.5.2 Where manifolded, cylinders shall be adequately mounted and suitably supported in a rack provided for this purpose, including facilities for convenient, individual servicing or weighing of contents. When any cylinder is removed for maintenance, automatic means shall be provided to prevent leakage from the manifold if the system is operated.

4-5.5.3 Storage temperatures shall be maintained within the range specified in the manufacturer's listing. External heating or cooling shall be an acceptable method to keep the temperature of the storage container within desired ranges.

4-5.5.4 Containers shall be secured with manufacturer listed supports to prevent container movement and possible physical damage.

4-5.6 Low Pressure Storage Cylinders.

4-5.6.1 The pressure container shall be made, tested, approved, equipped, and marked in accordance with recognized, international standards, such as the current specifications of the ASME *Boiler and Pressure Vessel Code*, Section VIII, or the requirements of U.S. Department of Transportation, Title 49, *Code of Federal Regulations*, Parts 171 to 190, Sections 178.36 and 178.37, or both. The design working pressure shall be in accordance with the manufacturer's listing.

Exception: Pressure containers for heated water mist systems shall be in accordance with the manufacturer's listing.

4-5.6.2 Each pressure container shall be equipped with a liquid level gauge, a pressure gauge, and a high/low pressure supervisory alarm set at the values identified in the manufacturer's listing.

Exception: Media storage containers that become pressurized only during system activation shall not require high/low pressure supervisory alarms.

4-5.7 Storage temperatures shall be maintained within the range specified in the manufacturer's listing. External heating or cooling shall be an acceptable method to keep the temperature of the storage container within desired ranges.

4-5.7.1 Containers shall be secured with manufacturer-listed supports to prevent container movement and possible physical damage.

4-6 Pumps and Pump Controllers.

4-6.1* Pumps shall be sized to provide 120 percent of the required system water flow rate, at the minimum system operating pressure, as determined by hydraulic calculations.

4-6.2 Pumps shall start automatically and shall supply water to the water mist system until manually shut off or automatically shut off in accordance with the manufacturer's listing.

4-6.3 Power supplies for system pumps shall meet the requirements specified in NFPA 20, *Standard for the Installation of Centrifugal Fire Pumps*, or shall be in accordance with the manufacturer's listing.

4-6.4 Pumps shall be provided with supervisory service from a listed central station, proprietary, or remote station system or equivalent.

Exception: Pumps for single family dwellings.

4-7 Strainers and Filters.

4-7.1 Strainers and filters shall be provided at all water supply connections in accordance with Chapter 7. Filters and strainers shall be installed to minimize potential head loss due to accumulation of particulates.

4-8 Valves and Pressure Gauges.

4-8.1 General.

4-8.1.1 All valves shall be installed in accordance with the manufacturer's listing.

4-8.1.2 Valves having components that extend beyond the valve body shall be installed in a manner that does not interfere with the operation of any system components.

4-8.1.3 All valves shall be listed for their particular application and installation.

4-8.1.4 All control, drain, and test connection valves shall be provided with permanently marked, weatherproof, metal or rigid plastic identification signs. The sign shall be secured by corrosion-resistant wire or chain or by other approved means.

4-8.1.5 System valves and gauges shall be installed such that they are accessible for operation, inspection, and maintenance.

4-8.1.6 At least one listed indicating valve shall be installed in each source of water supply.

Exception: Systems with a single water supply source composed of a self-contained system (cylinders, containers).

4-8.1.7 Valves on connections to water supplies, sectional control valves, and other valves in supply pipes to nozzles shall be locked open or equipped with tamper-monitoring devices.

Exception: Normally closed, automatic water control valves.*

4-8.2 Control/Activation Valves.

4-8.2.1 Control/activation valves shall include any device or valve that automatically opens to supply water to the nozzles after the detection of a fire.

4-8.2.2 Control/activation valves shall operate by a listed mechanical, electrical, or pneumatic means. An adequate and reliable source of energy shall be used.

4-8.2.3 Control/activation valves shall be installed such that they are not subject to mechanical, chemical, or other damage that would render them inoperative.

4-8.3 Pressure Regulating and Pressure Relief Valves.

4-8.3.1 Water Pressure Regulating Valves.

4-8.3.1.1 Pressure regulating valves shall be installed in any portion of the system where the potential exists for the system pressure to exceed the maximum-rated working pressure of the system or system components, or both. These valves shall open when the system pressure reaches 95 percent of the system-rated pressure.

4-8.3.1.2 A relief valve of not less than $^1/_2$ in. (13 mm) shall be provided on the discharge side of the pressure regulating valve that is set to operate at a pressure not exceeding the system-rated pressure.

4-8.3.1.3 A listed indicating valve shall be provided on the inlet side of each pressure reducing valve.

Exception: A listed indicating valve shall not be required where the pressure regulating valve meets the listing requirements for use as an indicating valve.

4-8.3.1.4 A water flow test valve that is sized to produce the designed flow of the pressure reducing valve shall be installed on the downstream side of the pressure reducing valve.

4-8.3.1.5 A sign indicating the correct discharge pressure for static and residual pressures shall be attached to the pressure reducing valve.

4-8.3.2 Compressed Gas Pressure Regulating Valves (PRVs).

4-8.3.2.1 PRVs shall be installed in accordance with the manufacturer's listing.

4-8.3.2.2 PRVs shall be installed when the supply pressure is higher than the design operating pressure of the water mist system.

4-8.3.2.3 PRVs shall be capable of providing a stable regulating output at the rated flow capacity and design set point over the full range of input pressures that will be experienced over the course of the discharge period.

4-8.3.2.4 Downstream pressure drift under no-flow conditions shall not exceed the lesser of the downstream components pressure rating or the pressure relief valve set point, if provided.

4-8.3.2.5 Pressure set, point-adjusting mechanisms on the PRVs shall be tamper resistant, and the adjustment shall be indicated by a permanent marking. A means to indicate evidence of tampering shall be provided.

4-8.3.2.6 The PRVs set point shall be set by the manufacturer.

4-8.3.2.7 Permanent markings shall indicate the inlet and outlet connections of the PRVs.

4-8.4 Check Valves and Backflow Preventers.

4-8.4.1 Check valves shall be installed in accordance with the manufacturer's listing.

4-8.4.2 A check valve shall be installed between the system and the point of permanent connection to a potable water supply.

Exception: Where additives are used in the water mist system, either by injection into flowing lines or by premixing into stored water sources, a backflow preventer shall be installed between the system control valve or stored water supply and a permanent connection to a potable water supply.

4-8.4.3 Check valves shall be installed in the main feed lines, near the control valves of both the water and pneumatic system piping of a twin fluid system, to prevent the backflow of water or atomizing fluid into the companion piping.

4-8.5 Pressure Gauges.

4-8.5.1 Pressure gauges shall be installed in the following locations:

(a) On both sides of a pressure regulating valve;

(b) On the pressurized side of all supply connections;

(c) On the pressurized side of all system control valves;

(d) On all pressurized storage containers; and

(e) On all air supplies for dry pipe and preaction systems.

4-8.5.2 The required pressure gauges shall be compatible with their intended use and shall have an operating range not less than twice the normal working pressure of the system.

4-9 Electrical Systems.

4-9.1 Electrical Equipment.

4-9.1.1 Water mist systems shall be installed in accordance with the requirements of NFPA 70, *National Electrical Code*.

4-9.1.2* All signaling system circuits and wiring shall be installed in accordance with NFPA 72, *National Fire Alarm Code*.

4-9.2 Control Equipment.

4-9.2.1 Electrical fire detection and control equipment used to activate water mist systems shall be installed in accordance with NFPA 70, *National Electrical Code;* NFPA 72, *National Fire Alarm Code* or equivalent; or the manufacturers' recommendations, as appropriate.

4-9.2.2 All circuitry that is monitoring or controlling the water mist system shall be electrically supervised in accordance with NFPA 72, *National Fire Alarm Code*.

4-9.2.3 Adequate and reliable primary and 24-hour minimum standby sources of energy shall be used to provide for operation of the detection, signaling, control, and actuation requirements of the system.

4-9.2.4 Alarms shall be provided to indicate system activation or system trouble conditions, or both. Trouble and supervisory signals shall include power failure, operation (closing) of monitored valving, and electrical faults in the detection/activation of pump power control systems. These alarms shall be both visible and audible inside the protected space, at the location of the primary system components (e.g., pumps, storage tanks), and in a continuously attended location. The system activation alarm shall be distinctly different from the system trouble signal to prevent confusion.

4-9.3 Fire Detection.

4-9.3.1* When electrically operated automatic fire detection systems are used, the installation shall be in accordance with NFPA 72, *National Fire Alarm Code*.

4-9.3.2 Adequate and reliable primary and 24-hour minimum standby sources of energy shall be used to provide for operation of the detection, signaling, control, and actuation requirements of the system.

4-9.3.3 Where a new water mist system is installed in a space that has an existing detection system, an analysis shall be made of the detection devices to ensure that the detection system meets the requirements of the water mist system listing and that the detection system is in good operating condition.

4-9.4 Automatic and Manual Activation.

4-9.4.1 A means of automatic operation of the water mist system shall be provided. This shall be accomplished by means of automatic nozzles (independently thermally activated), automatic group control valves, or an independent automatic fire detection system, coupled with a listed system activation panel.

Exception: Manual-only actuation shall be permitted if approved by the authority having jurisdiction.

4-9.4.2 A means of manual release of the system shall be installed and arranged in accordance with 2-10.3.

Chapter 5 Design Objectives and Hazard Classifications

5-1 General. Currently, no general design method is recognized for water mist protection systems. Water mist protection systems shall be designed and installed in accordance with their listing for the specific hazards and protection objectives specified in the listing. The characteristics of the specific application (compartment variables and hazard classification) shall be consistent with the listing of the system. The compartment geometry, fire hazard, and system variables described in this chapter shall be considered adequate to ensure that the system design and installation are consistent with the system listing.

5-1.1 The fire-fighting performance objectives of a water mist system shall be described using the following three terms:

(a) Control;

(b) Suppression; and

(c) Extinguishment.

5-1.1.1 Fire Control. Fire control can be measured using three basic approaches:

(a) A reduction in the thermal exposure to the structure, where the primary objective is to maintain the structural integrity of the building (e.g., prevent flashover);

(b) A reduction in the threat to occupants, where the primary objective is to minimize the loss of life; and

(c) A reduction in a fire-related characteristic, such as heat release rate, fire growth rate, or spread to adjacent objects.

5-1.1.2 Fire Suppression. Fire suppression is the sharp reduction in the heat release rate of a fire and the prevention of its regrowth by a sufficient application of water mist.

5-1.1.3 Fire Extinguishment. Fire extinguishment is the complete suppression of a fire until there are no burning combustibles.

5-2 Application Parameters. Design considerations shall address both compartment variables and fire hazard classification.

5-2.1 Compartment Variables. Compartment variables shall include both the geometry of the compartment and the ventilation conditions in the compartment.

5-2.1.1 Compartment Geometry. The compartment geometry (floor area, compartment volume, ceiling height, and aspect ratio) shall be considered when designing such parameters as nozzle locations, system flow rate, and total water use needs of the system.

5-2.1.2 Ventilation. Ventilation considerations shall include both natural and forced ventilation parameters.

5-2.1.2.1* Natural Ventilation. The number, size, and location of the openings in the space (e.g., door, windows) shall be addressed in the design and installation of the system. In some cases, special precautions are necessary to minimize the effects

of these openings. These precautions include, but are not limited to, automatic door closures and water mist curtains.

5-2.1.2.2 Forced Ventilation. The magnitude of the forced ventilation in the compartment shall be addressed in the design and installation of the water mist system. In some cases, consideration shall be given to shutting down the forced ventilation prior to mist system activation.

5-2.2 Fire Hazard Classification. The fire hazard shall be classified by both the combustible loading and fuel type.

5-2.2.1 Combustible Loading. A fire hazard analysis shall be conducted to determine both the design parameters of the water mist system and the type of detection/activation scheme employed by the system. The system shall be based on the fuel type, combustible loading, and anticipated fire growth rate as well as the desired fire-fighting performance objectives.

5-2.2.2 Fuel Type. Overall fire hazard is directly related to the type and quantity of the fuel present in a space. The ease of ignition/reignition of the fuel, the fire growth rate, and the difficulty of achieving control, suppression, extinguishment, or any combination thereof, shall be considered when selecting or designing a water mist system.

5-2.2.2.1 Class A Fires. Fuel loading and configuration shall be considered when selecting/designing a system to protect a space or area containing Class A materials. If fire extinguishment is desired, consideration shall be given to the potential for deep-seated fires as well as to the potential for smoldering fires.

5-2.2.2.2 Class B Fires. The hazard associated with Class B fires is related primarily to the fuel loading, fuel configuration, flashpoint, and burning rate of the fuel. Preburn time also affects the overall characteristics of the fire. Class B fires are grouped into two categories: two-dimensional pool fires and three-dimensional spray and running fuel fires. The parameters associated with each category are as follows:

(a) Class B two-dimensional fires:
   1. Fuel loading and configuration;
   2. Fuel flashpoint; and
   3. Preburn time pool/spill size.

(b) Class B three-dimensional fires:
   1. Fuel loading and configuration;
   2. Fuel flashpoint;
   3. Preburn time;
   4. Cascade/running fuel fires;
   5. Fuel flow rate;
   6. Fire configuration;
   7. Spray fires;
   8. Fuel line pressure;
   9. Fuel spray angle;
   10. Fuel spray orientation; and
   11. Reignition sources.

When designing and installing water mist systems to protect Class B hazards, the parameters specified in 5-2.2.2.2(a) and (b) shall be considered.

5-2.2.2.3 Class C Fires. Electrical conductivity of water and water mist shall be addressed when considering applications where the primary fire is a Class C fire.

5-2.2.2.4 Combination Fires. Combinations in fuel loadings and hazards shall be addressed.

5-2.3 Fire Location. The location of the fuel in the space shall be considered when selecting/designing a water mist system. Some of the locations of concern include:

(a) Fuel located at higher elevations in the space;

(b) Fuel located in close proximity to vent openings;

(c) Fuel located in the corners of the space; and

(d) Fuel stacked against walls.

5-2.4 Obstructions and Shielding. Water mist nozzles shall be positioned to distribute mist to all locations in the area or around the object being protected. The presence of obstructions and the potential for shielding of misting spray patterns shall be evaluated to ensure that the system performance is not affected.

5-3 Listing Testing. Tests shall be conducted as part of the nozzle or system listing to address the compartment geometry, fire hazard, and performance objectives of the application specified in the listing.

5-3.1 Applicability. Tests shall be designed to replicate most or all of the application parameters associated with a given installation. Any variations in these parameters shall be substituted using the worst case conditions. The listing of the system hardware shall be consistent with the intended system application.

5-3.2 Adequacy of Testing. Tests shall be designed and conducted to stress the system in order to determine the working limits and parameters of the system and to incorporate adequate severity to minimize the effects of test parameter variations.

5-3.3* Results. The results documented in the listing testing shall identify the working limits and parameters of the system, the fire hazard, and the range of compartment parameters.

Chapter 6 Calculations

6-1 General. System flow calculation procedures for water mist systems shall be in accordance with Section 6-2.

Exception No. 1: Hydraulic calculations for systems with no additives and with working pressures not exceeding 175 psi (12 bars) shall be permitted to be performed using the method provided in Section 6-3.

Exception No. 2: Calculations for piping carrying atomizing media in twin fluid systems shall be performed in accordance with Section 6-4.

6-1.1* Where any modification is made that alters the system flow characteristics of an existing, engineered water mist system, system flow calculations shall be furnished indicating the previous design, volume, and pressure at points of connection, and adequate calculations also shall be provided to indicate the effect on existing systems.

6-1.2 Pre-engineered systems shall not be modified outside the limits of the listing.

6-2* Darcy-Weisbach Calculation Method for Intermediate and High Pressure, Single Fluid, Single Liquid Phase Systems.

6-2.1 Pipe friction losses shall be determined using the formulae in Table 6-2.1.

Table 6-2.1. Darcy-Weisbach and Associated Equations for Pressure Loss in Intermediate and High Pressure Systems.

English Units	SI Units
Darcy-Weisbach Equation:	
$\Delta p = 0.000216 \frac{fL\rho Q^2}{d^5}$	$\Delta p_m = 2.252 \frac{fL\rho Q^2}{d^5}$
Reynolds Number:	
$\mathrm{Re} = 50.6 \frac{Q\rho}{d\mu}$	$\mathrm{Re} = 21.22 \frac{Q\rho}{d\mu}$
Relative roughness:	
$\text{relative roughness} = \frac{\epsilon}{D}$	$\text{relative roughness} = \frac{\epsilon}{d}$
Δp= friction loss, psi gauge	Δp_m = friction los, bars gauge
L = length of pipe, ft	L = length of pipe, m
f = friction factor, psi/ft	f = friction factor, bars/m
Q = flow, gpm	Q = flow, L/min
d = internal pipe diameter, in.	d = internal pipe diameter, mm
D = internal pipe diameter, ft	
ϵ = pipe wall roughness, ft	ϵ = pipe wall roughness, mm
ρ = weight density of fluid, lb/ft^3	ρ = weight density of fluid, kg/m^3
μ = absolute (dynamic) viscosity, in centipoise (cP)	μ = absolute (dynamic) viscosity, in centipoise (cP)

6-2.2 Figure 6-2.2 (Moody Diagram) shall be used to determine the value of the friction factor, *f*, in the Darcy-Weisbach equation, where the Reynolds number and relative roughness are calculated as shown in Table 6-2.1, using coefficients provided in Tables 6-2.2(a) and 6-2.2(b).

6-2.3 Minimum and maximum operating pressure at each nozzle shall be within the listed operating range.

6-2.4 System piping shall be hydraulically designed to deliver the water flow requirements in accordance with the manufacturer's listing and the provisions of Chapter 5.

6-3* Hazen-Williams Calculation Method (Low Pressure Systems).

6-3.1 Hydraulic calculations for water mist systems with working pressures not exceeding 175 psi (12 bars) shall be permitted to be performed using the Hazen-Williams calculation method.

6-3.2 Friction Loss Formula. Friction losses for water-filled pipe shall be determined on the basis of the Hazen-Williams formula:

$$P_f = \frac{4.52\ Q^{1.85}}{C^{1.85} d^{4.87}}$$

where:

P_f = Frictional resistance (psi/ft of pipe)
Q = Flow (gpm)
d = Actual internal diameter of pipe (in.)
C = Friction loss coefficient.

For SI units:

$$P_m = 6.05 \frac{Q_m^{1.85}}{C^{1.85} d_m^{4.87}} \times 10^5$$

where:

P_m = Frictional resistance (bars/m of pipe)
Q_m = Flow (L/min)
d_m = Actual internal diameter of pipe (mm)
C = Friction loss coefficient.

Table 6-2.2(a) Recommended Values of Absolute Roughness or Effective Height of Pipe Wall Irregularities, for Use in Darcy-Weisbach Equation

	Design Value of ϵ	
Pipe Material (New)	**(ft)**	**(mm)**
Copper, copper nickel, drawn tubing	0.000 005	0.0015
Stainless steel	0.000 15	0.045

Table 6-2.2(b) Approximate Values of μ, Absolute (Dynamic) Viscosity, and ρ for Clean Water, over the Temperature Range 40°F to 100°F (4.4°C to 37.8°C)

Temperature °F	Temperature °C	Weight Density of Water, lb/ft^3	Weight Density of Water, kg/m^3	Absolute (Dynamic) Viscosity, μ, in Centipoise
40	4.4	62.42	999.9	1.5
50	10.0	62.38	999.7	1.3
60	15.6	62.34	998.8	1.1
70	21.1	62.27	998.0	0.95
80	26.7	62.19	996.6	0.85
90	32.2	62.11	995.4	0.74
100	37.8	62.00	993.6	0.66

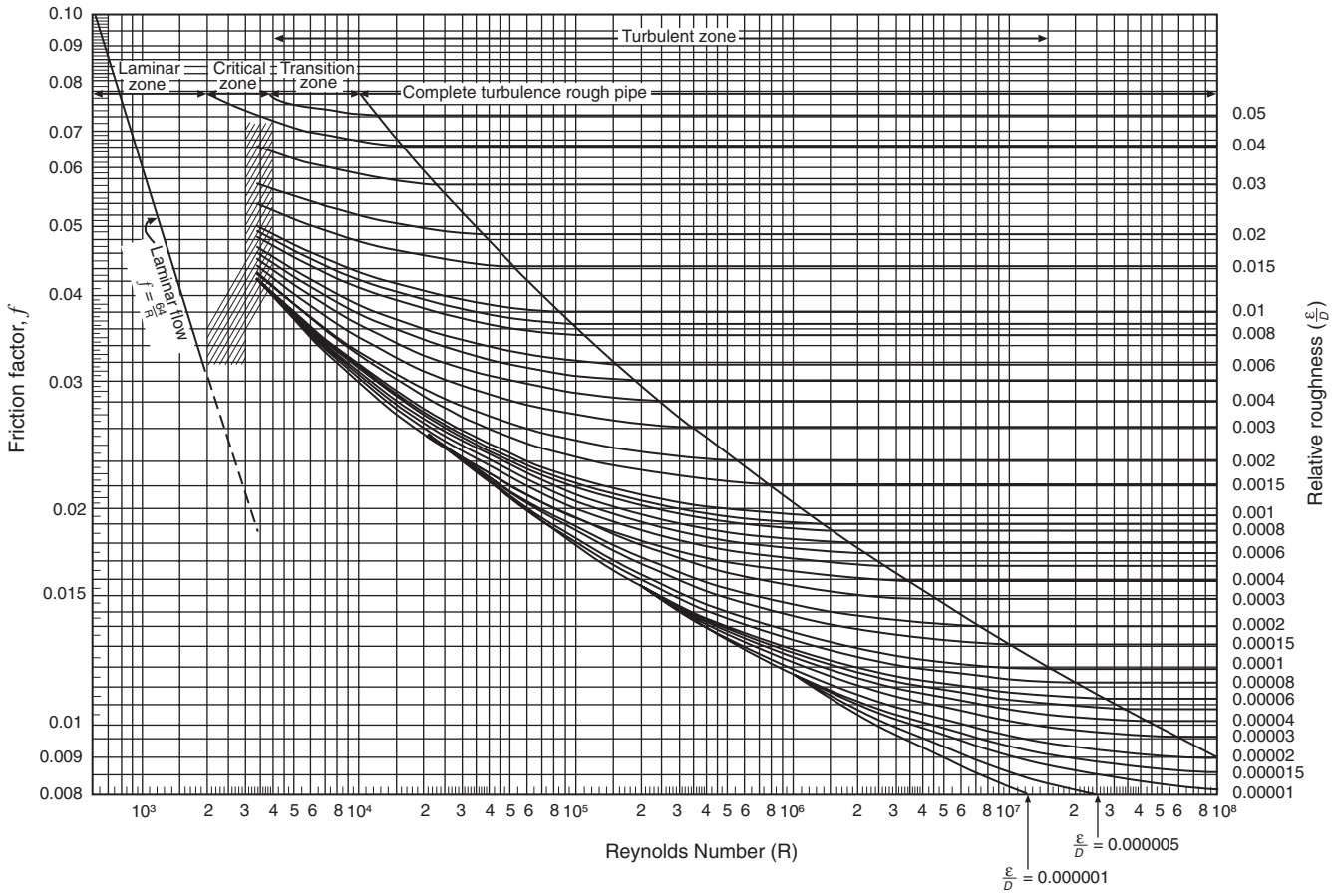

Figure 6-2.2 Moody diagram.

6-3.3 Velocity Pressure Formula. Velocity pressure for water-filled pipe shall be determined on the basis of the following formula:

$$P_v = \frac{0.001123\ Q^2}{D^4}$$

where:
P_v = Velocity pressure (psi)
Q = Flow (gpm)
D = Inside diameter (in.).

For SI units:

$$P_v = 5.61(10)^{-7}\ \frac{Q^2}{D^4}$$

where:
P_v = Velocity pressure (bars)
Q = Flow (L/min)
D = Inside diameter (mm).

6-3.4 Normal Pressure Formula. Normal pressure, P_n, shall be determined on the basis of the following formula:

$$P_n = P_t - P_v$$

where:
P_n = Normal pressure
P_t = Total pressure [psi (bars)]
P_v = Velocity pressure [psi (bars)].

6-3.5 Hydraulic Junction Points. Pressures at hydraulic junction points shall balance within 0.5 psi (0.03 bar). The highest pressure at the junction point, and the total flows as adjusted, shall be used in the calculations.

6-3.6 Equivalent Pipe Lengths of Valves and Fittings.

6-3.6.1 Table 6-3.6.1 shall be used to determine the equivalent length of pipe for fittings and devices, unless the manufacturer's test data indicate that other factors are appropriate. For saddle-type fittings having friction loss greater than that shown in Table 6-3.6.1, the increased friction loss shall be included in hydraulic calculations. For internal pipe diameters that differ from copper tubing, the equivalent feet shown in Table 6-3.6.1 shall be multiplied by a factor derived from the following formula:

$$\left[\frac{\text{Actual inside diameter}}{\text{Type K copper tube I.D.}}\right]^{4.87} = \text{Factor}$$

The factor thus obtained shall be modified further in accordance with Table 6-3.6.2.

6-3.6.2 Table 6-3.6.1 shall be used with Hazen-Williams only where C=150. For other values of C, the values in Table 6-3.6.1 shall be multiplied by the factors in Table 6-3.6.2.

6-3.6.3 Specific friction loss values or equivalent pipe lengths for special valves, strainers, and other devices shall be made available to the authority having jurisdiction.

Table 6-3.6.1 Equivalent Length of Pipe for Copper Fittings and Values

Nominal or Standard Size		Fittings										Valves							
		Standard Ell				90° Tee													
		90°		45°		Side Branch		Straight Run		Coupling		Ball		Gate		Butterfly		Check	
(in.)	(mm)	(ft)	(m)	(ft)	(m)	(ft)	(m)	(ft)	(m)	(ft)	(m)	(ft)	(m)	(ft)	(m)	(ft)	(m)	(ft)	(m)
3/8	9.53	0.5	0.15	—		1.5	0.46	—		—		—		—		—		1.5	0.46
1/2	12.7	1	0.31	0.5	0.15	2	0.61	—		—		—		—		—		2	0.61
3/8	15.88	1.5	0.46	0.5	0.15	2	0.61	—		—		—		—		—		2.5	0.76
3/4	19.05	2	0.61	0.5	0.15	3	0.91	—		—		—		—		—		3	0.91
1	25.4	2.5	0.76	1	0.31	4.5	1.37	—		—		0.5	0.15	—		—		4.5	1.37
1 1/4	31.75	3	0.91	1	0.31	5.5	1.68	0.5	0.15	0.5	0.15	0.5	0.15	—		—		5.5	1.68
1 1/2	38.1	4	1.22	1.5	0.46	7	2.13	0.5	0.15	0.5	0.15	0.5	0.15	—		—		6.5	1.98
2	50.8	5.5	1.68	2	0.61	9	2.74	0.5	0.15	0.5	0.15	0.5	0.15	0.5	0.15	7.5	2.29	9	2.74
2 1/2	63.5	7	2.13	2.5	0.76	12	3.66	0.5	0.15	0.5	0.15	—		1	0.31	10	3.05	11.5	3.51
3	76.2	9	2.74	3.5	1.07	15	4.57	1	0.31	1	0.31	—		1.5	0.46	15.5	4.72	14.5	4.42
3 1/2	88.9	9	2.74	3.5	1.07	14	4.27	1	0.31	1	0.31	—		2	0.61	—		12.5	3.81
4	101.6	12.5	3.81	5	1.52	21	6.40	1	0.31	1	0.31	—		2	0.61	16	4.88	18.5	5.64

NOTES: Allowances are for streamlined, soldered fittings and recessed threaded fittings. For threaded fittings, double the allowances shown. The equivalent lengths presented above are based upon a C factor of 150 in the Hazen-Williams friction loss formula. The lengths shown are rounded to the nearest half foot.

Table 6-3.6.2 C Value Multiplier

Value of C	100	120	130	140
Multiplying Factor	0.472	0.662	0.767	0.880

NOTE: The multiplying factor is based upon the friction loss through the fitting being independent of the C factor available to the piping.

6-3.6.4 Pipe friction loss shall be calculated in accordance with the Hazen-Williams formula C values from Table 6-3.6.4.

Table 6-3.6.4 Hazen-Williams C Values

Pipe or Tube	C Value[1]
Plastic (listed per 2-3.2 or 2-3.4.2) — all types	150
Copper tube or stainless steel	150

[1]The authority having jurisdiction is permitted to consider other C values.

6-4 Pneumatic Calculation Procedures for Atomizing Media in Twin Fluid Systems.

6-4.1 Calculations shall be performed to determine the maximum and minimum pneumatic pressures and flow rates (at standard temperature and pressure) at the atomizing media inlet of each twin-fluid nozzle in multi-nozzle system. Maximum and minimum pressures at each nozzle shall be within the performance tolerances for the nozzle, as provided by the nozzle manufacturer. The following iterative procedure is described as one approach.

6-4.2 A pneumatic calculation procedure shall be based on standard engineering methods for sizing of compressed air piping systems. Air flow at each nozzle is dependent on water pressure at the same nozzle. To start the calculation, the air pressure and air flow rate at the hydraulically most remote nozzle shall be set at the optimum air pressure and flow rate for the corresponding water pressure and water flow rate at that nozzle.

6-4.3 The initial water pressure condition at the most remote nozzle shall be taken from hydraulic calculations performed independently (i.e., treating the water piping as a single fluid system), using assumed nozzle discharges. Once the water pressure and flow rate at each nozzle are determined, the corresponding required air pressure and flow rate to allow the assumed water flow rate can be estimated from information provided by the nozzle manufacturer.

6-4.4 Having determined the nominal air pressure and flow requirements at each nozzle, the pneumatic piping system shall be calculated independently, to verify that the pipe sizes are adequate to provide the required pressure and flow at each nozzle location. Using the calculated pressures at each nozzle, the effect on the water discharge rate must be checked. If the water flow rate at the calculated air pressure is within 10 percent of the assumed flow rate in 6-4.3, no correction is required. If not, the nozzle discharge shall be adjusted, and the hydraulic calculation of 6-4.3 shall be repeated. This procedure is iterative, and must be repeated until calculated air and water pressures are within the desired range and ratio.

6-4.5 The ratio of the air pressure to water pressure at each nozzle shall be maintained within 10 percent of the manufacturer's recommended operating ratio as provided by the nozzle manufacturer.

6-4.6 The results of the hydraulic and pneumatic calculations shall indicate the total water demand as a flow rate and pressure at the system supply point, and the total air flow rate (in SCFM) and initial air pressure at the atomizing media supply point.

Chapter 7 Water Supplies and Atomizing Media

7-1 General. Unless otherwise specified, the following requirements shall apply to the water supplies, the atomizing media, and any additives necessary for fire-extinguishing performance.

7-1.1 Every water mist system shall have at least one automatic water supply.

7-1.2* Compressed gas or other atomizing medium, where used as part of a twin fluid water mist system, shall be automatically supplied in concurrence with the water.

7-2* Quantity. The quantities of water, water additives in listed concentrations (if used), and of atomizing media (if used) shall be at least sufficient for the largest single hazard or group of hazards to be protected simultaneously.

7-3* Duration. Automatic supplies of water and of atomizing media (if used) shall be adequate to supply the system for a minimum of 30 minutes.

Exception No. 1: For pre-engineered systems, the minimum duration shall be sufficient for two complete discharges, as required by the listing and by Chapter 5.

Exception No. 2: Where the hazard has been evaluated by a fire protection engineer using standard methods of fire hazard analysis, the water supply duration shall be determined by the specified performance characteristics of the water mist system. It shall be permitted for this method to result in water supply duration requirements greater than or less than those specified in Section 7-3.

7-4 Reserve Supplies.

7-4.1* A reserve supply shall be provided where the extinguishing agent cannot otherwise be replaced within 24 hours following system operation.

7-4.2 Where a reserve supply is provided, it shall be connected to the system piping at all times. If a manual changeover is necessary, the mechanism shall be readily accessible from outside of the protected space.

7-4.3 Means shall be provided to prevent discharge of reserve supplies from open manifold connections when supplies are removed for servicing.

7-5 Water Supplies.

7-5.1* Water Quality.

7-5.1.1 The water supply for a water mist system shall be taken from a source that is equivalent in quality to a potable source with respect to particulate and dissolved solids, or from a source of natural seawater.

Exception No. 1: In areas which are normally occupied, liquid or dissolved chemicals are permitted to be added to the water supplies in accordance with the listing, provided they are used at concentrations for which the manufacturer can demonstrate to the satisfaction of the U.S. Environmental Protection Agency that no adverse toxilogical or physiological effects have been observed.

Exception No. 2: For systems which protect normally unoccupied areas, liquid or dissolved chemicals are permitted to be added to the water supplies in accordance with the listing.

7-5.1.2 A filter or strainer shall be provided at the supply side of each nozzle.

Exception: Nozzles with multiple orifices and with minimum waterway dimensions greater than 800 μm per opening shall not be required to be provided with a strainer or filter at each nozzle.

7-5.1.3 A filter or a strainer shall be provided at each water supply connection or system riser. The filter or strainer shall be installed downstream (on the system side) of all piping that is not corrosion resistant. Such strainers shall be provided with a cleanout port and shall be arranged to facilitate inspection, maintenance, and replacement.

7-5.1.4 The maximum filter rating or strainer mesh opening shall be 80 percent of the minimum nozzle waterway dimension.

7-5.1.5 Systems which utilize nozzles with a minimum nozzle waterway dimension less than 51 μm shall be supplied with demineralized water.

7-5.2 Pumps.

7-5.2.1 Centrifugal pumps shall be sized to supply the greatest demand at not more than 140 percent of rated flow capacity.

7-5.2.2 Other pumps shall be sized to supply 110 percent of system demand at the design pressure.

7-5.2.3 Pumps supplying water mist systems shall be automatically controlled and shall be of sufficient capacity to meet the system demand.

7-5.2.4 Supervision. Pumps supplying water mist systems shall be supervised for the conditions specified in 7-5.2.4.1 and 7-5.2.4.2.

7-5.2.4.1 Electric Pumps.

(a) Pump running;
(b) Loss of power; and
(c) Phase reversal.

7-5.2.4.2 Diesel-Driven Pumps.

(a) Pump running;
(b) Power failure;
(c) Controller not in automatic position;
(d) Low oil pressure;
(e) High water temperature;
(f) Failure to start/overcrank;
(g) Overspeed; and
(h) Fuel level (set at 75 percent capacity).

7-5.3 Tanks.

7-5.3.1 Water tanks shall be arranged in accordance with NFPA 22, *Standard for Water Tanks for Private Fire Protection.*

7-5.3.2 Water tanks shall be supervised for the following conditions:

(a) Water level;
(b) Water temperature (for tanks located in unheated areas); and
(c) Air pressure (for pressure tanks).

7-5.4 Storage Containers.

7-5.4.1 Storage containers and accessories shall be located and arranged to facilitate inspection, testing, recharging, and other maintenance. Interruption to protection shall be held to a minimum.

7-5.4.2 Storage containers shall not be located where they are likely to be subject to severe weather conditions or to mechanical, chemical, or other damage.

7-5.4.3 Where excessive climatic or mechanical exposures are expected, suitable safeguards or enclosures shall be provided.

7-5.4.4 Storage containers shall be mounted securely in accordance with the manufacturer's installation manual. This shall include mounting the container on the appropriate mounting surface.

7-5.4.5 Each pressurized container or cylinder shall be provided with a safety device to release excess pressure.

7-5.4.6 A reliable means shall be provided to indicate the pressure and level in all storage containers.

7-5.5* Fire Department Connection. A fire department connection shall be provided on the discharge side of the pressure source components. The connection to the system shall be made on the upstream (supply) side of the system strainer or filter.

Exception No. 1: For systems with operating pressures in excess of 175 psi (12 bars), the connection shall be made on the suction side of the pressure source components.

Exception No. 2: Fire department connections shall not be required for systems protecting less than 2000 ft^2 (200 m^2).

Exception No. 3: Fire department connections shall not be required for systems with operating pressures in excess of 175 psi (12 bars) and supplied only by storage cylinders.

Exception No. 4: Fire department connections shall not be required for systems where the atomizing medium is essential for fire suppression.

7-6 Atomizing Media for Twin Fluid Systems.

7-6.1 General.

7-6.1.1 Atomizing media essential to the production of water mist shall be taken from a dedicated source.

Exception: Where the facility has an air supply that meets or exceeds the requirements of a dedicated main and reserve air supply, both meeting the quality, quantity, pressure, and reliability requirements of the listing and the approval of the authority having jurisdiction. Plant air used as an atomizing medium for a water mist system shall be monitored by the fire control panel, with the low air alarm set at a point at least 50 percent above the availability of two full system discharge requirements.

7-6.1.2 Atomizing media shall be supervised for high and low pressure.

7-6.1.3 Moisture content in the atomizing medium shall not exceed 25 ppm.

7-6.1.4 Regulators controlling the supply of water for the atomizing medium shall be listed for the intended purpose.

7-6.1.5 A check valve or other means shall be installed in the piping at the supply point to prevent the entrance of water into the atomizing medium.

7-6.1.6 Filters or other means to protect nozzles from obstructions shall be provided in accordance with 7-5.1.2.

7-6.2 Air Compressors.

7-6.2.1 Air compressors used as a dedicated source shall be listed for use on fire protection systems.

7-6.2.2 Compressors used as a dedicated supply shall be connected to a backup power supply.

7-7 Pressure Gauges. A pressure gauge shall be provided for each water supply and each atomizing medium.

Chapter 8 Plans and Documentation

8-1 Working Plans.

8-1.1 Working plans shall be submitted for approval to the authority having jurisdiction before any equipment is installed or remodeled. Deviation from approved plans shall require permission of the authority having jurisdiction.

8-1.2 Working plans shall be drawn to specified scale on sheets of uniform size. Special symbols shall be defined and used to identify components of the water mist system clearly. The plans shall provide the following information that pertains to the design of the system:

(a) Name of owner and occupant;

(b) Location, including street address;

(c) Point of compass and symbol legend;

(d) Location and construction of protected enclosure walls and partitions;

(e) Location of fire walls;

(f) Enclosure cross section, with full height or schematic diagram, including location and construction of building floor/ceiling assemblies above and below, raised access floor, and suspended ceiling;

(g) Description of occupancies and hazards being protected, designating whether or not the enclosure is normally occupied;

(h) Description of exposures surrounding the enclosure;

(i) Description of water and gas storage containers used including make, internal volume, storage pressure, and nominal capacity expressed in units of mass or volume at standard conditions of temperature and pressure;

(j) Description of nozzles used including manufacturer, size, orifice port configuration, and orifice size or part number;

(k) Description of pipe and fittings used including material specifications, grade, and pressure rating;

(l) Description of wire or cable used including classification, gauge (AWG), shielding, number of strands in conductor, conductor material, and color coding schedule. The segregation requirements of various system conductors shall be clearly indicated. The required method of making wire terminations shall be detailed;

(m) Description of the method of detector mounting;

(n) Equipment schedule or bill of materials for each piece of equipment or device indicating device name, manufacturer, model or part number, quantity, and description;

(o) Plan view of the protected area showing enclosure partitions (full and partial height); water distribution system including storage containers or pumps; gas distribution system including gas storage containers; piping; nozzles; type of pipe hangers and rigid pipe supports; detection, alarm, and control system including all devices; end-of-line device locations; location of controlled devices such as dampers and shutters; and location of instructional signage;

(p) Isometric view of the water mist distribution system showing the length and diameter of each pipe segment; node reference numbers relating to the flow calculations; fittings including reducers and strainers; orientation of tees; and nozzles including size, orifice port configuration, and flow rate;

(q) Seismic building joints, if any, showing where water mist distribution or supply piping crosses the joint; expected movement of the seismic joint; details of the piping arrangement; and flexible connectors used to accommodate seismic movement;

(r) The calculation of seismic loads if seismic restraint is required by the authority having jurisdiction;

(s) Scale drawing showing the layout of the annunciator panel graphics if required by the authority having jurisdiction;

(t) Details of each unique rigid pipe support configuration showing method of securement to the pipe and to the structure;

(u) Details of the method of container securement showing method of securement to the container and to the structure;

(v) Complete step-by-step description of the system sequence of operations including functioning of abort and maintenance switches, delay timers, and emergency power shutdown;

(w) Schematic diagrams and point-to-point wiring diagrams showing all circuit connections to the system control panels, detectors, system devices, controlled devices, external and add-on relays, and graphic annunciator panels;

(x) Schematic diagrams and point-to-point wiring diagrams of the system control panels;

(y) Complete calculations to determine enclosure volume for the application of water mist; and

(z) Complete calculations to determine the size of backup batteries; the method used to determine the number and location of audible and visual indicating devices; and number and location of detectors.

8-2 Hydraulic Calculation Documentation.

8-2.1 Hydraulic calculations shall be prepared on form sheets that include a summary sheet, detailed work sheets, and a graph sheet.

Exception: Pre-engineered systems.

8-2.2 Summary Sheet. The summary sheet shall contain the following information:

(a) Date;

(b) Location;

(c) Name of owner and occupant;

(d) Building number or other identification;

(e) Description of hazard;

(f) Name and address of contractor or designer;

(g) Name of approving agency;

(h) System design requirements, including:

1. Design area of water application or volume of space protected;
2. Minimum rate of water application (density); and
3. Area per nozzle.

(i) Total water requirements as calculated; and

(j) Limitations (dimension, flow, and pressure) resulting from the use of automatic sprinkler systems or other water fire suppression systems.

8-2.3 Detailed Work Sheets. The detailed work sheets or computer printouts shall contain the following information:

(a) Sheet number;

(b) Nozzle description;

(c) Hydraulic reference points;

(d) Flow in gpm (L/min);

(e) Pipe size;

(f) Pipe lengths, center to center of fittings;

(g) Equivalent pipe lengths for fittings and devices;

(h) Friction loss in psi/ft (bars/m) of pipe;

(i) Total friction loss between reference points;

(j) Elevation head in psi (bars) between reference points;

(k) Required pressure in psi (bars) at each reference point;

(l) Velocity pressure and normal pressure if included in calculations;

(m) System flushing locations;

(n) Notes to indicate starting points, reference other sheets, or clarify data shown;

(o) Diagram to accompany gridded system calculations to indicate flow quantities and directions for lines with water mist nozzles operating in the remote area; and

(p) Other calculations necessary for design of the water mist system.

8-2.4 Graph Sheet. A graphic representation of the complete hydraulic calculation shall be plotted on semilogarithmic ($Q^{1.85}$) graph paper and shall include the following:

(a) Water supply curve; and

(b) Water mist system demand.

8-3 Pneumatic Calculation Documentation.

8-3.1 Pneumatic calculations shall be prepared on form sheets that include a summary sheet and detailed work sheets.

Exception: Pre-engineered systems.

8-3.2 Summary Sheet. The summary sheet shall contain the following information:

(a) Date;

(b) Location;

(c) Name of owner and occupant;

(d) Building number or other identification;

(e) Description of hazard;

(f) Name and address of contractor or designer; and

(g) Total gas volume required.

8-3.3 Detailed Work Sheets (for pneumatic calculations). The detailed work sheets or computer printouts shall contain the following information:

(a) Sheet number;

(b) Nozzle description;

(c) Pneumatic reference points;

(d) Atomizing media flow rate (in SCFM) and pressure at each nozzle;

(e) The air pressure to water pressure ratio at each nozzle;

(f) Pipe size;

(g) Pipe lengths;

(h) Total pressure loss between reference points;

(i) Required pressure in psi (bars) at each reference point; and

(j) Notes to indicate starting points, reference other sheets, or clarify data shown.

8-4 Detection, Actuation, and Control Systems Documentation. After successful completion of acceptance tests satisfactory to the authority having jurisdiction, as-built installation documentation shall be prepared and provided to the system owner or the owner's designated representative, including as-built installation drawings, operation and maintenance manuals, a written sequence of operation, and reports.

8-4.1 As-Built Installation Drawings. A set of as-built installation drawings, reproducible and drawn to a scale specified on sheets of uniform size, shall provide the as-built configuration of detection, actuation, and control systems and shall include:

(a) The name of owner and occupant;

(b) The location, including street address;

(c) The plan view of the protected area showing all detector locations; end-of-line device locations; location of detector indicating lights if separate from the detectors; location of audible and visual indicating devices; location of control panels; location of manual release and abort switches; location of controlled devices such as dampers and shutters; location of maintenance and emergency power shutdown switches; and location of the annunciator panel;

(d) An equipment schedule or bill of materials for each piece of equipment or device indicating the device name, manufacturer, model or part number, quantity, and description;

(e) A description of wire or cable used including classification, gauge (AWG), shielding, number of strands in conductor, conductor material, and color coding schedule. The segregation requirements of various system conductors shall be clearly indicated. The as-built method of making wire terminations shall be detailed;

(f) A scale drawing showing the graphics layout of all annunciator panels;

(g) Schematic diagrams and point-to-point wiring diagrams showing all circuit connections to the system control panels, detectors, system devices, controlled devices, external and add-on relays, and graphic annunciator panels;

(h) Schematic diagrams and point-to-point wiring diagrams of the system control panels;

(i) The size and type of backup batteries; and

(j) The details of any special features.

8-4.2 Operation and Maintenance Manuals. Operation and maintenance manuals shall include operation and maintenance instructions for each piece of equipment or device of the as-built system.

8-4.3 Written Sequence of Operation. The written sequence of operation of the as-built system shall include a complete step-by-step description of the functioning of abort and maintenance switches, delay timers, and emergency power shutdown features.

8-4.4 Reports. Reports shall include inspection, testing, and maintenance reports.

Chapter 9 System Acceptance

9-1 Approval of Water Mist Systems. The completed system shall be reviewed and tested by qualified personnel to meet the approval of the authority having jurisdiction. These personnel shall confirm that listed equipment and devices have been used in the system where required by this standard. To determine that the system has been properly installed and functions as specified, the installing contractor shall:

(a) Notify the authority having jurisdiction and the owner's representative of the time and date testing is to be performed; and

(b) Perform all required acceptance tests.

9-2* Acceptance Requirements.

9-2.1 Flushing or Cleaning of Piping.

9-2.1.1 Water Supply Connection. Where systems are connected to municipal or private water supplies, underground mains and lead-in connections to water mist system piping shall be flushed completely before connection is made to water mist piping. The flushing operation shall be continued for a sufficient time to ensure thorough cleaning. The minimum rate of flow shall be one of the following, whichever is greater:

(a) The hydraulically calculated water demand rate of the system; or

(b) The maximum flow rate available to the system under fire conditions.

9-2.1.2 System Pipe or Tube. Each pipe or tube section shall be cleaned internally after preparation and before assembly in accordance with the manufacturer's installation manual. The piping network shall be free of particulate matter and oil residue before installation of nozzles or discharge devices.

9-2.2 Hydrostatic Tests.

9-2.2.1 General.

9-2.2.1.1 The test pressure shall be read from a gauge located at the low elevation point of the system or portion being tested.

9-2.2.1.2 Water used for testing shall be filtered or strained to remove all solids of a size sufficient to obstruct the water mist nozzles.

9-2.2.1.3 Additives, corrosive chemicals such as sodium silicate or derivatives of sodium silicate, brine, or other chemicals shall not be used while hydrostatically testing systems or for stopping leaks.

9-2.2.1.4 Test blanks shall have painted lugs protruding in such a way as to clearly indicate their presence. The test blanks shall be numbered, and the installing contractor shall have a recordkeeping method to ensure their removal after work is completed.

9-2.2.2 Low Pressure System. All interior piping and attached appurtenances subjected to system working pressure shall be hydrostatically tested at 200 psi (13.8 bars) and shall maintain that pressure without loss for 2 hours. Loss shall be determined by a drop in gauge pressure or visible leakage.

Exception No. 1: Portions of systems normally subjected to working pressures in excess of 150 psi (10.4 bars) shall be tested as described above at a pressure of 50 psi (3.5 bars) in excess of normal working pressure.

Exception No. 2: Where cold weather does not allow testing with water, an interim air test shall be conducted as described in 9-2.3.

9-2.2.3 Intermediate and High Pressure Systems. All interior piping and attached appurtenances subjected to system pressure shall be hydrostatically tested to 150 percent of the normal working pressure, and they shall maintain that pressure without loss for 2 hours. Loss shall be determined by a drop in gauge pressure or visible leakage.

9-2.3 Air Tests. For dry and preaction systems, an air pressure leakage test at 40 psi (2.8 bars) shall be conducted for 24 hours in addition to the standard hydrostatic test. Any leakage that results in a loss of pressure in excess of 1 ½ psi (0.1 bars) during the 24 hours shall be corrected.

CAUTION: Pneumatic pressure testing creates a potential risk of injury to personnel in the area as a result of airborne projectiles if rupture of the piping system occurs. Prior to the pneumatic pressure test being conducted, the area shall be evacuated and appropriate safeguards shall be provided for test personnel.

9-2.4 Review of Components.

9-2.4.1 Review of Mechanical Components.

9-2.4.1.1 The piping system shall be inspected to determine that it is in compliance with the design and installation documents and hydraulic calculations.

9-2.4.1.2 Nozzles and pipe size shall be in accordance with system drawings. The means of pipe size reduction and the attitudes of tees shall be checked for conformance to the design.

9-2.4.1.3 Piping joints, discharge nozzles, and piping supports shall be fastened securely to prevent unacceptable vertical or lateral movement during discharge. Discharge nozzles shall be installed in such a manner that piping cannot become detached during discharge.

9-2.4.1.4 The discharge nozzle shall be oriented in such a manner that optimum water mist application can be effected.

9-2.4.1.5 The discharge nozzles, piping, and mounting brackets shall be installed in such a manner that they do not potentially cause injury to personnel.

9-2.4.1.6 All water and gas storage containers shall be located properly in accordance with an approved set of system drawings.

9-2.4.1.7 All containers and mounting brackets shall be fastened securely in accordance with the manufacturer's requirements.

9-2.4.2 Review of Electrical Components.

9-2.4.2.1 All wiring systems shall be checked for proper installation in conduit and in compliance with the approved drawings. It shall be confirmed that ac wiring and dc wiring are not combined in a common conduit or raceway unless properly shielded and grounded.

9-2.4.2.2 All field circuits shall be confirmed to be free of ground faults and short circuits. Where measuring field circuitry, all electronic components, such as smoke and flame detectors or special electronic equipment for other detectors or their mounting bases, shall be removed, and jumpers shall be installed properly to prevent the possibility of damage within these devices. Components shall be replaced after measuring.

9-2.4.2.3 The detection devices shall be checked for proper type and location as specified on the system drawings.

9-2.4.2.4 The detectors shall be installed in a professional manner and in accordance with technical data regarding their installation. NFPA 72, *National Fire Alarm Code*, shall be referenced for installation requirements. In Canada, CAN/ULC S524-M86, *Standard for the Installation of Fire Alarm Systems,* and CAN/ULC S529-M87, *Smoke Detectors for Fire Alarm Systems,* shall be referenced.

9-2.4.2.5 Manual pull stations shall be confirmed as readily accessible, accurately identified, and properly protected to prevent damage.

9-2.4.2.6 For systems using abort switches, the switches shall be confirmed to be of the deadman type that necessitates constant manual pressure, properly installed, readily accessible within the hazard area, and clearly identified. Switches that remain in the abort position when released shall not be permitted for this purpose. Verification that normal and manual emergency control overrides the abort function shall be made.

9-2.4.2.7 Polarity shall have been observed on all polarized alarm devices and auxiliary relays.

9-2.4.2.8 All end-of-line resistors shall have been installed across the detection and alarm bell circuits where required.

9-2.4.2.9 The control unit shall be checked for proper installation and ready accessibility.

9-2.4.2.10* All wiring systems shall be checked for proper grounding and shielding. It shall be verified that the water mist system branch piping has not been used as an electrical ground.

9-2.5 Preliminary Functional Tests.

9-2.5.1 If the system is connected to an alarm receiving office, the alarm receiving office shall be notified that the fire system test is to be conducted and that an emergency response by the fire department is not desired. All concerned personnel at the end-user's facility shall be notified that a test is to be conducted and shall be instructed as to the sequence of operation.

9-2.5.2 Each water mist release mechanism shall be disabled so that activation of the release circuit does not release water mist. The release circuit shall be reconnected with a functional device in lieu of each water mist release mechanism. For electrically actuated release mechanisms, these devices can include 24-volt lamps, flash bulbs, or circuit breakers. For pneumatically actuated release mechanisms, these devices can

include pressure gauges. The manufacturer's installation manual shall be referenced for recommended procedures and test methods.

9-2.5.3 Each detector shall be checked for proper response.

9-2.5.4 All auxiliary functions such as alarm sounding or displaying devices, remote annunciators, air-handling shutdown, and power shutdown shall be checked for proper operation in accordance with system requirements and design specifications.

9-2.5.5 Manual pull stations shall be checked to confirm that they override abort switches.

9-2.5.6 All supervised circuits shall be checked for proper trouble response.

9-2.6 System Operational Tests.

9-2.6.1 Where practicable, full flow tests of the system piping using water shall be made as a means of checking the nozzle layout, discharge pattern, and any obstructions, determining the relationship between design criteria and actual performance, and ensuring against the clogging of the smaller piping and nozzles by foreign matter carried by the water.

9-2.6.2 Where practicable, the maximum number of systems that are expected to operate in case of fire shall be in full operation simultaneously when checking the adequacy and condition of the water supply.

9-2.6.3 All operating parts of the system shall be tested fully to ensure that they function as intended. It shall be verified that all devices function properly and that they are properly sequenced.

9-2.6.4 After flow testing, all filters and strainers shall be inspected, and cleaned or replaced, as necessary.

Chapter 10 System Maintenance

10-1 Responsibility of the Owner or Occupant.

10-1.1 The responsibility for properly maintaining a water mist fire protection system shall be the obligation of the property owner. By means of periodic inspection, tests, and maintenance, the equipment shall be shown to be either in good operating condition or that defects or impairments exist.

10-1.2 Inspection, testing, and maintenance activities shall be implemented in accordance with procedures meeting or exceeding those established in this document and in accordance with the manufacturer's instructions. These tasks shall be performed by personnel who have developed competence through training and experience.

10-1.3 The owner or occupant shall notify the authority having jurisdiction, the fire department (if required), and the alarm receiving facility before shutting down a system or its supply. The notification shall include the purpose for the shutdown, the system or component involved, and the estimated time needed. The authority having jurisdiction, the fire department, and the alarm receiving facility shall be notified when the system, supply, or component is returned to service.

10-1.4 The owner or occupant shall promptly correct or repair deficiencies, damaged parts, or impairments found while performing the inspection, test, and maintenance requirements of this standard. Corrections and repairs shall be performed by qualified maintenance personnel or a qualified contractor.

10-1.5 The owner or occupant shall give special attention to factors that might alter the requirements for a continued satisfactory or acceptable installation. Such factors shall include, but shall not be limited to:

(a) Occupancy changes;

(b) Process or material changes;

(c) Structural revisions such as relocated walls, added horizontal or vertical obstructions, or ventilation changes; and

(d) Removal of heating systems in spaces with piping subject to freezing.

10-1.6 Where changes in the occupancy, hazard, water supply, storage arrangement, structural modification, or other condition that affects the installation criteria of the system are identified, the owner or occupant shall promptly take steps to evaluate the adequacy of the installed system to protect the hazard in question, such as contacting a qualified contractor, consultant, or engineer. Where the evaluation reveals a deficiency, the owner shall notify the insurance underwriter, the authority having jurisdiction, and the local fire department.

10-1.7 Where a water mist system is returned to service following an impairment, it shall be verified that it is working properly. Chapter 9 shall be referenced to provide guidance on the type of inspection or test, or both, that is required.

10-2 Inspection and Testing. All components and systems shall be inspected and tested to verify that they function as intended. The frequency of inspections and tests shall be in accordance with Tables 10-2(a) and (b) or as specified in the manufacturer's listing, whichever is more frequent. Following tests of components or portions of water mist systems that require valves to be opened or closed, the system shall be returned to service, with verification that all valves are restored to their normal operating position. Plugs or caps for auxiliary drains or test valves shall be replaced.

10-2.1 Test results shall be compared with those of the original acceptance test (if available) and with the most recent test results.

10-2.2 Inspection and testing requirements for each component are provided in Tables 10-2(a) and (b).

10-2.3 Specialized equipment required for testing shall be in accordance with the manufacturer's specifications.

10-2.4 High pressure cylinders used in water mist systems shall not be recharged without a hydrostatic test (and remarking) if more than 5 years have elapsed from the date of the last test. Cylinders that have been in continuous service without discharging shall be permitted to be retained in service for a maximum of 12 years, after which they shall be discharged and retested before being returned to service.

Table 10-2(a) Inspection Frequencies

Item	Activity	Frequency
Water tank (unsupervised)	Check water level	Weekly
Air receiver (unsupervised)	Check air pressure	Weekly
Dedicated air compressor (unsupervised)	Check air pressure	Weekly
Water tank (supervised)	Check water level	Monthly
Air receiver (supervised)	Check air pressure	Monthly
Dedicated air compressor (supervised)	Check air pressure	Monthly
Air pressure cylinders (unsupervised)	Check pressure and indicator disk	Monthly
System operating components, including control valves (locked/unsupervised)	Inspect	Monthly
Air pressure cylinders (supervised)	Check pressure and indicator disk	Quarterly
System operating components, including control valves	Inspect	Quarterly
Waterflow alarm and supervisory devices	Inspect	Quarterly
Initiating devices and detectors	Inspect	Semiannually
Batteries, control panel, interface equipment	Inspect	Semiannually
System strainers and filters	Inspect	Annually
Control equipment, fiber optic cable connections	Inspect	Annually
Piping, fittings, hangers, nozzles, flexible tubing	Inspect	Annually

Table 10-2(b) Testing Frequencies

Item	Activity	Frequency
Pumps	Operation test (no flow)	Weekly
Compressor (dedicated)	Start	Monthly
Control equipment (functions, fuses, interfaces, primary power, remote alarm) (unsupervised)	Test	Quarterly
System main drain	Drain test	Quarterly
Remote alarm annunciation	Test	Annually
Pumps	Function test (full flow)	Annually
Batteries	Test	Semiannually
Pressure relief valve	Manually operate	Semiannually
Control equipment (functions, fuses, interfaces, primary power, remote alarm) (supervised)	Test	Annually
Water level switch	Test	Annually
Detectors (other than single use or self-testing)	Test	Annually
Release mechanisms (manual and automatic)	Test	Annually
Control unit/programmable logic control	Test	Annually
Section valve	Function test	Annually
Water	Analysis of contents	Annually
Pressure cylinders (normally at atmospheric pressure)	Pressurize cylinder (discharge if possible)	Annually
System	Flow test	Annually
Pressure cylinders	Hydrostatic test	5–12 years
Automatic nozzles	Test (random sample)	20 years

10-3 Maintenance.

10-3.1 Maintenance shall be performed to keep the system equipment operable or to make repairs. As-built system installation drawings, original acceptance test records, and device manufacturer's maintenance bulletins shall be retained to assist in the proper care of the system and its components.

10-3.2 Preventive maintenance includes, but is not limited to, lubricating control valve stems, adjusting packing glands on valves and pumps, bleeding moisture and condensation from air compressors and air lines, and cleaning strainers. Scheduled maintenance shall be performed as outlined in Table 10-3.2.

10-3.3 Corrective maintenance includes, but is not limited to, replacing loaded, corroded, or painted nozzles, replacing missing or loose pipe hangers, cleaning clogged fire pumps, replacing valve seats and gaskets, and restoring heat in areas subject to freezing temperatures where water-filled piping is installed.

Table 10-3.2 Maintenance Frequencies

Item	Activity	Frequency
Water tank	Drain and refill	Annually
System	Flushing	Annually
Strainers and filters	Clean or replace as required	After system operation

10-3.4 Emergency maintenance includes, but is not limited to, repairs due to piping failures caused by freezing or impact damage, repairs to broken water mains, and replacing frozen or fused nozzles, defective electric power, or alarm and detection system wiring.

10-3.5 Specific maintenance activities, where applicable to the type of water mist system, shall be performed in accordance with the schedules in Table 10-3.2.

10-3.6 Replacement components shall be in accordance with the manufacturer's specifications and the original system design. Spare components shall be readily accessible and shall be stored in a manner to prevent damage or contamination.

10-3.7* After each system operation, a representative sample of operated water mist nozzles in the activated zone shall be inspected.

10-3.8 After each system operation due to fire, the system filters and strainers shall be cleaned or replaced.

10-4 Training. All persons who might be expected to inspect, test, maintain, or operate water mist systems shall be trained thoroughly in the functions they are expected to perform. Refresher training shall be provided as recommended by the manufacturer or by the authority having jurisdiction.

Chapter 11 Marine Systems

11-1 General. This chapter outlines the deletions, modifications, and additions that are necessary for marine applications. All other requirements of NFPA 750, *Standard on Water Mist Fire Protection Systems*, shall apply to shipboard systems except as modified by this chapter.

11-1.1 The following definitions shall be applicable to this chapter.

Flammable Liquid Hazard Systems. Systems protecting spaces where the predominant hazard consists of flammable and combustible liquids. Examples include machinery spaces, flammable liquid store rooms, cargo pump rooms and paint lockers.

Sprinkler Equivalent Systems. Systems protecting spaces where the predominant hazard consists of Class A combustibles. Examples include accommodation spaces, public spaces, galleys, and store rooms.

11-1.2* The efficacy and reliability of all marine water mist system arrangements and their components shall be tested in accordance with standards developed by the International Maritime Organization (IMO).

11-1.2.1 Sprinkler equivalent systems shall comply with the fire suppression and component manufacturing tests of IMO Assembly Resolution A.800(19).

11-1.2.2 Flammable liquid hazard systems shall comply with fire suppression and components manufacturing tests contained in IMO *Maritime Safety Committee Circular* 668, as amended by IMO FP40/WP.9 Annex 3, *Report of the 40th Session of the Subcommittee on Fire Protection*..

11-1.3 All marine water mist systems and their components shall be listed or approved.

11-1.4 The system and equipment shall be suitably designed to withstand ambient temperature changes, vibrations, humidity, shock, impact, clogging, and corrosion normally encountered in ships.

11-1.5* Equipment and piping systems mounting and hanging practices shall be in accordance with internationally recognized standards for marine applications.

11-1.6* The required water mist pumps shall be arranged such that with the largest pump out of service, the greatest system demand can still be satisfied.

11-1.7 Controls and Alarms.

11-1.7.1 Pump systems shall have the following:

(a) Automatic pump start-up; and

(b) Manual pump start and annunciation at the following locations:

1. Near the pump;
2. Engine control room; and
3. Central control station where provided.

11-1.7.2 Annunciation shall include (as applicable):

(a) Power available/power failure;

(b) Water flow and location;

(c) Pump run; and

(d) Diesel driver oil pressure.

11-1.7.3 Any flow condition shall sound an alarm on the bridge or at a constantly manned control station.

11-1.7.4 On the bridge and in the engine control room there shall be a pressure monitor consisting of one of the following:

(a) Pressure gauge;

(b) Transducer system; or

(c) High/low/OK pressure switch.

11-2 Sprinkler Equivalent Systems.

11-2.1 The system shall be automatic.

11-2.2 The water mist system shall be adequate to supply the system with fresh water for a period of at least 30 minutes. The vessel's potable water supply shall be permitted to constitute an acceptable source to satisfy the 30-minute demand period.

11-2.3 A pressure tank system shall be provided to meet the functional requirements for Safety of Life at Sea (SOLAS) Regulation II-2/12.4.1.

11-2.4* After 30 minutes of system activation, manual intervention shall be permitted for continued operation.

11-2.5 The system shall be fitted with a permanent sea inlet and be capable of continuous operation using sea water for a period of at least 120 minutes.

11-2.6 Strainers and filters shall be provided and sized for the worst case water quality conditions expected.

11-2.7* The system shall be of the wet pipe type.

Exception: Where environmental conditions dictate, small sections are permitted to be of another approved type.

11-2.8 The system shall be provided with main and emergency sources of power.

11-2.9 Pumps and alternate supply components shall be sized to be capable of maintaining the required flow.

11-2.10 The water supply shall be sufficient to meet the flow and pressure requirements as determined by the listing of all nozzles in the hydraulically most remote design area determined in accordance with 11-2.10.1 and 11-2.10.2.

11-2.10.1 In ordinary hazard public spaces, the design area shall be 3014 ft^2 (280 m^2).

11-2.10.2 In light hazard public spaces and accommodation spaces, the design area shall be 1507 ft^2 (140 m^2).

Exception: The water supply requirements for nozzles only shall be based upon the room that creates the greatest demand. The density selected shall be in accordance with the listing. To utilize this method, all rooms shall be enclosed with walls having a fire resistance rating equivalent to an A-15 or B-15 rating.

Minimum protection of opening shall be as follows:

Light hazard. Automatic or self-closing doors.

Exception: Where opening is not protected, calculations shall include the nozzle in the room plus two nozzles in the communication space nearest each such unprotected opening unless the communication space has only one nozzle, in which case calculations shall be extended to the operation of that nozzle. The selection of the room and communication space nozzles to be calculated shall be that which produces the greatest hydraulic demand.

Ordinary and extra hazard. Automatic or self-closing doors with appropriate fire resistance ratings for the enclosure.

11-2.11 The water supply shall be sufficient to meet the total flow and pressure requirements of all nozzles in the hydraulically most remote design area determined in conformance with 11-2.11.1 and 11-2.11.2.

11-2.11.1 In ordinary hazard public spaces, the design area shall be 3014 ft^2 (280 m^2).

11-2.11.2 In light hazard public spaces and accommodation spaces, the design area shall be 1507 ft^2 (140 m^2), plus 3 nozzles in the corridor outside the compartment.

Exception: In accommodation spaces consisting of small compartments and an adjacent corridor, the design area shall include all nozzles in the largest compartment plus 3 nozzles in the corridor outside the compartment, provided that the compartment boundaries (floors, walls, ceilings) meet the following conditions:

(a) Open to the weather; or

(b) Have a fire resistance rating of not less than 15 minutes; and

(c) Doors opening into adjacent spaces or onto the corridor have a fire resistance rating of not less than 15 minutes and are equipped with automatic self-closing devices designed to close the doors on receipt of signal from the fire alarm system or upon actuation of the water mist system.

11-2.12 Spaces shall be permitted to be protected with alternate, approved fire suppression systems when such areas are separated from mist protected areas with a 1-hour rated assembly.

11-2.13 Water mist supply components shall be located outside Category A machinery spaces. This shall apply to pumps, pressure tanks, cylinder tanks, emergency power cables, and controllers.

11-3 Flammable Liquids.

11-3.1 This section applies to flammable liquid hazard systems.

11-3.2 Flammable liquid hazard systems shall be shown by test to be capable of extinguishing a variety of fires that can occur in spaces where the predominate hazard consists of flammable liquids.

11-3.2.1 Systems for machinery spaces and cargo pump rooms shall be capable of fire extinguishment as demonstrated by testing in accordance with IMO Fire Test Procedures. Systems for flammable liquid store rooms, paint lockers, and other flammable liquid hazards shall be based on tests acceptable to the authority having jurisdiction. Nozzle locations, types of nozzles, and spray characteristics shall be within the limits tested.

11-3.3* The system shall be capable of manual actuation allowing water to discharge into the protected space without the necessity of further human intervention.

11-3.3.1* After 30 minutes of system activation, manual intervention shall be permitted for continued operation.

11-3.4* Where time delays are provided, audible and visual signals shall be provide throughout the protected space.

11-3.5 Water Supply.

11-3.5.1 The system's water supply shall be available for immediate use.

11-3.5.2 The water supply shall be based on complete protection of the space demanding the greatest quantity of water.

11-3.5.3 Pressure tank(s) shall be provided to immediately supply the system at the design flow and pressure for not less than 60 seconds.

11-3.5.4 The water supply shall be adequate to supply the system with fresh water for a period of at least 30 minutes. The vessel's potable water supply shall be permitted to constitute an acceptable source to satisfy the 30-minute demand period.

11-3.5.4.1 The fresh water supply shall meet the water quality requirements of 7-5.1.

11-3.5.5 Where the water mist system is designed for uniform cycling, the maximum-reduced discharge period is 60 seconds.

11-3.5.6* The minimum quantity of water used in uniform cycling systems shall be the maximum system flow for a 15-minute constant duration.

11-3.5.7* The system shall be fitted with a permanent sea inlet and be capable of continuous operation using sea water.

11-3.6* Power Supplies. The system shall be provided with both main and emergency sources of power and shall be provided with automatic change over. One of those sources of power shall be wholly provided from outside the protected space.

11-3.7 Pressure source components of the system shall be located outside the protected space.

11-3.8 A means to allow for periodic testing of the operation of the system for assuring the required pressure and flow shall be provided.

11-4* Human Factors. Human factors shall be considered to the extent practicable during the design of water mist systems on marine vessels.

Chapter 12 Referenced Publications

12-1 The following documents or portions thereof are referenced within this standard and shall be considered part of the requirements of this document. The edition indicated for each reference is the current edition as of the date of the NFPA issuance of this document.

12-1.1 NFPA Publications. National Fire Protection Association, 1 Batterymarch Park, P.O. Box 9101, Quincy, MA 02269-9101.

NFPA 13, *Standard for the Installation of Sprinkler Systems*, 1996 edition.

NFPA 20, *Standard for the Installation of Centrifugal Fire Pumps*, 1996 edition.

NFPA 22, *Standard for Water Tanks for Private Fire Protection*, 1996 edition.

NFPA 70, *National Electrical Code*, 1996 edition.

NFPA 72, *National Fire Alarm Code*, 1996 edition.

12-1.2 Other Publications.

12-1.2.1 ANSI Publications. American National Standards Institute, 11 West 42nd Street, New York, NY 10036.

ANSI B1.20.1-83, *Pipe Threads, General Purpose (Inch)*, 1992.

ANSI B16.18-84, *Cast Copper Alloy Solder Joint Pressure Fittings*, 1994.

ANSI B16.22-89, *Wrought Copper and Copper Alloy Solder Joint Pressure Fittings*, 1989.

ANSI B31.1-95, *Power Piping Code*, 1995.

12-1.2.2 ASME Publication. American Society of Mechanical Engineers, 345 East 47th Street, New York, NY 10017.

ASME *Boiler and Pressure Vessel Code*, 1995.

12-1.2.3 ASTM Publications. American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.

ASTM A 269, *Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service*, 1994.

ASTM A 351/ASTM A 351M, *Standard Specification for Castings, Austenitic, Austenitic-Ferritic (Duplex) for Pressure-Containing Parts*, 1994.

ASTM A 403/ASTM A 403M, *Standard Specification for Wrought Austenitic Stainless Steel Piping Fittings*, 1995.

ASTM A 632, *Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing (Small-Diameter) for General Service*, 1990.

ASTM A 774/ASTM A 774M, *Standard Specification for As-Welded Wrought Austenitic Stainless Steel Fittings for General Corrosive Service at Low and Moderate Temperatures*, 1995.

ASTM A 778, *Standard Specification for Welded, Unannealed Austenitic Stainless Steel Tubular Products*, 1990.

ASTM A 789/ASTM A 789M, *Standard Specification for Seamless and Welded Ferritic/Austenitic Stainless Steel Tubing for General Service*, 1995.

ASTM A 815/ASTM A 815M, *Standard Specification for Wrought Ferritic, Ferritic/Austenitic, and Martensitic Stainless Steel Piping Fittings*, 1995.

ASTM B 32, *Standard Specification for Solder Metal*, 1995.

ASTM B 75, *Standard Specification for Seamless Copper Tube*, 1995.

ASTM B 88, *Standard Specification for Seamless Copper Water Tube*, 1995.

ASTM B 251, *Standard Specification for General Requirements for Wrought Seamless Copper and Copper-Alloy Tube*, 1993.

ASTM B 813, *Standard Specification for Liquid and Paste Fluxes for Soldering Applications of Copper and Copper-Alloy Tube*, 1993.

ASTM E 380, *Standard Practice for Use of the International System of Units (SI) (the Modernized Metric System)*, 1993.

12-1.2.4 AWS Publications. American Welding Society, Inc., 550 N.W. LeJeune Road, Maimi, FL 33126.

AWS A5.8, *Specification for Filler Metals for Brazing and Braze Welding*, 1992.

AWS D10.9, *Specification for Qualification of Welding Procedures and Welders for Piping and Tubing*, 1980.

12-1.2.5 CSA Publication. Canadian Standards Association, Rexdale, Ontario, Canada.

CAN3-A234.1, *Canadian Metric Practice Guide*, 1979.

12-1.2.6 IMO Publications. International Maritime Organization, 4 Albert Embankment, London, SEI 7SR, United Kingdom.

IMO A.800(19) Assembly Resolution.

IMO Fire Test Procedures.

IMO FP40/WP.9 Annex 3, *Report of the 40th Session of the Subcommittee on Fire Protection.*

IMO MSC Cir 668, *Maritime Safety Committee Circular.*

SOLAS Regulation 11-2/12.4.1, Consolidated Edition 1992.

12-1.2.7 ULC Publications. Underwriters Laboratories Canada, 7 Crouse Road, Scarborough, ON M1R 3A9.

CAN/ULC S524-M86, *Standard for the Installation of Fire Alarm Systems.*

CAN/ULC S529-M87, *Smoke Detectors for Fire Alarm Systems.*

12-1.2.8 U.S. Government Publication. Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20401.

Title 49, *Code of Federal Regulations.*

Appendix A Explanatory Material

This Appendix is not part of the requirements of this NFPA document but is included for informational purposes only.

A-1-1 Other NFPA standards should be referenced for additional requirements relating to underground or lead-in connections to water mist systems from municipal or private water supplies.

A-1-4.1 Approved. The National Fire Protection Association does not approve, inspect, or certify any installations, procedures, equipment, or materials; nor does it approve or evalu-

ate 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 concerned with product evaluations that is in a position to determine compliance with appropriate standards for the current production of listed items.

A-1-4.1 Authority Having Jurisdiction. The phrase "authority having jurisdiction" is used in NFPA documents in a broad manner, since jurisdictions and approval agencies vary, as do their responsibilities. Where public safety is primary, the authority having jurisdiction may be a federal, state, local, or other regional department or individual such as a fire chief; fire marshal; chief of a fire prevention bureau, labor department, or health department; building official; electrical inspector; or others having statutory authority. For insurance purposes, an insurance inspection department, rating bureau, or other insurance company representative may be the authority having jurisdiction. In many circumstances, the property owner or his or her designated agent assumes the role of the authority having jurisdiction; at government installations, the commanding officer or departmental official may be the authority having jurisdiction.

A-1-4.1 Listed. The means for identifying listed equipment may vary for each organization concerned with product evaluation, some of which do not recognize equipment as listed unless it is also labeled. The authority having jurisdiction should utilize the system employed by the listing organization to identify a listed product.

A-1-4.1 Water Mist. This standard addresses the use of fine water sprays for the efficient control or extinguishment of fires using limited volumes of water. Properly designed water mist systems can be effective on both liquid fuel (Class B) and solid fuel (Class A) fires. Research indicates that droplets smaller than 400 microns are essential for extinguishment of Class B fires, while larger drop sizes are effective for Class A combustibles, which benefit from extinguishment by fuel wetting. For this reason the definition of water mist in this standard includes sprays with $Dv_{0.99}$ of up to 1000 microns.

This standard's definition of "water mist" includes some water sprays used in NFPA 15, *Standard for Water Spray Fixed Systems for Fire Protection*, some sprays produced by standard sprinklers operating at high pressure, as well as light mists suitable for greenhouse misting and HVAC humidification systems. This range is so broad that some important differences in the performance of sprays with finer distributions are not distinguished.

As a means of allowing distinctions to be made between "coarser" and "finer" sprays across the 1000-micron spectrum of this standard's definition of water mist, it is useful to subdivide mist into Class 1, 2, or 3 water mist, according to the drop size distribution. The defining boundaries for the three classifications are illustrated in Figure A-1-4.1.

Class 1 Water Mist. The cumulative percent volume distribution curve lies entirely to the left of a line connecting $Dv_{0.1}$ = 100 microns and $Dv_{0.9}$ = 200 microns. This represents the "finest" water mist. Many commercially available water mist nozzles produce Class 1 mists.

Class 2 Water Mist. A portion of the cumulative percent volume distribution curve lies beyond the limits of a Class 1 spray, but entirely to the left of the line connecting $Dv_{0.1}$ = 200 microns and $Dv_{0.9}$ = 400 microns. Such sprays can be generated by pressure jet nozzles, twin-fluid nozzles, and many impingement nozzles. Due to the presence of larger drops, higher mass flow rates are easier to achieve with Class 2 sprays than with Class 1 sprays. The larger drops are not too large to be effective on liquid fuel fires, however. Considerable surface wetting occurs with sprays in this range, so a Class 2 mist is also likely to be effective on fires involving ordinary combustibles.

Class 3 Water Mist. The $Dv_{0.9}$ is greater than 400 microns, or for which any portion of the curve extends to the right of the Class 2 cut-off line (but the $Dv_{0.99}$ is less than 1000 microns). Such sprays are typically generated by intermediate pressure, small orifice sprinklers, impingement nozzles of various sorts, and fire hose fog-nozzles. High mass flow rates are possible. They are suitable for Class A combustibles, and under some circumstances provide fire control or fire extinguishment for Class B fires.

The relationship between drop size distribution and extinguishing capacity of a water mist is complex. In general, Class 1 and Class 2 sprays are successful at extinguishing liquid fuel pool fires and spray fires without agitation of liquid pool surfaces. Given an appropriate geometry, Class 3 sprays are reported to have extinguished pool fires, however. Also in general, it is difficult to extinguish Class A combustibles with Class 1 sprays, which may not achieve the fuel wetting necessary to penetrate the char layer. However, Class A fires can be extinguished with Class 1 mists, particularly if the velocity is high, the burning is superficial, or enclosure effects enhance the degree of oxygen reduction. This evidence confirms that drop size distribution alone does not determine the ability of a spray to extinguish a given fire. Factors such as fuel properties, enclosure effects, spray flux density, and spray velocity (momentum) are all involved in determining whether a fire will be extinguished.

The drop size distribution of a spray does not uniquely define its suitability for a given application. It is inseparable from the spray direction relative to the fire plume, its velocity and flux density. The "momentum" of an element of spray is the product of its velocity (which includes direction as well as speedrpar; and the mass of dispersed water droplets. Therefore, all three variables, drop size distribution, flux density and momentum, are involved in determining the ability to extinguish a fire in a given scenario. The classification system allows a designer to distinguish between the fine and coarse end of the spectrum of sprays encompassed by the definition.

A-1-5 Applications of Water Mist Systems. Water mist systems have been proven effective in controlling, suppressing, or extinguishing many types of fires. Potential applications include:

(a) Gas jet fires;

(b) Flammable and combustible liquids;

(c) Hazardous solids, including fires involving plastic foam furnishings;

(d) Protection of aircraft occupants from an external pool fire long enough to provide time to escape;

(e) Ordinary (Class A) combustible fires such as paper, wood, and textiles;

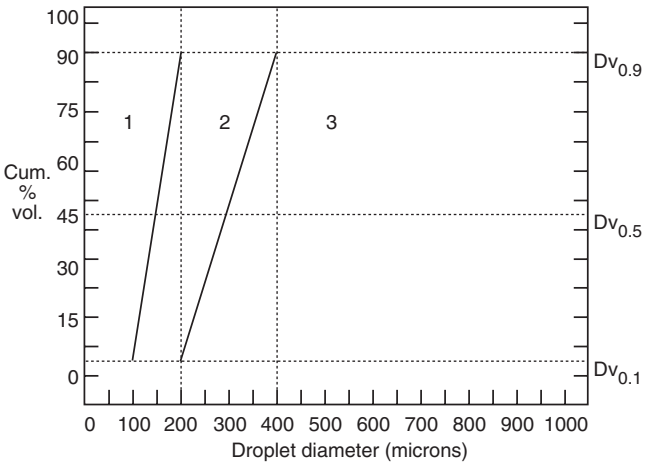

Figure A-1-4.1 Classification of water mist according to drop size distribution.

(f) Electrical hazards, such as transformers, switches, circuit breakers, and rotating equipment; and

(g) Electronic equipment, including telecommunications equipment.

A-1-5.2.2 Water Reactive Materials. In special cases, where adequate safeguards have been provided, water mist systems for the protection of structures, equipment, or personnel in the presence of such materials as described in 1-5.2.2 may be permitted.

A-1-6.1 Water mist is unlikely to present any significant hazard to personnel in most applications; however, direct impingement of the water mist could present an eye hazard. Noise during operation of the water mist systems could be a hazard to hearing. Water mist can reduce visibility and increase the time and difficulty in egress from an affected compartment. Additionally, whipping or swinging of broken piping, tubing, and hoses could be a hazard, particularly for intermediate and high pressure systems.

A-1-6.2.1 Electrical Clearances. All system components should be located so as to maintain minimum clearances from live parts, as shown in Table A-1-6.2.1.

As used in this standard, "clearance" is the air distance between water mist equipment, including piping and nozzles, and unenclosed or uninsulated live electrical components at other than ground potential.

The clearances in Table A-1-6.2.1 are for altitudes of 3300 ft (1000 m). The clearance should be increased at the rate of 1 percent for each 330 ft (100 m) increase in altitude above 3300 ft (1000 m).

A-2-2.2.1 Local building codes specify minimum requirements for seismic restraint or bracing.

A-2-2.2.2 Independent inspection and certification is recommended for gas and water containers.

A-2-3.1 It is important to select pipe or tube for water mist systems that exhibits minimal corrosion because of the potential for the clogging of water mist nozzles.

A-2-3.4.2 Listed flexible connections may be permitted. Flexible connections for water mist installations should be kept as short as possible and should be protected against mechanical injury.

Table A-1-6.2.1 Clearance from Water Mist Equipment Live Uninsulated Electrical Components[1]

Nominal System Voltage (kV)	Maximum System Voltage (kV)	Design BIL[2] (kV)	Minimum Clearance[1] (in.)	(mm)
To 13.8	14.5	110	7	178
23	24.3	150	10	254
34.5	36.5	200	13	330
46	48.5	250	17	432
69	72.5	350	25	635
115	121	550	42	1067
138	145	650	50	1270
161	169	750	58	1473
230	242	900	76	1930
		1050	84	2134
345	362	1050	84	2134
		1300	104	2642
500	550	1500	124	3150
		1800	144	3658
765	800	2050	167	4242

[1]For voltages up to 161 kV, the clearances are taken from NFPA 70, *National Electrical Code*. For voltages 230 kV and above, the clearances are taken from Table 124 of ANSI C2, *National Electrical Safety Code*.
[2]BIL values are expressed as kilovolts (kV), the number being the crest value of the full wave impulse test that the electrical equipment is designed to withstand. For BIL values that are not listed in the table, clearances may be found by interpolation.

A-2-4.1 It is important to select fittings for water mist systems that exhibit minimal corrosion because of the potential for the clogging of water mist nozzles.

A-2-4.2.2 Rubber-gasketed pipe fittings and couplings should not be installed where ambient temperatures can be expected to exceed 150°F (66°C) unless listed for such service. If the manufacturer further limits a given gasket compound, those recommendations should be followed.

A-2-6.1 In recognition of the future value of scientifically based fire protection system engineering or design methods but in consideration of the fact that the present water mist technology base is likely incomplete for general system design purposes, it is recommended that the nozzle-listing agencies collect and report to the manufacturer the following data for possible future use as required listing information:

(a) Cumulative volumetric distribution of water droplets to be measured at the centers on nine 1-ft × 1-ft (0.305-m × 0.305-m) areas projecting outward from the central axis of the nozzle for a total of 3 ft × 3 ft (0.914 m × 0.914 m), in a quadrant, with the plane of the measurements to be oriented perpendicular to the central axis of the nozzle and positioned 39.4 in. (1.0 m) below the nozzle. The measurements are to be made at the minimum- and maximum-rated operating pressures of the nozzle, in accordance with ASTM E 799, *Standard Practice for Determining Data Criteria and Processing for Liquid Drop Size Analysis.*

(b) Water discharge distribution in a plane 3.3 ft (1.0 m) below and perpendicular to the central axis of the nozzle using 1-ft × 1-ft (0.305-m × 0.305-m) collection pans. The water distribution measurements are to be made at the minimum- and maximum-rated operating pressures of the nozzle and over an area sufficient to collect at least 90 percent of the water discharge.

(c) Profile of the nozzle spray envelope encompassing at least 90 percent of the water discharge, measured from the tip of the nozzle and extending over the effective range deter-