WATER MIST SYSTEMS

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1.0 SCOPE

This data sheet contains recommendations related to FM Approved water mist systems, including guidelines for their design, installation, acceptance testing, inspection, and maintenance.

Water mist systems are not a substitute for sprinkler protection unless specifically recommended as primary protection in the appropriate occupancy-or equipment hazard- specific data sheet.

1.1 Hazards

1.1.1 Water Mist System Applications

A water mist system is a special protection system developed for the protection of a specific hazard. There are no generally accepted design criteria for water mist systems; their effectiveness must be proven by fire testing.

Data Sheet 4-0, *Special Protection Systems*, Appendix C, provides a list of hazard- and occupancy-specific data sheets that recommend water mist systems.

1.1.1.1 Primary Protection

Water mist systems are FM Approved for primary protection of the following:

- HC-1 occupancies
- HC-2 occupancies
- HC-3 occupancies
- Data processing equipment rooms
- Below raised floors in data processing equipment rooms
- Ignitable liquid use or storage in cutoff rooms
- Combustion turbine compartments (oil fire hazard, equipment protection)
- Steam turbines in enclosed or unenclosed areas (oil fire hazard, equipment protection/local application)

1.1.1.2 Supplementary Protection

Water mist systems are FM Approved for supplementary protection (i.e., in addition to sprinklers) of the following:

- Chemical exhaust fume hoods
- Continuous wood board presses
- Flight simulators
- Industrial oil cookers
- Indoor transformers
- Machinery in enclosures or unenclosed areas
- Wet benches in cleanrooms

1.1.2 Availability

Water mist systems connected to a water supply that could be exhausted before a fire is extinguished are more susceptible to failure than automatic sprinkler systems or water mist systems fed from a pump drawing water from the public water supply. High-pressure water mist systems are also inherently more complex than automatic sprinkler systems. See FM's Understanding the Hazard (UTH) brochure Special Protection System Reliability (P0379) for information on general deficiencies related to special protection systems.

1.2 Changes

October 2026. Interim revision. The following changes were made:

A. Revised Section 1.1 and Section 2.4 to identify the following:

1. Additional equipment hazards and occupancies suitable for HC-2 and HC-3 water mist protection (See affected data sheets)

2. Ignitable liquid use or storage in cutoff room applications as primary protection

B. Updated Section 2.4.1 (Occupancy Protection) to address:

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1. Conditions for design of water mist systems
2. Water mist systems for ignitable liquid use and storage
3. Using water mist systems in areas adjacent to those being protected by automatic sprinklers

C. Updated Section 2.4.3.1 (Water Mist Nozzles) to address:

1. The clearance between automatic nozzles and incidental storage or low pile storage
2. Inclusion of guidance for skylights and heat vents
3. Nozzle temperature ratings and localized maximum ambient temperatures.

D. Updated Section 2.4.4.7 (Preaction Systems) to include:

1. The use of a double-interlock configuration
2. Confirmation of maximum water delivery time by Acceptance Test
3. Drain connections at the preaction valve to verify proper operation

E. Revised Section 2.5.2 (Pump Systems) to differentiate electrical availability for supplementary water mist system protection.

F. Removed superfluous content from Section 3.0 (Support for Recommendations).

G. Relocated Illustrative Losses to Section 3.8 of the data sheet.

2.0 LOSS PREVENTION RECOMMENDATIONS

2.1 Introduction

2.1.1 Use FM Approved equipment, materials, and services whenever they are applicable. For a list of products and services that are FM Approved, see the *Approval Guide*, an online resource of FM Approvals.

2.1.2 Design and install water mist systems in accordance with the following:

A. The application associated with their listing in the *Approval Guide*

B. The manufacturer's design, installation, operation, and maintenance (DIOM) manual identified as part of the FM Approval by document identification number and revision level

C. The relevant hazard- or occupancy-specific data sheet

D. Any specific jurisdictional requirements

2.1.3 When a component is not identified in the manufacturer's FM Approved design, installation, operation, and maintenance manual, use FM Approved equipment that conforms to the water mist system's specifications (e.g., pressure rating, rate of flow, etc.) and this data sheet.

2.1.4 FM Approved water mist systems may be used in conjunction with independent sprinkler systems to protect occupancy areas for which no applicable water mist system category exists.

2.2 Construction and Location

2.2.1 Provide heating, ventilation, and air conditioning to maintain the operable storage temperature of between 40°F (4°C) and 130°F (54°C) in accordance with the applicable recommendations in Data Sheet 9-18, *Protection Against Freeze-Ups* (see Section 3.2).

2.2.2 When water mist system equipment is installed in a separate, stand-alone enclosure from normal building services, provide backup power or a supervisory alarm in case temperatures fall outside the range specified in 2.2.1.

2.2.3 Locate gas cylinders, water tank assembly, pumps, control/actuating valves, regulating devices, monitoring devices, and control panel in a room separate from the protected area.

2.2.4 Locate all equipment so it is not subject to mechanical, chemical, climatic, or other conditions that can render it inoperative or susceptible to accidental damage or operation.

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2.2.4.1 For water mist systems located in 50-year through 500-year earthquake zones (as defined in Data Sheet 1-2, *Earthquakes*), provide anchoring of equipment in accordance with Data Sheet 2-8, *Earthquake Protection for Water-Based Fire Protection Systems*.

2.2.4.2 Locate gas cylinders so they are not exposed to direct sunlight.

2.2.5 Locate all equipment so it is fully accessible for inspection, testing, maintenance, and removal/replacement.

2.3 Occupancy

2.3.1 Interlocks

2.3.1.1 Provide interlocks to automatically perform critical functions upon operation of the water mist system in accordance with the occupancy-specific data sheet for the protected area or equipment. Examples include, but are not limited to, de-energizing power and fuel supplies, shutting down ventilation, closing doors and dampers, and stopping conveyors feeding combustible material to protected equipment.

2.3.1.2 Establish the timing sequence for actuation of an automatic interlock with discharge of the water mist system in accordance with the applicable hazard- or occupancy-specific data sheets.

2.3.2 System Identification

2.3.2.1 Provide system water and gas containers with nameplates or other permanent markings that indicate their contents (i.e., type of gas), pressurization level, and volume, as applicable.

2.3.2.2 Provide nameplates/instructions in the immediate vicinity of valves, piping, and other critical system components to identify their function, operating positions, and contents (i.e., water or gas).

2.3.2.3 Provide operating instructions that indicate the location and purpose of the actuation controls.

2.3.2.4 Provide signage on the proper shutdown sequence of valves and equipment after the water mist system has activated.

2.4 Protection

2.4.1 Occupancy Protection

2.4.1.1 FM Approved water mist systems for HC-1, HC-2 or HC-3 may be used to provide primary protection of the occupancies shown in Table 2.4.1.1. Use only water mist systems specifically FM Approved to provide adequate protection for the listed hazard category and its associated limitations.

2.4.1.1.1 The designs for HC-1 are intended to provide protection of occupancies with the following construction:

A. Noncombustible or fire rated walls and ceiling, and

B. Noncombustible Class 1 or Class 2 steel roof deck

2.4.1.1.2 The designs for HC-2 and HC-3 are intended to provide protection of occupancies with the following construction (See Data Sheet 1-12, *Ceilings and Concealed Spaces*):

A. Roof:

1. Class 1 steel deck
2. Class 2 steel deck
3. Wood

B. Wall:

1. Class 1 materials

2.4.1.2 These occupancy protection designs are not intended for use under the following conditions:

A. Combustible dust or lint collected on horizontal surfaces within the occupancy (See Data Sheet 7-1, *Fire Protection for Textile Mills*; and Data sheet 7-76, *Combustible Dusts*).

B. Plastic construction elements (See Data Sheet 1-57, *Plastics in Construction*).

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C. Concealed/shielded spaces with combustible construction or content, unless in compliance with 2.4.1.3 (See Data Sheet 1-12, *Ceilings and Concealed Spaces*, or Data Sheet 3-26, *Fire Protection for Nonstorage Occupancies*).

D. Storage or commodity type not in accordance with incidental storage for the hazard category (See Data Sheet 3-26, *Fire Protection for Nonstorage Occupancies*).

E. Incidental and low pile storage or incidental ignitable liquids not in accordance with Data Sheet 3-26.

F. Storage amounts (incidental or greater) of any uncartoned plastic.

G. Areas exposed to outdoor conditions (e.g., wind, temperatures), such as open parking garages.

2.4.1.3 For occupancies with concealed/shielded spaces or mezzanines (grated or solid), provide protection in/below those obstructions if combustible materials are present.

2.4.1.3.1 The ability to provide a water mist system in those areas will depend on the FM Approval listing and the manufacturer's installation limitations for discharge nozzles to provide adequate spray pattern development.

Table 2.4.1.1. Protection of Nonstorage Occupancies with Water Mist Systems

FM Approval Listing Category	*Occupancy*	*Restrictions*	*Associated Data Sheet(s)*
Protection of Non-Storage Occupancies, Hazard Category 1 (HC-1)	HC-1 - Pulp & Paper Industry; tissue embossing folders and log saw booths	Nonmanufacturing areas with ordinary combustibles. - No incidental storage of plastics - No low pile storage - No plastic construction elements Ignitable liquid use or stored in containers not in excess of HC-1 incidental quantities according to Data Sheet 3-26. FM Approved water mist systems for the HC-1 category are only suitable for HC-1 occupancies. - Application of FM Approved water mist systems for HC-1 occupancies is limited to: - wet pipe systems; do not use dry or preaction systems. - maximum ceiling height of 16.4 ft (5 m). - Do not use systems listed for a ″maximum protected area - restricted" to protect areas and ceiling heights greater than specified in the FM Approval listing. - For protection of large or open compartments, use FM Approved water mist systems specifically listed for a ″maximum protected area - unrestricted."	3-26

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Table 2.4.1.1. Protection of Nonstorage Occupancies with Water Mist Systems (continued)

FM Approval Listing Category	*Occupancy*	*Restrictions*	*Associated Data Sheet(s)*
Protection of Non-Storage Occupancies, Hazard Category 2 (HC-2)	HC-2 Protection designated as HC-2 in the specific data sheet	Nonstorage and manufacturing areas with ordinary combustibles, with cartoned plastics and ignitable liquids used or stored not in excess of incidental quantities. No plastic construction elements. No low-pile storage of CUP and CEP. FM Approved water mist systems for the HC-2 category are suitable for HC-2 or HC-1 occupancies. - Application of FM Approved water mist systems for HC-2 occupancies is limited to: - wet pipe systems; do not use dry or preaction systems, except for data centers. - Do not use systems listed to protect areas and ceiling heights greater than specified in the FM Approval listing.	3-26 5-28 5-31 5-32 7-13 7-35 7-50 7-91 7-95 7-110 7-112
Protection of Non-Storage Occupancies, Hazard Category 3 (HC-3)	HC-3 Protection designated as HC-3 in the specific data sheet	Nonstorage and manufacturing areas with ordinary combustibles with cartoned plastics and ignitable liquids not used or stored in excess of incidental quantities. No plastic construction elements. FM Approved water mist systems for the HC-3 category are suitable for HC-3, HC-2, or HC-1 occupancies. - Application of FM Approved water mist systems for HC-3 occupancies is limited to wet pipe systems: - Do not use dry or preaction systems, except for data centers. - Do not use systems listed to protect areas and ceiling heights greater than those specified in the FM Approval listing.	3-26 7-6 7-112
Protection of Data Processing Equipment Room/Halls - Above-floor Protection	Rooms/areas with forced ventilated and propagating cables: - Control rooms- Data center processing equipment rooms/halls - Diagnostic equipment rooms - Process control rooms-Telecommunication rooms	- Not intended to provide equipment protection. - Application of FM Approved water mist systems for data processing equipment rooms/halls is limited to: - wet pipe systems, non-interlock, single or double interlock preaction systems. - maximum ceiling height of 16.4 ft (5 m).	5-32

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Table 2.4.1.1. Protection of Nonstorage Occupancies with Water Mist Systems (continued)

FM Approval Listing Category	*Occupancy*	*Restrictions*	*Associated Data Sheet(s*
Protection of Data Processing Equipment Room/Halls - Below-floor Protection	Concealed areas below raised floors with forced ventilation and propagating cables in: - Control rooms - Data center processing equipment rooms/halls - Diagnostic equipment rooms - Process control rooms - Telecommunication rooms		5-32
Ignitable Liquid Storage Cutoff Room	Cutoff rooms with ignitable liquid use or storage having metal container sizes up to standard intermediate bulk container (IBC). Storage types permitted within the protection include palletized, rack and shelf.	Plastic container size is limited to a maximum of 6.5 gal (25 L) and includes both cartoned and uncartoned.	7-29 7-32

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Table 2.4.2.1. Protection of Equipment with Water Mist Systems

FM Approval Listing Category	*Equipment*	*Restrictions*	*Associated Data Sheet*
Continuous Wood Board Presses	- Continuous wood board press - Industrial ovens	- Adhere to maximum opening size - Interlock forced ventilation for shutdown	7-10
Protection of Combustion or Steam Turbines in Enclosures with Volumes: ≤9175 ft^3 (260 m^3) >9175 ft^3 (260 m^3)	- Enclosures with combustion turbines - Enclosures with steam turbines	- Maximum enclosure volume - Ceiling height - Do not extrapolate the design from a smaller tested enclosure to a larger, untested enclosure. - Provide protection to the enclosure based upon the gross volume. Do not make deductions for the volume occupied by equipment in the enclosure. (See Section 3.3.2.2.) - Maximum un-enclosable opening sizes - Provide protection to doorways and permanent openings based upon the dimensions specified in the FM Approved Design, Installation, Operation and Maintenance manual. - Install nozzles for turbine protection in accordance with the manufacturer's FM Approved design, installation, operation and maintenance manual to prevent the possibility of warping or cracking of the turbine casing due to direct impingement of the water mist on the turbine. - Interlock ventilation for shutdown.	7-79 7-101
Protection of Industrial Oil Cookers	- Industrial oil cookers - Non-insulated conveyorized fryers - Batch kettles	- Maximum width - Vertical nozzle distance from cooking oil surface - Maximum cooking oil depth - Auto-ignition temperature of the cooking oil - Excludes protection of ancillary equipment such as exhaust ducts, heaters, heat exchangers, and food processing areas.	7-20

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Table 2.4.2.1. Protection of Equipment with Water Mist Systems (continued)

FM Approval Listing Category	*Equipment*	*Restrictions*	*Associated Data Sheet*
Protection of Machinery in Enclosures with Volumes: ≤9175 ft^3 (260 m^3) >9175 ft^3 (260 m^3)	Enclosures with: - Internal combustion engines - Engine test cells without forced ventilation - Oil pumps - Oil tanks - Fuel filters - Indoor transformers vaults - Gear boxes - Drive shafts - Lubrication skids - Hydraulic press pits - Similar equipment using liquid hydrocarbon fuel - Hydraulic, heat transfer, and lubrication fluids - Incidental use, storage or release of hydrocarbon ignitable liquids - Pulp & paper industry; tissue embossed folders and log saw booths	- Maximum enclosure volume - Ceiling height - Do not extrapolate the design from a smaller tested enclosure to a larger, untested enclosure. - Provide protection to the enclosure based upon the gross volume. Do not make deductions for the volume occupied by equipment in the enclosure. (See Section 3.3.2.2) - Maximum un-enclosable opening sizes - Provide protection to doorways and permanent openings based upon the dimensions specified in the FM Approved Design, Installation, Operation and Maintenance manual. - Interlock ventilation for shutdown.	5-3 5-4 5-14 5-19 5-23 5-32 7-3 7-25 7-32 7-37 7-88 7-98 13-8
Protection of Wet Benches and Similar Processing Equipment	- Tools with ventilated and unventilated compartments - Spin rinse dryers - Alcohol vapor dryers - Chemical and mechanical polishing tools	- Adhere to minimum and maximum tested vertical distance from the surface	1-56 7-7
Local Application	- Ignitable liquid pool and spray fire hazards in unrestricted or open spaces - Flight simulators -Combustion turbines -Steam turbines	- Limit local application protection to the ignitable liquid configuration(s) (i.e. pool fires, spray fires, and/or channel pool fires) listed as part of the FM Approval. - Limit the application to protection of ignitable liquid fire hazards with equivalent or higher flash points than tested.	7-3 7-79 7-101

2.4.3 Alternative to Sprinklers

2.4.3.1 FM Approved HC-2 or HC-3 water mist systems may be used to provide primary protection with either a 0.2 gpm/ft^2 (8 mm/min) or 0.3 gpm/ft^2 (12 mm/min) application density, respectively as an alternative to sprinklers. This application applies to Data Sheet 5-33, *Lithium-Ion Battery Storage Energy Storage Systems,*

2.4.3.1.1 Provide the water mist system in accordance with the conditions and restrictions identified in the hazard or occupancy specific data sheet.

2.4.3.1.2 These designs are not intended for occupancies or equipment hazards with the conditions identified in Section 2.4.1.2.

2.4.3.2 Use only water mist systems specifically FM Approved for either HC-2 or HC-3 to provide adequate protection with their listings and associated limitations.

2.4.3.3 Provide a reduced area of coverage and nozzle spacing in accordance with the DIOM manual for either an actual delivered 0.2 gpm/ft^2 (8 mm/min) or 0.3 gpm/ft^2 (12 mm/min) application density.

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2.4.4 Design of Water Mist Systems

2.4.4.1 Water Mist Nozzles

2.4.4.1.1 Design FM Approved water mist nozzle(s) in accordance with the limitations of their FM Approval listing and the manufacturer's DIOM manual for the system. Limitations include the following:

A. The number of water mist nozzles based on to the equipment hazard or occupancy being protected

B. Maximum enclosure volume

C. Maximum height specification of the protected enclosure or hazard

D. Maximum nozzle area of coverage

E. Proper nozzle orientation (e.g., pendent or upright)

F. Nozzle spacing including distance from walls and each other

G. Nozzle distance from the ceiling

H. Nozzle location relative to obstructions (see Section 2.4.4.1.3)

I. Nozzles below skylights and heat vents (see Section 2.4.4.1.4)

J. When used in corrosive atmospheres, use nozzles of corrosion-resistant materials or coatings suitable for the application

2.4.4.1.2 Design FM Approved water mist systems in accordance with the parameters and limitations specified in the relevant occupancy- or hazard- specific data sheet.

2.4.4.1.3 Obstructions

2.4.4.1.3.1 When obstructions are present, evaluate the installation of water mist nozzle(s) to verify they are in accordance with the manufacturer's specifications for the following:

- Position
- Clearance
- Maximum allowable percentage of discharge pattern disruption from an obstruction

2.4.4.1.3.2 Provide additional water mist nozzles or adjust placement of water mist nozzles in accordance with the manufacturer's FM Approved design, installation, operation, and maintenance manual when there are obstructions that affect their performance in the distribution of the water mist.

2.4.4.1.3.3 When available, use the manufacturer's calculation method to determine the maximum obstruction percentage of the discharge pattern.

2.4.4.1.4 Skylights and Heat Vents

2.4.4.1.4.1 Install ceiling-level water mist nozzles below skylights, whether glass or plastic, in the same manner as installing under a noncombustible ceiling.

2.4.4.1.4.2 If the skylight is equipped with either a gravity heat/smoke vent or is elevated above the adjacent ceiling area, install water mist nozzles in accordance the applicable recommendations for "Skylights in the Presence of Nonstorage Sprinklers" of Data Sheet 2-0, *Installation Guidelines for Automatic Sprinklers*.

2.4.4.1.5 Incidental and Low Piled Storage or Ignitable Liquids

2.4.4.1.5.1 Design FM Approved water mist systems for protection of incidental and low piled cartoned storage with a maximum ceiling height in accordance with the FM Approval listing and Data Sheet 3-26, *Fire Protection for Nonstorage Occupancies*.

2.4.4.1.5.2 Design FM Approved water mist systems for protection of ignitable liquids with a maximum ceiling height in accordance with the FM Approval listing and Data Sheet 3-26, *Fire Protection for Nonstorage Occupancies*.

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2.4.4.1.5.3 Provide a minimum of 6 ft (1.8 m) clearance between the HC-2 or HC-3 nozzle and the incidental storage commodity.

2.4.4.1.6 Automatic Nozzles

2.4.4.1.6.1 Provide automatic nozzles with a temperature rating as identified in the relevant FM Approval listing category for the occupancy or hazard.

2.4.4.1.6.2 When automatic nozzles are used for the protection of a given occupancy, provide ordinary temperature rated nozzles where the maximum ceiling temperature throughout does not exceed 100°F (38°C).

2.4.4.1.6.3 Where the maximum ambient ceiling temperature (e.g. unventilated areas such as attics) throughout will exceed 100°F (38°C) use intermediate-temperature rated nozzles.

2.4.4.1.6.4 See Table 2.4.4.1.6.4 for the recommended temperature rating of the automatic nozzle based on the expected ambient temperature at nozzle level.

Table 2.4.4.1.6.4. Nominal Temperature Ratings of Automatic Nozzles Based on Maximum Ambient Temperature at Nozzle Level

Maximum Ambient Temperature at Nozzle Level, °F (°C)	*Nominal Temperature Rating of Nozzle, °F (°C)*	*Temperature Classification of Nozzle*	*Color of Automatic Nozzle Glass Bulb*
100 (38)	135 (57)	Ordinary	Orange
100 (38)	155 (68)	Ordinary	Red
150 (66)	175 (79)	Intermediate	Yellow
150 (66)	200 (93)	Intermediate	Green

2.4.4.1.6.5 When localized maximum ambient ceiling temperature (e.g., skylights or hot surfaces such as exhaust pipes or steam pipes) will exceed 100°F (38°C) and an automatic nozzle is to be placed within 10 ft (3 m) of the object, provide high-temperature-rated nozzles in accordance with Table 2.4.4.1.6.5.

Table 2.4.4.1.6.5. Nominal Temperature Ratings of Automatic Nozzles Based on Localized Maximum Ambient Temperature at Nozzle Level

Localized Maximum Ambient Temperature at Nozzle Level, °F (°C)	*Nominal Temperature Rating of Nozzle, °F (°C)*	*Temperature Classification of Nozzle*	*Color of Automatic Nozzle Glass Bulb*
225 (110)	286 (141)	High	Blue
300 (150)	360 (182)	Extra High	Mauve
375 (190)	425 (220)	Very Extra High	Black
475 (245)	525 (275)	Ultra High	Black
625 (330)	650 (343)	Ultra High	Black

2.4.4.1.6.6 Do not mix automatic nozzles having different nominal temperature ratings or response time index (RTI) values protecting the same hazard area, unless a localized maximum ambient ceiling temperature condition exists as identified in Table 2.4.4.1.6.5.

2.4.4.1.7 Open Nozzles

2.4.4.1.7.1 If open nozzles are exposed to vapor or fumes that could cause clogging (e.g., cooking oil vapor) or internal corrosion to the discharge piping, provide frangible disks, blow-off caps, or other suitable devices that are specifically FM Approved as a component of the system.

2.4.4.2 Discharge Duration

2.4.4.2.1 Provide a water supply and gas supply, if applicable, to meet the minimum discharge duration specified in the applicable occupancy or hazard-specific data sheet.

2.4.3.3 Water and Gas Quantity

2.4.4.3.1 Provide a water supply and, if applicable, a gas supply, to meet the following:

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- The number of nozzles in accordance with the applicable occupancy or hazard-specific data sheet and/or the FM Approved DIOM manual
- Discharge duration per the applicable occupancy or hazard-specific data sheet
  Hydraulic demand per Section 2.4.4.6

2.4.4.3.2 When a single system is protecting multiple hazards with selector valves, provide a water and gas supply for the largest single hazard or group of hazards to be protected simultaneously.

2.4.4.3.3 When main and reserve systems are used with a limited supply of gas and/or water, include in the water quantity calculation the lengths of water supply pipe from the valves in the manifold to the tee that joins the distribution piping.

2.4.4.4 Connected Reserve

2.4.4.4.1 If the water mist system has a limited supply of gas and/or water, provide a connected reserve supply equivalent to the in-service supply if any of the following conditions exist:

A. The system is protecting two or more hazards using a single supply through selector valves.

B. The system cannot be restored to service within 24 hours from an outside source.

C. The system provides primary protection for valuable or important assets of an occupancy, unless all of the following criteria are met:

1. Protection can be fully restored within 24 hours.
2. The occupancy is constantly attended.
3. Written impairment procedures have been established

2.4.4.4.2 Design the reserve supply as follows:

A. Provide a manually actuated switchover arrangement to activate the main or reserve supply (e.g., a manually actuated main/reserve switch at the control panel).

B. Provide a check valve or similar device to segregate the connected reserve supply from the pressure of the main water mist system. Install the check valve or device with the arrow pointing in the direction of flow.

C. Provide a manifold vent plug and safety burst disc or pressure relief in each manifold section segregated by a check valve.

D. Provide reserve and main water supply piping so the waterflow and pressure at the most remote nozzle remain within the operating pressure range specified in the FM Approved design, installation, operation, and maintenance manual.

E. Provide the connected reserve circuit to the fire alarm control panel for operation of all accessory equipment in the same manner as with the main supply.

2.4.4.5 System Distribution Arrangements

2.4.4.5.1 The water mist system distribution arrangement of an automatic and open nozzle system can be a single-path flow (e.g., tree) or loop.

2.4.4.5.2 Do not use a gridded piping arrangement for preaction water mist systems.

2.4.4.6 Hydraulic Design

2.4.4.6.1 Calculate waterflow and nozzle pressure at the most remote nozzle to be within the operating pressure range specified in the FM Approved design, installation, operation, and maintenance manual for the given application.

2.4.4.6.2 For pre-engineered systems, limit the pipe lengths and number of fittings in the distribution system to that specified in the FM Approved design, installation, operation, and maintenance manual.

2.4.4.6.3 For an engineered water mist system with a software program, use the version of the hydraulic flow calculation program identified in the FM Approval listing.

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2.4.4.6.4 For engineered systems without a software program, hydraulically design and calculate the system in accordance with the FM Approved design, installation, operation, and maintenance manual.

2.4.4.6.5 For twin fluid water mist systems, hydraulically design and calculate the water and pneumatic distribution system in accordance with the FM Approved design, installation, operation, and maintenance manual to maintain the specified nozzle gas pressure and flow, as well as appropriate gas/water ratios.

2.4.4.6.6 In calculations, include the friction loss or equivalent lengths for valves, check valves, selector valves, strainers, cylinder manifolds, and other devices in the distribution system to determine the water flow and nozzle pressure.

2.4.4.7 Preaction Systems

2.4.4.7.1 For preaction systems, design:

A. Non-interlock or single interlock systems as a wet pipe distribution arrangement

B. Double interlock systems as a dry pipe distribution arrangement

2.4.4.7.2 Calculate or confirm by acceptance test the maximum water delivery time to the limit specified in the Approval Guide listing or occupancy-specific data sheet, whichever is shorter.

2.4.4.7.3 Provide water mist systems in a preaction configuration only for those category classifications identified as part of the FM Approval listing with a “Maximum Water Delivery Delay.” See section 3.4.4.6 for additional information.

2.4.4.7.4 For preaction water mist systems protecting a data processing equipment room, battery room or switch gear room for a data center with a non-interlock, single interlock or double interlock preaction configuration, the installation is acceptable if all of the following are true:

- The requirements of the FM Approved Design, Installation, Operation, and Maintenance manual are met.
- The detection system is not cross-zoned between detectors.
- The 30-second water delivery time is met in the Acceptance Test.

2.4.4.7.5 Install a drain valve at the preaction valve riser for each water mist system.

2.4.4.7.5.1 Arrange the drain valve so it is accessible for operation, testing and maintenance purposes.

2.4.4.7.5.2 Provide each drain valve with an identification tag that indicates the function of the valve.

2.4.4.7.6 Install an inspector’s test connection in accordance with Section 2.5.7.2.

2.5 Equipment and Processes

When a component is not identified in the manufacturer’s FM Approved design, installation, operation, and maintenance manual, use FM Approved equipment that conforms to the water mist system’s specifications (e.g., pressure rating, rate of flow, etc.) and this data sheet.

Install only new system components. Do not use repurposed equipment for installation in the water mist system.

Schematics of typical low-pressure and high-pressure water mist systems are included in Section 3.5 as Figure 3.5.1 and Figure 3.5.2, respectively.

2.5.1 Water Supply

2.5.1.1 Provide a water supply with adequate flowrate and pressure per the applicable FM Property Loss Prevention Data Sheet, the *Approval Guide* listing, and the FM Approved manufacturer’s design, installation, operation, and maintenance (DIOM) manual.

2.5.1.2 Provide one of the following water supplies as specified in the manufacturer’s FM Approved DIOM manual for the type of water mist system:

A. Connection to a public water main, with automatic fire pump as necessary

B. Atmospheric covered tank, with automatic fire pump as necessary

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C. Low-pressure water storage tank with high-pressure gas cylinder systems, or high-pressure water storage cylinders with high-pressure gas cylinder systems

2.5.1.2.1 The use of the same water supply for low pressure water mist and sprinkler systems is acceptable.

2.5.1.3 Provide a water supply source of a quality in accordance with the FM Approved manufacturer's DIOM manual specification for particulate, corrosivity, and dissolved solids.

2.5.1.4 Do not use recycled water, process water, grey water, or any open body of water (e.g., pond), or uncovered tank.

2.5.1.6 Check Valves and Backflow Preventers

2.5.1.6.1 Install an FM Approved backflow preventer(s) or check valve(s) between the distribution system and connection to the water supply.

2.5.1.6.2 For twin fluid systems, install FM Approved check valves in the main feed lines, near the control valves of both the water and gas system piping to prevent the backflow of water or atomizing gas into the companion piping.

2.5.1.7 Strainers and Filters

2.5.1.7.1 Provide an FM Approved strainer(s) or filter(s) in the water supply piping.

2.5.1.7.1.1 Locate the strainer(s) and filter(s) in an area accessible for cleaning or flushing.

2.5.1.7.2 Provide strainer(s) with a blow down/off valve connection or similar outlet connection to enable cleaning (flushing) while maintaining system discharge during an emergency.

2.5.1.7.3 Provide the strainer corrosion resistant material compatible to the piping and fittings.

2.5.1.8 Fire Service Connection

2.5.1.8.1 Install a fire service connection for each water mist system providing occupancy protection.

2.5.1.8.2 Do not provide fire service connections for design pressures supplied by storage cylinders or for twin fluid systems.

2.5.1.8.3 For water mist systems with a design pressure less than or equal to 175 psi (12 bar), provide a fire service connection to the system on the downstream (discharge) side of the pump. (See Figure 2.5.1.8.3)

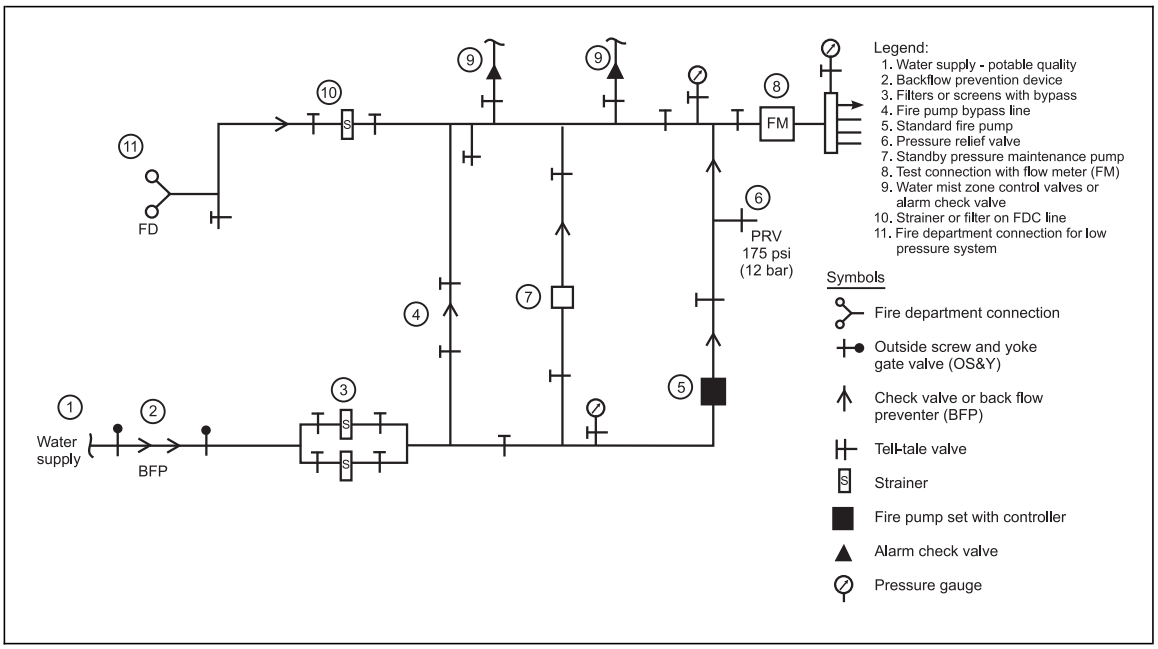


Fig. 2.5.1.8.3. Typical low-pressure water mist system fire department connection

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2.5.1.8.4 For water mist systems with a design pressure in excess of 175 psi (12 bar), provide a fire service connection on the upstream (suction) side of the pump. (See Figure 2.5.1.8.4)

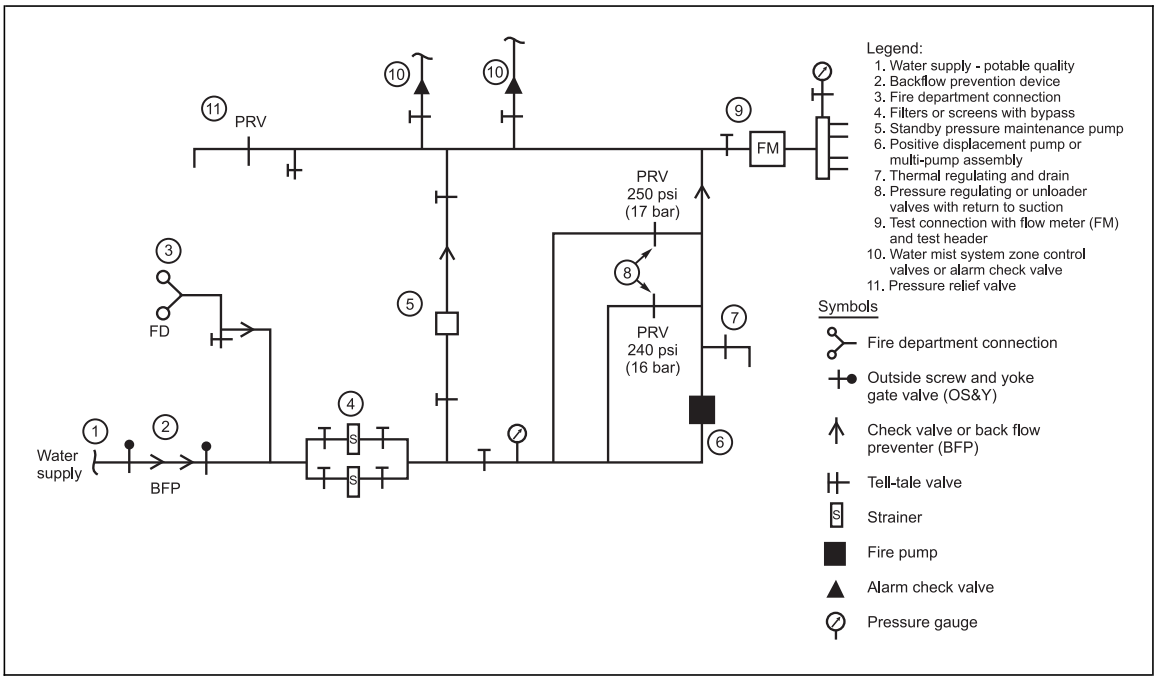


Fig. 2.5.1.8.4. Typical high-pressure water mist system fire department connection

2.5.1.8.5 Install the fire service connection as follows:

A. Along an exterior wall (or equivalent) near the water mist system it is intended to supply.

B. With fittings and internal connections that are compatible with those of the local fire service.

C. With an identification placard that identifies the water mist system the fire service connection supplies.

2.5.2 Pump Systems

2.5.2.1 For low-pressure water mist systems, provide one of the following:

A. A pump that is listed as a component in the water mist system manufacturer's FM Approved design, installation, operation, and maintenance manual.

B. An FM Approved fire pump that meets the demand requirements of the water mist system determined by hydraulics calculations as described in the manufacturer's FM Approved design, installation, operation, and maintenance manual.

2.5.2.2 For high-pressure water mist systems, provide a pump that is listed as a component in the water mist system manufacturer's FM Approved design, installation, operation, and maintenance manual.

2.5.2.3 Provide pump systems (electrical power, water supply arrangement, suction piping, etc.) for primary protection (see Section 1.1.1.1) per the water mist system manufacturer's design, installation, operation, and maintenance manual; and Data Sheets 3-7, *Fire Protection Pumps*, and 3-10, *Private Fire Service Mains and Connections*.

2.5.2.3.1 In addition to the recommendations in Data Sheet 3-7, *Fire Protection Pumps*, provide pump capacity to exceed the system flow rate and pressure demands as determined from hydraulic calculations by a minimum of 10% for both flow and pressure.

2.5.2.3.2 For water mist systems providing only supplementary protection (See Section 1.1.1.2), connecting the fire pump controller feeder circuit ahead of all other facility wid power loads as recommended in Data Sheet 3-7, *Fire Protection Pumps*, is not necessary.

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2.5.2.3.2.1 Provide an independent feeder circuit to the water mist system fire pump (see Section 3.5.2).

2.5.2.3.2.2 Identify the fire pump feeder circuit to prevent isolation of power to the fire protection pump prior to arrival of the fire service.

2.5.2.3.3 Provide FM Approved fire pump controllers compatible with the fire pump and motor.

2.5.2.4 For water mist systems with pumps driven by compressed gas, provide the pumps and compressed gas supply in accordance with the water mist system manufacturer's FM Approved design, installation, operation, and maintenance manual.

2.5.2.5 For twin fluid water mist systems, provide the pump in accordance with Sections 2.5.2.2 and 2.5.2.3 and the compressed gas supply in accordance with the water mist system manufacturer's FM Approved design, installation, operation, and maintenance manual.

2.5.3 Water Storage Tank Systems

2.5.3.1 Water Storage Pressurized Tank System

2.5.3.1.1 Provide devices (e.g., sight glass, liquid level indicator, pressure gauge, pressure transducer) to identify and supervise the water storage container for water level and pressure, respectively. It is unnecessary to provide supervision of pressure for water storage containers that only become pressurized during system activation.

2.5.3.1.2 Provide a safety relief device with the water supply storage container to prevent exceeding the design pressure of the container.

2.5.3.1.3 When flexible hoses are used, provide connection or manifold hoses that are FM Approved as a component of the water mist system for connection to the distribution system.

2.5.3.1.4 When multiple water tanks are used, provide an automatic closure device (e.g., check valve) installed in the correct direction of flow to prevent leakage from the manifold when the tank is removed.

2.5.3.2 Atmospheric Water Tanks

2.5.3.2.1 If an atmospheric water tank (e.g., reservoir, break water) is used, install it in accordance with Data Sheet 3-2, *Water Tanks for Fire Protection*.

2.5.3.3 Water Storage Container Valves

2.5.3.3.1 Secure the water fill valve and provide a cap plug to the valve outlet used to fill the water supply storage container.

2.5.4 Gas Supply

2.5.4.1 Gas Supply Cylinders

2.5.4.1.1 Provide a device (e.g., pressure gauge, pressure transducer) to identify the pressure in the gas supply cylinder or manifold.

2.5.4.1.2 Provide a device to supervise for pressure below the operable pressure of the water mist system.

2.5.4.2 Manifolded Gas Cylinders

2.5.4.2.1 Use gas cylinders of the equivalent size and interchangeability unless specifically FM Approved otherwise.

2.5.4.2.2 Provide an automatic closure device (e.g., check valve) installed in the correct direction of flow to prevent leakage from the manifold when a gas cylinder is removed.

2.5.4.2.3 Use manifold hoses that are FM Approved as a component of the water mist system to provide connection from the high-pressure gas cylinder to the manifold.

2.5.4.2.4 Provide a manifold vent plug and/or pressure safety relief on the manifold where the valve arrangement introduces the section of closed piping.

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2.5.4.2.5 If a master refill connection is used on the gas manifold, provide a check valve on the connection used to refill gas cylinders.

2.5.4.3 Preaction Systems

2.5.4.3.1 Provide dry air, inert gas, or a gas that is specifically a component of the FM Approved water mist system.

2.5.4.3.2 Provide the gas to the distribution system from a reliable gas supply. (See Appendix A for the definition of a reliable gas supply.)

2.5.4.3.3 Provide a pressure-relief valve arranged in accordance with the manufacturer's FM Approved design, installation, operation, and maintenance manual.

2.5.5 Pressure Safety Devices

2.5.5.1 Pressure Safety Relief Valve (Water)

2.5.5.1.1 Avoid the use of pressure-relief valves whenever possible by using the proper system design techniques to ensure the system will not experience excess pressure.

2.5.5.1.2 When the working pressure will exceed the design or component pressure, provide all pumps and any portion of the system with a pressure-relief valve in accordance with the manufacturer's FM Approved design, installation, operation, and maintenance manual and the applicable sections of Data Sheet 3-7, *Fire Protection Pumps*.

2.5.5.2 Pressure Unloader Valve (Water)

2.5.5.2.1 If the pump output has the potential to exceed the system flow requirements or is a positive displacement pump, provide a pressure unloader valve in accordance with the manufacturer's FM Approved design, installation, operation, and maintenance manual and Data Sheet 3-7, *Fire Protection Pumps*.

2.5.5.2.2 When an unloader valve is installed, provide a pressure-relief valve as identified in 2.5.5.1.

2.5.6 Valves

2.5.6.1 Provide indicating-type control valves (e.g., isolation valves) on connections to water supplies of the indicating type.

2.5.6.2 Secure valves (e.g., control valves and isolation valves) on connections to water supplies for normal operation in accordance with Data Sheet 2-81, *Fire Protection System Inspection*.

2.5.6.3 When electrical supervision of isolation valves is used, provide supervision to identify a "trouble/fault" in the abnormal position at the fire alarm control unit.

2.5.6.4 Ensure all valve types are:

A. installed in the proper orientation and direction of flow.

B. accessible for operation, inspection and maintenance.

C. protected from damage that would prevent their operation.

2.5.6.5 When selector valves are used for multi-hazard zone protection, do the following:

A. Provide an actuation device (e.g., electrical solenoid, pneumatic actuator) compatible with the automatic release module from the fire alarm control unit. Confirm the number, type, and electrical specifications for operation in accordance with the manufacturer's FM Approved design, installation, operation, and maintenance manual.

B. Identify the zone or area being protected by the selector valve.

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2.5.7 Test Connections

2.5.7.1 General

2.5.7.1.1 Provide discharge piping for the test connection of pumps in accordance with Data Sheet 3-7, *Fire Protection Pumps*.

2.5.7.2 Automatic Nozzle Systems

2.5.7.2.1 For automatic nozzle systems, provide an inspector's test connection using an orifice equal to the smallest K-factor nozzles installed on the water mist system.

2.5.7.2.2 Install the inspector's test connection downstream of each water mist system zone that is equipped with a waterflow alarm device.

2.5.7.2.3 Arrange the inspector's test connection piping from the water supply or water supply and gas connections to a drain area capable drain area of handling the maximum anticipated discharge.

2.5.7.2.4 Install an inspector's test connection for a preaction configuration at the hydraulically most remote part of the water mist system.

2.5.7.2.4.1 Provide each inspector's test connection with an identification tag which indicates the function of the valve and system being tested.

2.5.7.3 Open Nozzle Systems

2.5.7.3.1 For open nozzle systems when discharge testing cannot be conducted for acceptance testing and inspection, testing, and maintenance, provide a metering device(s) (e.g., orifice plate) or nozzle(s) on the test connection downstream of the flow meter to produce an equivalent pressure loss (K-factor of the system) for the number of water mist nozzles and piping on each zone the water mist system

A. Size the test connection piping to accommodate the design flow of either (a) the pressurized water, or (b) the pressurized water and gas.

B. Install the test connection in the discharge piping downstream of the water supply pump, water supply containers, or water supply container and gas supply. See Figure 2.5.1.8.3 (low pressure) and Figure 2.5.1.8.4 (high pressure) for a schematic of a typical configuration.

C. Provide isolation valves for each discharge outlet of the water supply and gas, as applicable, and on the test connection piping with valve supervision and valve securement in accordance with Data Sheet 2-81.

2.5.7.3.2 Arrange the test connection(s) piping from the water supply or water supply and gas connections to a drain area capable drain area of handling the maximum anticipated discharge.

2.5.8 Distribution System

2.5.8.1 When water mist systems are installed in 50-year through 500-year earthquake zones (as defined in Data Sheet 1-2, *Earthquakes*), install pipe connections, support, and bracing (metallic and non-metallic, such as CPVC pipe) in accordance with Data Sheet 2-8, *Earthquake Protection for Water-Based Fire Protection Systems*.

2.5.8.2 Provide an FM Approved pressure-relief devices as a component of the water mist system to vent closed sections of pipe from pressure beyond its strength rating. Locate pressure-relief devices on the piping so discharge will not pose a hazard to equipment or personnel.

2.5.8.3 Internally clean pipe or tube sections to be free of particulate matter and oil residue before assembly. Clean in accordance with the instructions from the manufacturer's FM Approved design, installation, operation, and maintenance manual.

2.5.8.4 When threaded pipe is used and specified by the manufacturer, provide joint compound, tape, or thread locker only to the pipe threads.

2.5.8.5 Use the appropriate installation equipment for connecting couplings, joints, and fittings or bending of tube and pipe as follows:

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A. As rated for the diameter and material of construction in accordance with the manufacturer's FM Approved design, installation, operation, and maintenance manual.

B. For pipe and tube ¾ in. (20 mm) and smaller, use hand bench or power bending tools with the correct radius dies.

C. For pipe and tube larger than ¾ in. (20 mm), use only power bending tools with the correct radius dies.

2.5.8.6 Water Supply

2.5.8.6.1 Provide drawn or seamless copper, stainless steel, or FM Approved CPVC pipe for the water distribution system in accordance with the manufacturer's FM Approved design, installation, operation, and maintenance manual for the working pressure of the system.

2.5.8.6.2 When CPVC pipe is used for low-pressure water mist systems, verify it is FM Approved and install it as follows:

A. Use only with a wet-pipe water mist system.

B. Use only with nonstorage occupancy hazards when the CPVC pipe is shielded from the fire area by a non-removeable barrier having a fire rating equal to or greater than 1 hour.

C. Use with compatible water mist system components in accordance with the FM Approved manufacturer's design, installation, operation, and maintenance manual.

D. Use compatible FM Approved adhesives for joint connections.

E. Verify that incompatible chemicals (e.g., organic fluid, pipe-cutting oil, adhesive, paint, antifreeze) do not come in contact with CPVC pipe. Consult the manufacturer of the installed CPVC for a list of incompatible products.

2.5.8.6.3 Do not use any of the following materials for the water distribution system (see Section 3.5.8):

- Galvanized pipe or fittings (see Section 3.5.8.4)
- Aluminum tubing or fittings
- Cast-iron pipe or fittings
- Polymer coated steel pipe or fittings (see Section 3.5.8.4)
- Combustible material pipe or fittings (FM Approved CPVC pipe is acceptable; see Section 2.5.8.6.2)
- CPVC pipe or fittings, when unshielded from the fire area
- Other materials that are not corrosion-resistant

2.5.8.6.4 For low-pressure systems, use fittings as follows:

A. Provide screw unions only on pipe less than 2 in. (51 mm).

B. Provide a one-piece reducing fitting wherever a change is made in the pipe diameter size.

C. An FM Approved standard ductile iron grooved coupling with elastomer gasket as a seal to the joint is permissible with A-312 stainless steel pipe. Installation is limited to an ambient temperatures not to exceed 150°F (66°C) or the temperature designated in the listing by FM Approvals.

2.5.8.6.5 For high-pressure systems, use fittings as follows:

A. Flared, compression-type, or brazed fittings that are compatible with the tubing and pressure rating.

B. When changing direction by bending Type K or Type L copper or stainless steel tube, create the bending radius in accordance the manufacturer's FM Approved design, installation, operation, and maintenance manual.

2.5.8.6.6 When piping is dry in the standby condition (e.g., open nozzle systems) provide the following:

A. Install flushing and drainage valves/connections.

B. A means of draining and a minimum pitch towards the drain of 1/4 in. (6 mm) per 10 ft (3 m).

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C. Install a weldolet downstream of the test connection isolation valve or alarm valve for determining if water mist nozzles are clogged. Plug the weldolet when it is not being used for inspection and testing.

2.5.8.6.7 In piping with dissimilar metals, insulate with dielectric components to reduce the possibility of galvanic corrosion.

2.5.8.7 Gas Supply

2.5.8.7.1 Provide gas piping and tubing, fittings for Schedule and Grade as specified in the manufacturer's FM Approved design, installation, operation and maintenance manual for the working pressure of the gas supply.

2.5.8.8 Hydraulic/Pneumatic Actuation Supply

2.5.8.8.1 Provide actuation supply piping and tubing, fittings, braided stainless steel hose(s) to the gas or water supply as specified in the manufacturer's FM Approved design, installation, operation, and maintenance manual for the working pressure of the actuation supply.

2.5.8.9 Piping Support

2.5.8.9.1 For any low-pressure distribution system with metallic or CPVC pipe, mount and space FM Approved pipe supports (hangers) in accordance the applicable recommendations with Data Sheet 2-0, *Installation Guidelines for Automatic Sprinklers*, and as specified in the manufacturer's FM Approved design, installation, operation, and maintenance manual.

2.5.8.9.2 For any high-pressure distribution system, provide pipe supports (hangers) as follows:

A. Design hangers in accordance with one of the following, in order of preference:

1. ANSI/B31.1, *Power Piping Code*
2. ANSI/MSS SP58, *Pipe Hangers and Supports: Materials, Design, Manufacturer, Selection, Application and Installation*
3. The equivalent national code or standard

B. Install the hangers in accordance with the spacing in Table 2.5.8.9.2 or the FM Approved design, installation, operation, and maintenance manual

Table 2.5.8.9.2. Spacing of Hanger Supports for High-Pressure Systems

Outside Diameter of Tubing		*Maximum Distance Between Hangers*	
in.	mm	ft	m
¼, 3/8, ½	6-14	4	1.2
¾ - 7/8	15-22	5	1.5
1	23-28	6	1.8
1 ¼ - 1 ½	30-38	7	2.0
	40-49	8	2.4
	50-59	10	3.0
	60-70	11	3.4
	71-89	12	3.7
	90-108	13	4.0

2.5.8.9.3 Provide pipe hangers so the length of unsupported pipe to a water mist nozzle does not exceed:

- 2 ft (0.6 m) for steel pipe
- 1 ft (0.3 m) for steel tubing

2.5.8.9.4 If galvanized clamps or supports are used with stainless steel pipes, provide galvanic isolation from the pipe by elastomeric elements, coating or similar isolation methods.

2.5.8.10 Distribution System Cleaning and Flushing

2.5.8.10.1 When appropriate, flush connections from municipal or private water supplies. Continue flushing for a sufficient time to ensure thorough cleaning.

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2.5.8.10.2 Verify atmospheric containers or break tanks are clean prior to installation to prevent debris and other impurities from entering the distribution system and potentially plugging the water mist nozzles.

2.5.8.10.3 Verify each pipe or tube section in the distribution system is internally cleaned after preparation and before assembly in accordance with standard piping practices or the manufacturer's instructions.

2.5.8.10.4 After installation of the distribution piping and before installation of the water mist nozzles:

A. Flush the water distribution piping using the system's normal water supply.

B. Continue flushing for a time sufficient to ensure thorough cleaning, allowing the water to run clear.

C. After flushing, reopen the valve connections to their normal operating position.

2.5.8.10.5 If complete flushing of the water distribution piping cannot be accomplished, do one of the following, in order of preference:

A. Install plugs at water mist nozzle connections and flush the system at the flushing connection and remote inspector's test connection. Following flushing, remove all plugs and ensure there is no debris prior to the installation of the water mist nozzles.

B. Pneumatically purge the water and inert gas piping from a weldolet installed on the riser downstream of the manifold isolation valve as a test connection.

2.5.8.11 Pressure Test of Distribution Piping

2.5.8.11.1 Use test blanks for the pressure tests in lieu of the water mist nozzles. Verify the test blanks are:

- painted/colored to clearly indicate their presence
- numbered to account for the number of test blanks used

2.5.8.11.2 Use a documentation method to ensure the removal of the test blank and installation of the water mist nozzles after the test is complete.

2.5.8.11.3 Verify all water distribution piping has been hydrostatically tested as follows (see Section 3.5.4):

A. Low-pressure systems

1. Use a test pressure of 200 psi (13.8 bar) or 50 psi (3.4 bar) in excess of the maximum static pressure where the maximum static pressure exceeds 150 psi (10.3 bar).

2. Maintain the hydrostatic test pressure without a drop in gauge pressure or visual leakage for 2 hours.

B. High-pressure systems

1. Use a test pressure 1.5 times the working pressure for 10 minutes, followed by 110 minutes at the working pressure.

2. Maintain the hydrostatic pressure without a drop in gauge pressure or visible leakage.

2.5.8.11.4 Verify all gas distribution piping for twin fluid systems and preaction systems has been pneumatically tested as follows:

A. Use a test pressure of 40 psi (2.8 bar).

B. Maintain the pneumatic test pressure without a drop in gauge pressure of 1.5 psi (0.1 bar) or visual leakage for:

- 2 hours for twin fluid systems
- 24 hours for preaction systems

2.5.9 Actuation and Control

2.5.9.1 General

2.5.9.1.1 For water mist systems actuated from electrical detection devices, provide FM Approved detection, initiating device(s), and fire alarm systems that are compatible with the water mist system.

2.5.9.1.2 When protecting hazardous location areas, ensure electric detection equipment and any auxiliary equipment has been specifically designed and rated for such areas.

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2.5.9.2 System Initiation

2.5.9.2.1 For water mist systems actuated by electrical detection devices, provide both of the following:

A. Manual release device from at least one remote location

B. Emergency manual mechanical release device

2.5.9.2.2 Use an FM Approved electrical, mechanical, or pneumatic manual release device that is a component of, or compatible with, the water mist system. If operation of the manual release device is electrical, provide the following:

A. A reliable primary source of power

B. Automatic transfer to a source of backup power with a minimum of 24 hours standby energy.

2.5.9.2.3 Provide a manual release device(s) and emergency mechanical release device that:

A. is clearly marked.

B. is secure from unauthorized operation.

C. clearly identifies each hazard being protected.

D. is mounted 42 in. (1.1 m) above the finished floor.

E. is in a location that is accessible at all times.

F. results in operation of all associated interlocks with the system discharge.

2.5.9.2.4 For emergency manual mechanical release operation, provide a discharge pressure switch or a flow switch to provide an alarm-initiating signal to the fire alarm control unit.

2.5.9.3 Control/Actuation Devices

2.5.9.3.1 Provide an FM Approved automatic release module for extinguishing systems in conjunction with a releasing service fire alarm control unit that is electrically compatible (voltage/current) with the following devices, as applicable:

- Actuation controls and actuation device (e.g., solenoid, pump controller) of the water and gas control valve(s)
- Pump
- Other system-control equipment

2.5.9.4 Supervision

2.5.9.4.1 Provide electrical supervision in accordance with Data Sheet 9-1, *Supervision of Property*.

2.5.9.4.2 Provide electrical supervision of the circuitry from the fire alarm control unit to the following devices, as applicable:

- Detection device
- Releasing circuit
- Automatic water supply and gas supply control valves
- Manual release devices
- Actuating devices

2.5.9.4.3 Provide supervisory alarm signals that are different from fire alarm signals at the fire alarm control panel.

2.5.9.4.4 For preaction water mist systems, provide supervision of the pressurized piping to ensure system integrity.

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2.5.9.5 Detection

2.5.9.5.1 When electrical detection is used, provide detection and actuation circuitry in accordance with Data Sheet 5-48, *Automatic Fire Detection*, in conjunction with the recommendations in this section.

2.5.9.5.2 Select the type of FM Approved automatic detection (pneumatic, optical, heat, or smoke) in accordance with the applicable occupancy or equipment hazard data sheet.

2.5.9.6 Alarms

2.5.9.6.1 Provide FM Approved audible and visual alarms to actuate upon operation of any of the supervised devices listed in Section 2.5.9.4.2 and in accordance with Data Sheet 5-40, *Fire Alarm Systems.*

2.5.9.6.2 Provide water mist system alarm signals that are distinct from other alarm signals (e.g., building fire alarm system).

2.5.9.6.3 Provide trouble/fault alarms that are distinctive from those indicating operation of the water mist system.

2.5.9.6.4 If a time delay is installed, limit the delay to 30 seconds following operation of the initiating device with an audible and visual pre-discharge alarm.

2.5.9.6.5 When multiple water mist systems are installed, provide separate alarms to indicate operation of each system.

2.5.10 Plan Review

2.5.10.1 General

2.5.10.1.1 Confirm the contractor/installer is an authorized distributor or representative of the water mist system manufacturer, and trained to design and install the system in accordance with the manufacturer's FM Approved design, installation, operation, and maintenance manual.

2.5.10.1.2 Confirm the water mist system is designed in accordance with the following documents:

A. The system's listing in the *Approval Guide*

B. The manufacturer's FM Approved design, installation, operation, and maintenance DIOM manual(s)

C. The original equipment manufacturer (OEM) equipment specification sheets

D. The applicable equipment hazard- or occupancy-specific data sheet(s)

2.5.10.1.3 If alterations on the as-built area or equipment have been carried out (e.g., structural changes) from the original submitted design, revise the documentation and resubmit it to a designated representative of FM.

2.5.10.2 Working Drawings

2.5.10.2.1 Submit one set of drawings, water mist system hydraulic calculations, and pneumatic calculations (if applicable), specifications, and any other documentation as described in Sections 2.5.10.2.2 through 2.5.10.3 to a designated representative of FM for review and acceptance prior to the start of any water mist system installation.

If revisions are recommended, submit revised documentation to a designated representative of FM for review and acceptance prior to the start of installation.

2.5.10.2.2 Provide the following information for review and acceptance:

A. The location and description of hazards being protected, designating for enclosures whether it is normally occupied.

B. The type of application (equipment, local application, total compartment, zoned, or occupancy protection. For local application or equipment protection, indicate any adjacent unprotected areas.

C. Location of any areas where the ambient temperature of the occupancy or hazard is expected to be less than 40°F (4°C) or more than 130°F (54°C).

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D. Designation of the supply pressure to the distribution system piping as one of the following:

1. Low pressure (175 psi [12.1 bar] or less)

2. High pressure (500 psi [34.5 bar] or greater)

E. Verification the minimum operating pressure of nozzles and equipment is provided by the water supply

F. System bill of material indicating component/device name, manufacturer, model or part number, quantity, including the following:

1. Description of water and gas storage used, as applicable

2. Description of pump(s)

3. Description/model of nozzles used, including the size, (designated by either K-factor or orifice size)

4. Description of pipe or tubing and fittings used, including material specifications and grade or type

G. Plan view, with an indicated scale, of the protected area, showing the following:

1. Enclosure partitions and walls (full and partial height if appropriate including construction details)

2. Water distribution system, including storage containers or pumps

3. Gas distribution system, including gas storage containers

4. Piping or tubing

5. Location, spacing, and size of nozzles

6. Type of pipe or tubing hangers and rigid pipe or tubing supports

7. Pitch of drainage

8. Flushing and purging weldolet location(s)

9. Location and size of pipe fittings including reducers and strainers

10. Location of isolation valves for test connections and test header

11. Location of control or selector valves

12. Detection, alarm, and control system, including all devices

13. End-of line detection circuit device locations

14. Location of controlled/interlocked devices, such as dampers and shutters

15. Location of instructional signage

H. Enclosure/building cross section showing the following:

1. Full height or schematic diagram, including location and construction of building floor/ceiling assemblies above and below

2. Vertical distance of nozzles from ceilings

3. That all obstructions are in accordance with the manufacturer’s FM Approved design, installation, operation, and maintenance manual

I. Isometric view of the water mist distribution system showing the following:

1. The length and diameter of each pipe segment

2. All nozzle and pipe nodes used in the hydraulic calculation

3. The position of the hydraulically most unfavorable area

J. Seismic building joints, if any, showing the following:

1. Where water mist distribution or supply piping crosses the joint

2. Expected movement of the seismic joint

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3. Details of the piping arrangement

4. Flexible connectors used to accommodate seismic movement

K. Schematic diagrams and point-to-point wiring diagrams showing the following:

1. All actuation circuit connections to the system control panels

2. Detectors, number and location

3. Audible and visual indicating devices, number and location

4. Controlled devices

5. Relays

6. Graphic annunciator panels

L. System sequence of detection/alarm/releasing device operations in coordination with the fire alarm control panel, including the functioning of any of the following:

1. Interlocks with time delays

2. Maintenance switches

3. HVAC equipment

4. Dampers

5. Production equipment

6. Fuel interlocks/shut-offs

7. Electric shutdowns

8. Door closers

2.5.10.3 Calculations

2.5.10.3.1 Document the following design factors:

A. Volume/size of the protected enclosure or design area

B. Location of any areas where the ambient temperature of the occupancy or hazard of expected to be less than 40°F (4°C) or more than 130°F (54°C).

C. Hazard or fuels to be protected

D. Fuel temperature

E. Fuel configuration

F. K-factor for nozzle(s)

2.5.10.3.2 Hydraulic flow calculations do not need to be provided for pre-engineered water mist systems. Review the isometric view of the distribution system (see 2.5.10.2.2, item I) for compliance with the pipework specifications in the manufacturer's FM Approved design, installation, operation, and maintenance manual.

2.5.10.3.3 When a computer program is used for hydraulic calculation, provide the name and version number of the program.

2.5.10.3.4 For water mist systems supplied by pumps, provide a graphic representation of the complete hydraulic calculation, including the water supply curve and the water mist system demand. Include the following items:

A. Nozzle and pipe nodes or reference number

B. The nozzle k-factor, flow, and pressure

C. For each pipe, show the flow, flow direction, velocity, length, equivalent length, pressure at inlet, and friction loss.

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2.5.10.3.5 For water mist systems connected to public water mains, provide the latest water test result, including the static and dynamic pressure, flow demand, and the date and time of the test.

2.5.10.3.6 Provide calculations to determine the following:

A. Quantity of water

B. Quantity of gas (if applicable)

C. Flow rates of the fire extinguishing media

D. Discharge time in accordance with Section 2.4.3

2.5.10.3.7 If seismic restraint is needed per Data Sheet 1-2, *Earthquakes*, provide calculation of seismic loads on seismic building joints.

2.5.10.3.8 When detection is used, provide calculations to determine the size of backup batteries for the fire alarm control panel. See Data Sheet 5-40, *Fire Alarm Systems*, for further information.

2.5.11 System Restoration

2.5.11.1 After acceptance tests are completed, or following system discharge, restore the water mist system, alarms, and interlocks to operational condition.

2.5.11.2 Follow the proper shutdown sequence of valves and equipment in accordance with the manufacturer's recommendations.

2.5.11.3 Perform appropriate cleanup and salvage of the protected enclosure.

2.5.11.4 Adhere to established impairment procedures. Refer to Data Sheet 10-7, *Fire Protection Impairment Management*, for details.

2.5.11.5 Flush piping that is charged only with water. Flush and drain piping that is normally empty.

2.5.11.6 Inspect, clean, and place strainer and filters into operational condition.

2.5.11.7 Restore valves to their operational position.

2.5.11.8 Follow the manufacturer's procedure(s) to restore the installed equipment to service, including replenishment of water and inert gas, if applicable.

2.6 Acceptance of Water Mist Systems

2.6.1 Acceptance Test Plan

2.6.1.1 Provide a designated representative of FM with a complete step-by-step description of the proposed acceptance test procedure(s), identifying each and all devices, controls, and functions to be tested and inspected, and how any tests will be conducted prior to scheduling the acceptance test. Include any individual and interconnected system tests to be conducted for acceptance with an integrated water mist system(s).

2.6.1.2 Verify the installation companies have furnished written documentation completed in accordance with the recommendations for system acceptance with specified hydrostatic pressure tests, water mist system operational and discharge tests for final acceptance.

2.6.2 Acceptance Testing

2.6.2.1 Use a contractor who is an authorized distributor or representative of the water mist system manufacturer, and trained to test the system in accordance with the manufacturer's FM Approved design, installation, operation, and maintenance manual.

2.6.2.2 When multiple systems are installed, operate the maximum number of systems that are expected to operate at the same time.

2.6.2.3 When multiple equipment hazards are being protected with a single water mist system zoned for each hazard, conduct an operational test of each protected area.

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2.6.3 Visual Inspection

Verify the water mist system has been installed to the submitted Working Drawings and specifications (see Section 2.5.10, Plan Review) as well as any applicable national or international codes and standards by conducting a visual inspection.

2.6.4 Discharge Test

2.6.4.1 Conduct a full discharge test to confirm the following:

A. Complete coordinated system operation

B. The water storage tank is pressurized and the design pressure is attained

C. Proper development of the discharge pattern

D. Unobstructed flow from the nozzles over the minimum discharge duration

E. Nozzle pressure is in accordance with hydraulic calculations, as confirmed at the most remote water mist nozzle or test node with a pressure gauge or pressure transducer.

F. Adequacy of the water supply duration and pressure when multiple water mist systems are expected to operate simultaneously.

G. For preaction water mist systems, that the water mist delivery time is in accordance with the design.

2.6.4.2 Provide collection and disposal of the discharged water in accordance with local and/or national regulations and the authority having jurisdiction.

2.6.5 Operation of Components

2.6.5.1 Verify all mechanical and electrical components and systems interconnected with the water mist system operate in accordance with the commissioning documentation (see Section 3.6.1).

2.6.5.2 Conduct operational tests to ensure the water mist system responds as designed, from both automatic detection and manual actuation devices. At a minimum, confirm the following:

- Visual and audible local alarms
- Time delays
- Remote annunciation at the fire alarm control panel
- Releasing devices
- Operation of auxiliary devices (equipment shutdown, fuel interlock, door or damper interlocks, etc.)
- Manual pull stations
- Operation in accordance with the system design specification
- For preaction water mist systems, verify the actual water delivery time delay does not exceed the calculated or specified time delay in the design

2.6.5.3 Confirm functionality of the system components listed in 2.6.5.2 during one of the following operational tests:

A. Full discharge test

B. For automatic nozzle systems, flow through the inspector’s test connection

C. For open nozzle systems, flow through the test connection

2.6.5.4 For open nozzle systems, when using the test connection, set the position of the isolation valves to discharge from the test connection in order not to discharge water mist into the distribution system piping.

2.6.6 Alarm and Detection Devices

2.6.6.1 Inspect and test alarm and detection devices in accordance with Data Sheet 5-40, *Fire Alarm Systems*, and Data Sheet 5-48, *Automatic Fire Detection*.

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2.6.7 Documentation

2.6.7.1 Maintain the following documents for reference (see Section 3.6.3):

A. Manufacturer's literature describing the correct operation, inspection, and maintenance of the water mist system and its components

B. As-built piping layout drawings, electrical schematics, and hydraulic and pneumatic calculations

C. Schematic of the set position of operating valves and devices

D. Procedure(s) on the proper manual shutdown sequence of valves and equipment for the water mist system(s) after activation

E. Manufacturer's design, installation, operation, and maintenance manual

F. Acceptance test report that includes the results of the following, at a minimum]:

1. Distribution system cleaning and flushing (Section 2.5.8.10)

2. Pressure test of distribution piping (Section 2.5.8.11)

3. Visual inspection (Section 2.6.3)

4. Acceptance testing

a. Discharge test (Section 2.6.4)

b. Operation of components (Section 2.6.5)

c. Water delivery time, preaction systems (Section 2.4.4.7)

5. Alarm and detection device (Section 2.6.6)

2.7 Inspection, Testing, and Maintenance

2.7.1 Inspect, test, and maintain the water mist system in accordance with Data Sheet 2-81, *Fire Protection System Inspection*.

2.7.2 Provide a valve supervision program for water supply and gas control valve(s) in accordance with Data Sheet 2-81, Fire Protection System Inspection.

2.7.3 Manage system impairments in accordance with Data Sheet 10-7, *Fire Protection Impairment Management*.

2.8 Training

2.8.1 Provide training for all personnel responsible for the operation and maintenance of the system, addressing the following at a minimum:

A. Review of the manufacturer's FM Approved design, installation, operation, and maintenance manual.

B. The purpose of the water mist system relative to the protected nonstorage occupancy or equipment and enclosure.

C. Functionality of the system and major system components.

D. Associated equipment and interlocks, if applicable (enclosure venting, dampers, power and ventilation shutdown, etc.)

E. Operation of the system under normal and emergency circumstances (i.e., automatic and manual operation), including the location of manual release devices.

F. Necessary inspection, testing, and maintenance of the water mist system and protected occupancy or equipment.

2.9 Contingency Planning

2.9.1 Maintain a 100% spare supply of water and gas, as appropriate, on site when a connected reserve supply is not used and if the system needs to immediately be restored after operating to address the conditions in Section 2.4.3.4.

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2.9.2 Maintain a spare supply of system components on site, as follows:

A. Spare automatic water mist nozzles of each type installed, based on the largest demand area with the appropriate temperature rating.

B. Spare open water mist nozzles of each type installed, based on the largest equipment hazard or enclosure volume.

C. Spare strainers or filters for water mist nozzles, if replaceable, for all types and sizes installed.

D. Any specialized equipment required for installation of the nozzles, strainers or filters.

2.9.3 Develop a plan to bring the water mist system and protected occupancy or equipment to working order following a system discharge, including the following at a minimum:

A. Adherence to established impairment procedures. Refer to Data Sheet 10-7, *Fire Protection Impairment Management*, for additional details.

B. Cleanup and salvage of the enclosure, particularly if it includes sensitive equipment.

C. Replenishment of water container(s) and gas cylinder(s), particularly if a reserve supply is not available on site.

D. Adherence to other items listed in the manufacturer's FM Approved design, installation, operation, and maintenance manual.

3.0 SUPPORT FOR RECOMMENDATIONS

3.1 General

Water mist systems are protection systems that use small water droplets to control or extinguish fires. Conventional sprinklers control, suppress, or extinguish fires primarily by wetting and cooling. Water mist systems control or extinguish fires through the following mechanisms:

- Heat absorption
- Oxygen displacement from the water vapor created locally at the origin of combustion
- Radiant heat blocking

Water mist systems may be single-fluid or twin-fluid systems, using water and an atomizing gas. They may be low pressure (less than 175 psi [12.1 bar]) or high pressure (greater than 500 psi [34.5 bar]). Hydraulically, they may be pre-engineered or engineered systems.

Water mist systems supplement sprinkler protection and are not a substitute unless specifically recommended as primary protection in the applicable occupancy-specific data sheet.

3.1.1 Applications for Which Water Mist Systems are Not Recommended

Water mist systems are not recommended for protecting the following:

- Energized electrical equipment, enclosed or unenclosed (Class C)
- Storage of ignitable liquids (greater than 110 gal [greater than 420 L])
- Chemicals, such as cellulose nitrate, which release sufficient oxygen or other oxidizing agents to sustain combustion
- Liquefied or compressed gas
- Cascading fuel fires
- Combustible metals such as aluminum and magnesium
- Water-reactive metals such as lithium, sodium, potassium, titanium, zirconium, uranium, plutonium and sodium-potassium alloys
- Hazardous, water-reactive materials such as triethyl-aluminum and phosphorous pentoxide
- Metal alkoxides, materials such as sodium methoxide

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- Metal amides, materials such as sodium amide
- Carbides, materials such as calcium carbide
- Cyanates, materials such as methylisocyanate
- Halides, materials such as benzoyl chloride and aluminum chloride
- Hydrides, materials such as lithium aluminum hydride
- Silanes, such as trichloromethylsilane
- Sulfides, such as phosphorus pentasulfide

3.2 Construction and Location

Ambient temperature of the storage location should be a minimum of 40°F (4°C) as these protection systems are water based. The maximum component operability temperature evaluated for listing by FM Approvals is 130°F (54°C). Alternate temperature ranges are acceptable when identified in the FM Approval listing. Maintain heating, ventilation and cooling for normal building service areas and separate stand-alone enclosures.

When installing a water storage tank and gas cylinders, provide sufficient clearance for removal or replacement during inspection, testing or maintenance.

3.3 Personnel Safety

The following personnel safety issues should be considered where water mist systems are used:

- **Temperature/visibility.** Water mist discharge can reduce temperature and visibility. Visibility will return to pre-discharge conditions when the enclosure temperature rises above the dew point.
- **Wetting of surfaces.** Use caution when walking on wetted surfaces after discharge. Electrical energy may conduct across wetted surfaces, and wetting is more likely when insufficient heat is present to evaporate the droplets.

3.4 Protection

No general design method is recognized for water mist systems. Performance objectives must be proven by fire testing in the expected installation configuration and fire scenarios. Applicable tests are identified in FM 5560, *Examination Standard for Water Mist Systems*.

The FM Approval listing for the standard includes fire tests that replicate the fuel type, configuration and severity of the hazard being protected. The FM Approval's standard also includes functional testing of integral water mist system components. Fire tests validate effective system performance for the fire scenario, while functional testing verifies proper operation of the system and its components.

FM Approval's only allowable scaling method is based on Froude modeling. This method, supported by fire testing, may be used to assess water mist protection requirements for larger or smaller geometrically similar enclosures. Examination Standard FM 5560 permits this scaling method for scale ratios up to two.

3.4.1 System Limitations

The fire tests referenced in Section 3.4 confirm water mist system performance only for the specific fire hazards tested. System performance for hazards outside the tested scope cannot be assumed. For example, a system that successfully protects gas turbine compartments against ignitable liquid spray and pool fires under the FM 5560 Fire Performance Testing Appendix is not suitable for light hazard occupancies; unless fire testing specific to that occupancy has been conducted.

3.4.1.1 System Configuration

Fire testing is conducted using the anticipated system configuration and manufacturer-stated limitations. This testing includes but is not limited to maximum nozzle spacing, protected enclosure height, enclosure volume and maximum area of enclosure openings. System performance beyond these tested limits is unknown.

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For example, extrapolating a water mist system design from a smaller tested compartment to a larger, untested compartment will not result in equivalent performance. A system tested in a 10,000 ft^3 (283 m^3) compartment cannot be assumed to protect a 20,000 ft^3 (568 m^3) compartment by simply doubling the number of nozzles and the water or gas supply.

3.4.1.2 Interlocks

Water mist system installations must align, to the extent possible, with the installation conditions used during fire testing. These conditions include any auxiliary interlock functions needed for effective fire control or extinguishment, such as power disconnect, fuel shutoff, HVAC control, damper closure, door closure and similar devices.

How the water mist system interacts with auxiliary functions and environmental control systems should be evaluated to determine which systems should shut down or continue operating during activation. For example, the FM 5560 machinery-space fire test protocol includes only natural ventilation. Forced ventilation can remove excessive water vapor and combustion products, reducing system performance; therefore, it should be interlocked to shut down before water mist system activation.

For more information on ventilation effects, including no ventilation, natural ventilation, and forced ventilation, see "*Examination of Performance of Water Mist Fire Suppression Systems under Ventilated Conditions*" in the Journal of Fire Protection Engineering.

3.4.2 Occupancy Protection

3.4.2.1 Nonstorage (HC-1, HC-2 and HC-3) Protection

Water mist may be used as primary protection when recommended by the occupancy-specific data sheet. Equipment protection applications generally require automatic sprinkler protection in addition to the water mist system.

To use an FM Approved water mist system for an HC-1, HC-2 or HC-3 category, a thorough review and assessment of the occupancy hazard should be conducted for the conditions listed in Section 2.4.1.1. If these conditions are present, the application may require a water mist system FM Approved for a different category, such as enclosures for machinery, or may determine a water mist system cannot provide adequate protection at all.

Water mist systems may be used as an alternative to automatic sprinklers for nonstorage and certain manufacturing occupancies. These systems control, rather than extinguish, fires and require discharge durations equivalent to those for automatic sprinkler systems.

Nonstorage Hazard Category 1 (HC-1) occupancies, such as offices and hotels, are examples where water mist protection is acceptable for light hazard occupancies (LHO). "Light Hazard" is a traditional occupancy classification used by the National Fire Protection Association (NFPA) and others in the fire protection and loss prevention industry.

Nonstorage Hazard Category 2 (HC-2) occupancies, such as utility rooms and supermarkets, are represented in Data Sheet 3-26, *Fire Protection for Nonstorage Occupancies*, by a Class 2 commodity in a two-tier standard rack arrangement. Nonstorage Hazard Category 3 (HC-3) occupancies, such as storerooms, are represented by cartoned expanded plastic (CEP) commodity in a one-pallet-load-high palletized arrangement. The tested fuel array is two pallet loads wide and four pallet loads long. NFPA ordinary hazard classifications and European Ordinary Hazard 3 (OH-3) are similar to FM hazard classifications.

FM conducted fire test programs in 2016 and 2018 to evaluate water mist protection for higher fire hazard categories recognized by CEN and NFPA. The selected water mist spray characteristics were based on droplet behavior, including fire plume penetration, vaporization and surface deposition. The tests confirmed that spray characteristics strongly influence suppression performance. For solid combustible fires in open environments, fuel wetting—not localized oxygen depletion—was the primary suppression mechanism. In addition to application density, median droplet size had to be large enough to deposit water on combustible surfaces. Overall, the water mist application density needed to achieve comparable suppression was similar to that required for sprinkler protection.

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3.4.2.2 Data Processing Equipment Room/Hall, Below Raised Floor Protection

Two design methods are used for data processing equipment rooms/halls and below raised floor protection:

- Area of coverage
- Local application

The “area of coverage” design method is used when cable tray locations are unknown at installation. The nozzles are installed to protect the entire area below the raised floor.

The “local application” design method is used when cable tray locations are known at installation. The nozzles are installed in direct proximity to the cable trays.

3.4.2.3 Ignitable Liquid Storage

The Ignitable Liquid Storage category is for use or storage in cutoff room applications. This arrangement is considered primary protection with a 60-minute water supply duration to all nozzles in the protected space, with the following restrictions:

- The protection is limited to ignitable liquids with volatility less than or equal to heptane.
- Metal container size includes all sizes up to standard intermediate bulk container (IBC). Plastic container size is limited to a maximum of 6.5 gal (25 L) and includes both cartoned and uncartoned.
- Storage types permitted include palletized, rack and shelf. Storage height is limited to the storage height in the FM Approval listing.
- Maximum volume, ceiling height, and opening size are limited to these in the FM Approval listing.

3.4.3 Equipment Protection

3.4.3.1 Enclosure Protection

Water mist has proven effectiveness as an alternative to automatic sprinklers for extinguishing high heat release rate fires in enclosures, including rooms or compartments containing gas turbines, indoor transformers and similar equipment with ignitable liquid fire hazards. However, automatic sprinkler protection should still be provided for those areas outside the water-mist-protected enclosure, including the surrounding building areas.

These systems are fire tested with enclosure openings present to verify performance under limited natural ventilation as a fault condition. As a best practice, all installation openings should close with interlocks or dampers before system activation to create a sealed enclosure.

If unclosable openings are present in an enclosure, they may be tolerated if the size and location of the openings are similar to those included in the fire testing protocol. The opening size and location are important to the performance of the system. The heat generated in the enclosure enhances the water mist’s ability to extinguish a fire; as water mist is turned to steam as it is heated in the enclosure, providing cooling and reducing the oxygen concentration. Openings in the fire testing protocol are at ground level. If openings of similar size are located in the ceiling or near ceiling level, the impact on performance will be significant; as heat rises and will be lost from the enclosure.

Water mist systems may be used as an alternative to emergency drainage when provided as supplementary protection to sprinklers, as recommended in:

- Data Sheet 5-23, *Design and Protection for Emergency and Standby Power Systems*
- Data Sheet 7-9, *Dip Tanks, Flow Coaters and Roll Coaters*
- Data Sheet 7-32, *Ignitable Liquid Operations*
- Data Sheet 7-88, *Outdoor Ignitable Liquid Storage Tanks*

The gross volume of the enclosure should be used to determine the volume of protection. If net volume is used, the same net volume could have a large variation of total surface area. That variation in surface area could have an impact on heat transfer and loss of discharged droplets to provide protection.

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3.4.3.2 Local Application

3.4.3.2.1 Local application systems can extinguish ignitable liquid pool and spray fires. Critical design factors include nozzle spacing, nozzle height above the hazard, and ignitable liquid containment such as curbs or dikes. These systems extinguish primarily through flame cooling; inerting contributes less than it does in enclosure fires.

3.4.3.2.2 This application is similar to a local application carbon dioxide system. Ceiling-level automatic sprinkler protection is usually also needed.

3.4.4 Design of Water Mist Systems

3.4.4.1 Water Mist Components

Water mist systems use specialized equipment designed by the manufacturer for this type of fire protection system.

Water mist system components include the following:

- Nozzles (automatic or deluge)
- Gas cylinder(s)
- Water supply container(s)
- Pump
- Actuation/control valves
- Pressure regulating valve
- Piping/tubing
- Pipe connections (fittings)
- Hangers and bracing
- Actuation controls
- Check valves
- Discharge alarms
- Pressure gauges/transducers
- Drain valves
- Relief valves
- Regulators

3.4.4.2 Water Mist Systems in the *Approval Guide*

Water mist systems are listed under Fixed Extinguishing Systems in the Fire Protection volume of the *Approval Guide*. Listings are organized by occupancy, hazard, or hazard enclosure type and include the critical application limitations.

Some water mist systems are deluge-type special protection systems and must be paired with compatible detection and fire alarm control units. The following components are listed in the Electrical Signaling section of the Fire Protection volume of the *Approval Guide*:

- Alarm Signal Initiating Devices
  - Fire Detection; Flame, Heat, Smoke
  - Manual Stations
- Automatic Release for Extinguishing Systems
- Notification Appliances
- Signaling Systems (Fire)

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3.4.4.3 Obstructions to Nozzle Discharge

Obstructions will affect water mist system performance. The impact of the obstruction depends on the spray characteristics and type of application. Water mist systems have a wide range of nozzle projection distances, spray velocities, and spray patterns.

The water spray from a nozzle discharge that is too close to an obstruction may not fully atomize, removing some water from suspension. This scenario can reduce the extinguishing effectiveness of total flooding or local application systems. Where prewetting helps limit fire growth, obstructions that disrupt spray development can prevent wetting of unburned materials and reduce system performance.

Additional nozzles may be needed to maintain adequate performance where obstructions, or the maximum coverage distances to obstructions, were not evaluated as part of the listing by FM Approvals.

3.4.4.4 Connected Reserve

Reserve supplies are necessary to permit prompt restoration of the system after a discharge, to minimize interruption of the process and the interval of impaired protection.

3.4.4.5 Discharge Duration

Most applications, especially those where water mist supplements automatic sprinklers, use a limited agent supply. If the fire is not extinguished before the water or gas supply is depleted, it will continue to grow. FM Approval fire testing determines the time needed to extinguish test fires. The required water and gas quantities are based on those extinguishment times, with an appropriate safety factor.

The occupancy-specific data sheet may recommend a discharge duration, based on the expected fire hazard, which exceeds the duration in the manufacturer's FM Approved design, installation, operation and maintenance manual. If the data sheet permits water mist as primary protection and the system is FM Approved for that application, the agent supply duration must match the duration recommended for automatic sprinkler protection.

Water discharge after the compressed gas supply is depleted is not effective for fire suppression. For systems FM Approved for intermittent discharge, the required quantity is based on actual discharge time.

3.4.4.6 Hydraulic Design

A pre-engineered system is limited to specific combinations of pipe sizes and lengths, including the number of tees (flow splits), elbows, and nozzles, and does not require flow calculations. These systems are typically limited to balanced piping configurations, such as 50-50 flow splits.

An engineered system is flow calculated, typically using a proprietary calculation program. The program is evaluated and verified through testing as part of the FM Approval process for each manufacturer's system. The hydraulic calculation report identifies "errors" for limitations outside of the FM Approved specification(s) for plan acceptance.

For single-fluid water mist systems, hydraulic pressure loss is calculated using the Hazen-Williams equation when working pressure does not exceed 175 psi (12 bar). For systems with working pressures exceeding 175 psi (12 bar), the Darcy-Weisbach equation is used.

3.4.4.7 Preaction Systems

3.4.4.7.1 Water mist systems in preaction configuration are evaluated as part of the FM Approval listing for the effect of maximum water delivery time on fire-extinguishment performance (e.g., protection of data processing equipment rooms/halls, including above-floor and below-floor protection). The maximum water delivery time is identified in the FM Approval listing.

3.4.4.7.2 Preaction configurations proposed for other occupancy categories but not evaluated as part of the FM Approval listing may provide inadequate fire protection, because fire growth before water mist application may exceed that evaluated for the FM Approved wet-system configuration.

3.5 Equipment and Process

Typical low-pressure and high-pressure water mist systems are identified in Figure 3.5-1 and Figure 3.5-2.

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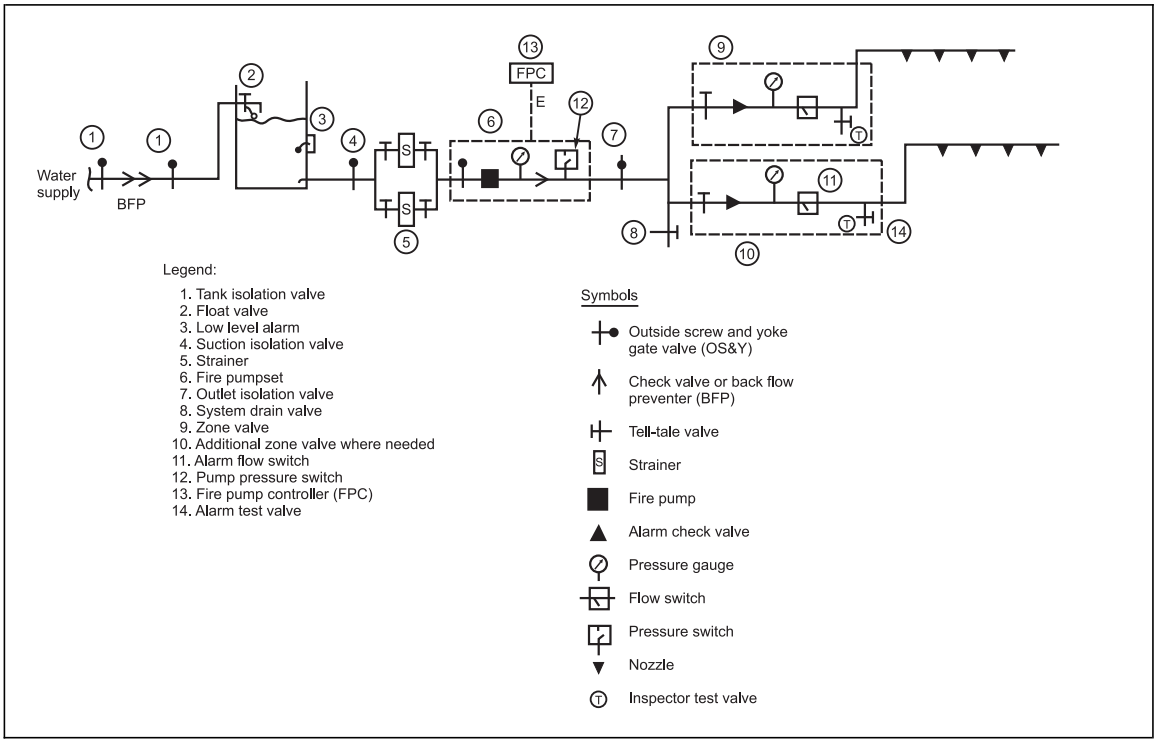


Fig. 3.5-1. Schematic of low-pressure water mist system (pump driven)

3.5.1 Water Supply

3.5.1.1 Water Supply Storage Container

Atmospheric water supply storage tanks constructed from the polymeric materials identified as part of the FM Approved design, installation, operation and maintenance manual are acceptable to be used as components of the water mist system.

3.5.1.2 Strainers

The use of a strainer with corrosion resistant material, compatible with the piping and fittings, will prevent galvanic corrosion that can enter the water supply and clog the water mist nozzle.

3.5.2 Pumps

For fire pumps providing supplementary protection, connecting the fire pump controller feeder circuit such that power can be shut down in just the building containing the water mist system-protected equipment or area is permissible, provided the action does not depower the pump. Typical examples of how this could be achieved are:

A. Locate the pump in an adjacent building on a separate power feed than the protected building.

B. Locate the pump in the protected building, but feed power to it from an adjacent building that is on a separate power feed than the protected building.C.Locate the pump in the protected building but feed power to it ahead of all other connected building loads.

3.5.3 Pressure Safety Devices

Pressure unloader valves are typically used with positive displacement pumps in variable-demand piping systems, such as systems with automatic nozzles. An unloader valve opens at a preset pressure, allowing unused pump discharge to bypass the distribution system. This allows the positive displacement pump to be represented as a horizontal line on the pump curve.

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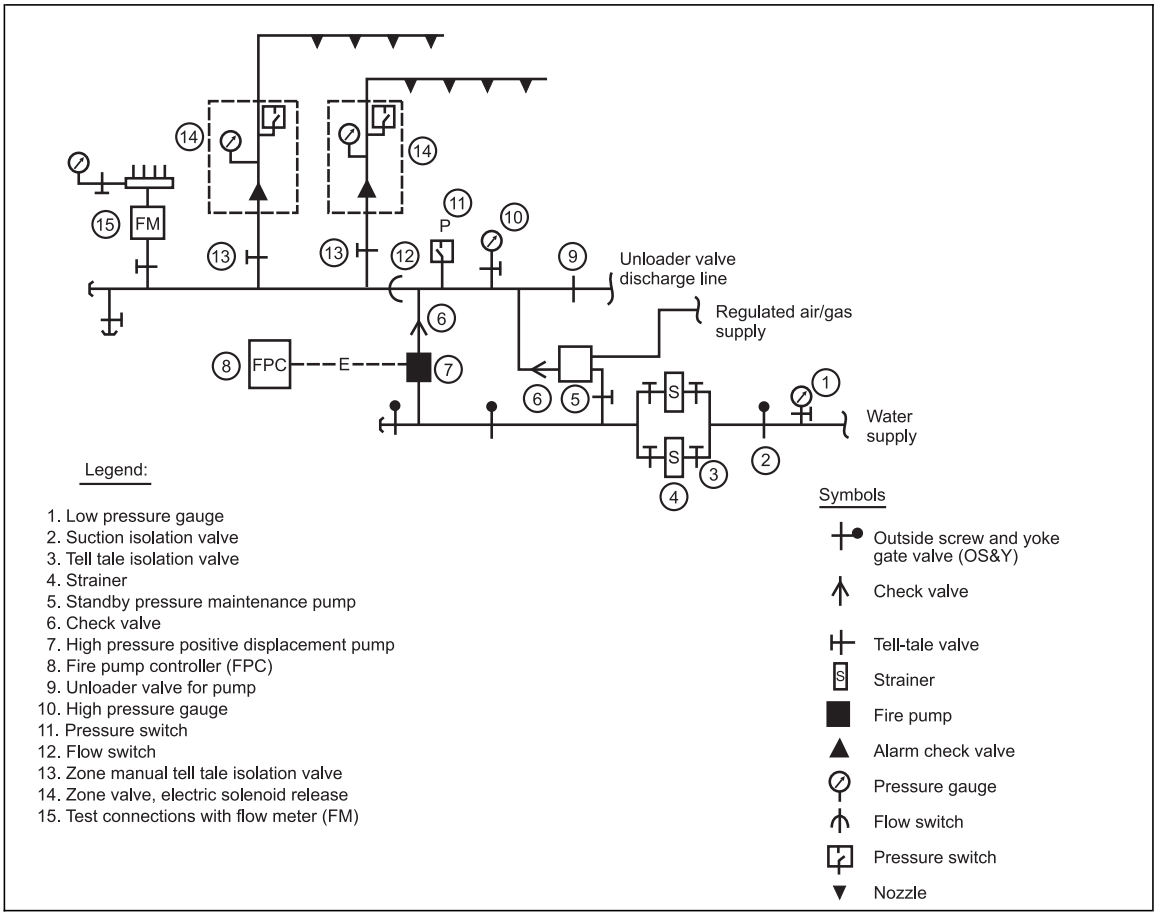


Fig. 3.5-2. Schematic of high-pressure water mist system (pump driven)

3.5.4 Valves

When selector valves are used for multi-hazard protection, water mist migrating into adjacent zones may cause unwanted releases with standard smoke detection. Select detection devices suitable to both normal and discharge conditions for multi-hazard protection.

3.5.5 Test Connections

Location of the test connection may need to allow for disposal access if the discharged water is to be collected and removed from the premise.

3.5.6 Distribution System

3.5.6.1 Pipe and tubing are both used interchangeably as part of the distribution system terminology. Pipe is typically used for larger liquid flows at lower internal pressures. As pressure increases, pipe wall thickness (schedule) and weight per unit length also increase. Tubing is generally used for smaller flow rates at medium to high internal pressures. High-strength tubing materials allow reduced wall thickness and lower weight per unit length. The manufacturer's FM Approved design, installation, operation and maintenance manual specifies whether pipe or tubing should be used.

3.5.6.2 Teflon tape or the water mist system manufacturer's thread-locking compound may be used at pipe joints to prevent leakage. Do not allow pipe sealants, Teflon tape or lubricants to enter the pipe network. Apply these materials only to the pipe threads to reduce the potential for plugging small orifices in control devices or discharge nozzles.

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3.5.6.3 Using installation equipment that is not rated for the pipe or tubing material can cause distribution system leaks.

3.5.6.4 Galvanized steel pipe and fittings, and aluminum tubing and fittings, are not recommended for water mist system supply lines. Small-orifice nozzles can become blocked by corrosion, poor water quality, or flaking pipe coatings. Current galvanized piping standards cannot ensure that internal coatings will not flake and obstruct nozzles or strainers. Select pipe or tubing materials with minimal corrosion potential to reduce the risk of nozzle blockage from internal coating degradation.

3.5.6.5 Using compatible pipe materials will limit galvanic corrosion between piping, fittings and other materials that can promote leakage.

3.5.6.6 Piping Support

The piping should be supported and braced to restrict movement from nozzle reaction and water surges, so that system performance and integrity is maintained. Consideration should be given to areas subject to earthquake damage by using piping supports specifically listed to secure the distribution system from damage.

3.5.6.7 Pressure Test of Distribution Piping

3.5.6.7.1 To prevent the risk of water damage in the case of a break, use a small-capacity pump to maintain pressure.

3.5.6.7.2 Use standardized test procedures to conduct the hydrostatic pressure test such as Section 137, Pressure Tests of the ASME B31.1. Power Piping Code, which includes requirements on:

- Temperature of the Test Medium
- Personnel Protection
- Preparation for Testing
- Water Quality

3.5.7 Operation and Control of Systems

3.5.7.1 Actuation

3.5.7.1.1 For large hazard areas or areas with limited access, consider additional manual actuation devices located both near and remote from the emergency mechanical manual actuator for the water mist (water and gas) agent supply.

3.5.7.1.2 Auxiliary interlock functions are actions needed to ensure effective fire control or extinguishment within the limitations of the water mist system. Examples include power disconnect, fuel shutoff, HVAC control, damper closure, door closure and similar devices.

3.5.7.1.3 The interaction of the water mist system with auxiliary functions and environmental control systems should be carefully evaluated to determine which infrastructure systems should shut down or remain operating during activation. For example, fuel supplies, lubrication oils, ignition sources, and ventilation systems can impact water mist system performance and the equipment being protected.

3.5.7.2 Supervision

Many valves, if left in the incorrect position, can compromise or even disable the water mist system. Examples of valves critical to operation of the water mist system include valves from the water supply tank, valves in the gas manifold supply and isolation valves on the test connection.

3.5.7.3 Alarms

3.5.7.3.1 Provide suitable alarms to initiate egress and prevent entry into areas with fire conditions. Warning and safety instruction signs should be readily visible to personnel. In addition to the recommendations for alarms, safety procedures such personnel training, evacuation plans and fire drills should be considered.

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3.5.7.3.2 A pre-discharge alarm and time delay can be used to prevent human exposure to the discharge and allow egress from areas with reduced visibility. Where a pre-discharge time delay is installed, it should delay the system discharge only for sufficient time to allow evacuation of personnel from areas most remote from the exits.

3.6 Acceptance of the Water Mist Systems

3.6.1 Commissioning and Integrated Testing

3.6.1.1 Water mist systems are complex fire protection systems that may include both active and passive fire protection systems, as well as critical support equipment for the protected hazard or occupancy. A commissioning and integrated test program may be needed to verify equipment functionality and system performance.

3.6.1.2 The following documents provide guidance for developing a program to verify that integrated fire protection and life safety systems perform as intended:

- NFPA 3, *Standard for Commissioning of Fire Protection and Life Safety Systems*
- NFPA 4, *Standard for Integrated Fire Protection and Life Safety System Testing*

3.6.2 Acceptance Test Plan

A mutually agreed upon test plan should be developed between the owner, installing contractor and FM representative to document the expected results when validating operation of the water mist system, associated alarms and interlocks.

3.6.3 Acceptance Testing

3.6.3.1 In order to guarantee the water mist system is designed and installed properly for its intended application, conducting an operational test is imperative. Most water mist system equipment is installed at the job site. In order to ensure all the specified equipment has been installed properly and in the correct arrangement, an acceptance test must be performed that indicates operability as identified in the manufacturer's FM Approved design, installation, operation and maintenance manual.

3.6.3.2 Acceptance testing verifies all components are installed and operable in their proper orientation and pressure settings. Documenting the performance of the system at its acceptance test, and comparing the results of annual testing to flag any potential problems is recommended.

3.6.4 Documentation

The recommended documentation to be kept on file by the client allows for verification of proper operation of the water mist system over its intended life cycle. It can be referenced should the installing contractor or manufacturer of the water mist system no longer directly support the product, it is no longer FM Approved or the provided protection needs to be modified.

3.7 Inspection, Testing, and Maintenance

Since field conditions cannot be fully controlled, Inspection, Testing, and Maintenance (ITM) activities are needed at regular intervals to ensure the following:

A. Degradations or faults due to any deviation from specified environmental/operating conditions (e.g., due to human error) are corrected.

B. Potential failures (e.g., due to design/manufacturing process deficiencies, overstresses or aging) or other issues that cause the component or system to not meet its design intent with respect to functionality and performance are identified.

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3.8 Illustrative Losses

3.8.1 Fire Extinguished in Power Equipment for Data Storage Equipment

A loss occurred from the component failure in an Uninterruptable Power System (UPS) at a data storage and recovery service facility. The emission of smoke resulted in activation of the water mist system situated above the module and successfully stopped further fire damage. Three other UPS modules reportedly sustained water damage. The UPS installation is part of a dedicated system supporting one customer's environment. Visual examination by a forensic investigation confirmed signs of soot and fire debris deposits, and water staining.

3.8.2 Lack of Proper Acceptance Testing for Water Mist System Leads to Discharge During Renovation

A small room, 12 ft x 12 ft (3.7 m x 3.7 m) in the main office of the facility used as a server room was exposed to water damage from the discharge of the water mist system. This server room contains five racks. Three of the racks are filled with servers, and the two other racks contain cabling and network equipment. The servers were reported to run the computer operations, firewalls, phones, manufacturing software and communications for this location and three other locations. The high-pressure water mist system with a single deluge discharge nozzle is activated by detection. Detection is provided by two ceiling mounted smoke detectors in the room.

A heating, air conditioning and ventilation (HVAC) contractor was in the process of re-arranging the air intake and exhaust systems within the server room. In performing this work, the contractor caused one of the two ceiling mounted detectors associated with the water mist system to annunciate a trouble condition at the fire alarm control panel. The owner incorrectly entered a code to silence the control panel, which caused the activation of the water mist system due to improper wiring of the circuit by the fire alarm contractor. Upon activation, the majority of the equipment in the server room was wetted by the discharge from the high-pressure water mist system. As a result of this incident, normal business operations, which rely on the server equipment, were interrupted for approximately three days.

Failure to conduct a complete Acceptance Test contributed to this loss by not verifying the functionality of the circuitry for the detection system in conjunction with the water mist system.

3.8.3 Trained Operator and Sprinklers Minimize Loss to Industrial Oil Cooker

The moisture meter located at the take-off conveyor of the industrial oil cooker detected an abnormal condition and opened the abort gate on the conveying system, discharging product onto the floor in front of the elevator to the flavor floor.

An operator alongside the fryer investigating this condition noticed a fire coming from the left-hand side of the take-off conveyor (in direction of the product). The operator immediately activated the water mist system under the hood of the oil cooker manually, which extinguished the fire. This situation placed the line into an automated shutdown, stopping the flow of product at the slicer head and circulation of oil to the heat exchanger.

Activation of the water mist system also automatically triggered the site fire alarm and commenced evacuation of the factory. Security reported the alarm to the public fire service.

While extinguishing the fire in the oil cooker, residues under the oil cooker hood spread back to the unprotected flue stack and flue stack filters. The fire traveled back upstream through the oil cooker. A secondary fire in the take-off area for rejected product also occurred from damage to the plastic pipework on the unit. Above each of these areas (flue stack, flue stack filters and rejected product) automatic sprinklers operated (three sprinklers in total). Site emergency personnel are reported to have made sure the two sprinkler fire pumps in the main sprinkler pumphouse operated. The public fire service responded to extinguish residual fire and assist with site clean-up.

3.8.4 Lack of Automatic Sprinklers and Automatic Activation of the Water Mist System Contribute to Loss of Glass Forming Machine

A fire started at a glass forming machine due to a blockage of molten glass in one section. The operator was assisting at another forming line where a section was also stopped. The fire quickly spread to the roof due to oily deposits on the machines, structural members and roof. The emergency process stops were

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activated, and the valves were manually operated to activate the deluge water mist system for three of the glass forming lines. This action extinguished the fire in the glass forming machines, but the fire had already spread across the area protected by the nozzles. The fire spread quickly via the roof towards another glass forming line and to the roof above the furnace. Activation of the deluge water mist system caused the gobs of molten glass to be directed away from the gob distributor, the machine and oil transfer, and cooling ventilation stops to reduce oxygen to the fire. The machine operator informed security to call the public fire service.

Due to ineffectiveness of the water mist system (not FM Approved for the application) and lack of automatic sprinklers, three of the six glass forming machines were interrupted. The overall downtime was one week for two of the three glass forming machines. The downtime for the third glass forming machine was about three days.

3.8.5 Improperly Impaired Water Mist System Prevents Discharge

Office workers in the adjacent office building towers noticed dark smoke coming out of the hotel ventilation exhaust ports. Multiple callers notified the public fire service. Automatic sprinklers activated in the medical clinic above a restaurant. The entire complex was evacuated, approximately 5,000 people.

The location of the fire was inside a duct that exhausts fumes from the hotel restaurant's wood oven. After making several openings to access the duct, firefighters were able to bring the fire under control and extinguish it.

The restaurant, medical clinic and several adjacent tenants sustained heavy water damage. Water also entered into the mall common area. However, concrete and stone construction mitigated damage in these areas. The hotel sustained widespread smoke damage, as the exhaust duct traveled through portions of the hotel.

According to the fire department investigator, the fire started inside the section above the medical clinic. This portion of the duct reportedly contained six to eight inches (15 to 20 cm) of grease accumulations.

The oven's hood is equipped with two sprinklers that appear not to have activated. This observation is consistent with the fire occurring upstream in the duct.

Immediately inside the duct are water mist nozzles that protect against cinders generated by the wood fire that are occasionally sucked into the duct. Following the fire, the water mist system to protect against cinders was found to have been turned off.

4.0 REFERENCES

4.1 FM

Data Sheet 1-2, *Earthquakes*
Data Sheet 2-8, *Earthquake Protection for Water-Based Fire Protection Systems*
Data Sheet 2-81, *Fire Protection System Inspection, Testing and Maintenance*
Data Sheet 4-0, *Special Protection Systems*
Data Sheet 5-4, *Transformers*
Data Sheet 5-40, *Fire Alarm Systems*
Data Sheet 5-48, *Automatic Fire Detection*
Data Sheet 7-3, *Flight and Other Simulators*
Data Sheet 7-32, *Ignitable Liquid Operations*
Data Sheet 7-79, *Fire Protection for Gas Turbines and Electric Generators*
Data Sheet 7-101, *Fire Protection for Steam Turbines and Electric Generators*
Data Sheet 9-1, *Supervision of Property*
Data Sheet 10-7, *Fire Protection Impairment Management*

UTH: *Special Protection System Reliability* (P0379)

4.1.1 FM Approvals

FM 5560, *Examination Standard for Water Mist Systems*

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4.2 Other

American National Standards Institute (ANSI). ANSI/ASME B31.1, *Power Piping Code*.

Liu, Zhigang, Andrew Kim, and Joseph Su. “Examination of Performance of Water Mist Fire Suppression Systems under Ventilated Conditions.” *Journal of Fire Protection Engineering*. Volume 11, Number 3, 2001: 164-193.

Manufacturers Standardization Society (MSS) of the Valve and Fitting Industry. Standard Practice SP-58, *Pipe Hangers and Supports-Materials, Design, Man ufacturer, Selection, Application and Installation*.

National Fire Protection Association (NFPA). NFPA 3, *Standard for Commissioning of Fire Protection and Life Safety Systems*.

National Fire Protection Association (NFPA). NFPA 4, *Standard for Integrated Fire Protection and Life Safety System Testing*.

4.3 Bibliography

European Standard (EN). *Fixed firefighting systems - Water mist systems - Part 1: Design, installation, inspection and maintenance.* prEN 14972-1, June 2017.

National Fire Protection Association (NFPA). *Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems.* NFPA 25, 2026.

National Fire Protection Association (NFPA). *Standard on Water Mist Fire Protection Systems.* NFPA 750, 2027.

Verband der Sachversicher (VdS). *VdS Guidelines for Water Mist Systems, Water Mist Sprinkler Systems and Water Mist Extinguishing Systems (High Pressure Systems), Planning and Installation.* VdS 3188en, 2015-02(01).

Yu, Hong-Zeng. *“The Ceiling Height Limits for Water Mist Protection of Two Solid Combustible Fire Hazards in Open Environment.” Fire Technology* 57, 163-187 (2021).

APPENDIX A GLOSSARY OF TERMS

Approval Guide: An online resource of FM Approvals, the *Approval Guide* provides access to a fully searchable database of the most up-to-date information on approximately 50,000 FM Approved fire protection products, building materials, electrical equipment, and services that conform to the highest property protection standards.

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

Compartmented: A building space that is divided and separated into smaller areas.

Corridor: An area in a building that acts as a passageway with walls on both sides, no contiguous storage or combustible loading, and where entrances to compartments or rooms are found.

CPVC pipe: Chlorinated poly vinyl chloride (CPVC) is a plastic polymer used in an automatic sprinkler or low-pressure water mist distribution system.

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.

Dv_{50}: The volume median diameter; that is 50% of the total volume of liquid is in drops of smaller diameter and 50% in drops of larger diameter.

Deluge water mist system: A water mist system utilizing open (nonautomatic) nozzles attached to a piping network to the water and gas (if applicable) supply through a valve. Controlled by an independent detection system installed in the same hazard area as the water mist nozzles.

Emergency mechanical manual release: A mechanical manual discharge control which can function on the absence of electrical power or other energy sources other than stored pressure.

Embossing folder: A machine used in the tissue converting process that imparts texture, then forms/bends tissue products (e.g., napkins, toilet paper) prior to packaging.

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Enclosure: A confined or partially confined volume.

Engineered systems: A system requiring individual hydraulic calculation and design to determine the flow rate, pipe size and pressure at each individual nozzle. These calculations analyze the entire piping system, taking into account variables such as friction loss in valves, piping, nozzles and other components.

FM Approved: Product and services that have satisfied the criteria for Approval by FM Approvals. Refer to the *Approval Guide* for a complete list of products and services that are FM Approved.

Gas: Compressed gas used as prime mover to push water out of storage containers, through pipe networks, or distribution components.

High-pressure system: A water mist system where the distribution system piping is exposed to pressures of 500 psi (34.5 bar) or greater.

Ignitable liquid: Any liquid or liquid mixture that is capable of fueling a fire. Whether described as flammable, inflammable, or combustible, any liquid that has a fire point is an ignitable liquid.

Incidental storage: Solid-pile, palletized, rack, shelf, or bin-box storage that is normal for an occupancy (e.g., small amounts of packaging, raw materials, or the products being made). This is likely to be at the start or end of a production line. (See Data Sheet 3-26 for more information.)

Inspection: A visual examination that determines if a condition, device, equipment, or system is suitable for service.

Inspector's test connection: A device consisting of a manual control valve, a section of piping that allows discharge to a safe location, and a smooth-bore corrosion-resistant orifice no larger than the smallest orifice of any nozzle installed on the water mist system. It is used to test the waterflow alarm mechanism provided for the water mist system. It is typically installed at the most hydraulically remote end of a water mist system. Integrated system: A combination of systems that are required to operate together as a whole to achieve overall fire protection and life safety objectives.

Integrated system: A combination of systems that are required to operate together as a whole to achieve overall fire protection and life safety objectives.

Interconnected system: An integrated system that has component systems or devices physically connected to achieve fire protection and life safety objectives.

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

Isolation valve: A manually operated valve with supervision in the distribution piping between the nozzles and water supply or test connection piping that in the closed position prevents the flow of water to the protected area or test discharge area, respectively.

Listed: Equipment or materials included in a list published by a nationally recognized testing laboratory, e.g. FM Approvals, UL, or VdS, that maintains periodic inspection of production and whose listing states the equipment or material meets designated standards for specified purpose.

Local application systems: A water mist system arranged to discharge on the protected hazard and within the containment or confinement area around the hazard.

Log saw booth: A machine in an enclosure used in the tissue converting process to cut rolls of tissue products (e.g., toilet paper, paper towels) to size prior to packaging.

Low-pressure system: A water mist system where the distribution system piping is exposed to pressures of 175 psi (12.1 bar) or less.

Maintenance: Work conducted to ensure the continued satisfactory operation of a device or system.

Manual release: An actuation device or arrangement of devices that requires action by a human operator. The manual release may be initiated either mechanically or electrically.

Maximum operating pressure: The maximum pressure to which pipe or components will be subjected.

Ordinary hazard group 3 (OH3): Occupancies in Europe where combustible materials with medium fire load and medium combustibility are processed or manufactured belong to the ordinary hazard class. This class is subdivided into four groups (OH1-OH4). Occupancies such as archives, libraries, store rooms, shopping

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centers, and consumer markets generally fall into the OH3 group. A design is to use a minimum water application density of 5 mm/min with a demand area of 216 m^2.

Positive displacement pump: A pump that is characterized by a method of producing flow by capturing a specific volume of fluid per pump revolution and reducing the fluid void by a mechanical means to displace the pumping fluid.

Preaction systems: Automatic nozzles attached to a piping network containing a pressurized gas with a supplemental, independent detection system installed in the same area as the water mist nozzles.

Pre-engineered systems: A system having predetermined flow rates, nozzle pressures, and quantities of agent. These systems have specific pipe sizes, maximum and minimum pipe lengths, flexible hose specifications, number of fittings, and number and types of nozzles prescribed by a testing laboratory such as FM Approvals.

Pressure-reducing valve: A valve that will reduce the downstream fire protection water pressure under both flowing and non-flowing conditions.

Primary protection: A system that provides adequate protection in accordance with the occupancy-specific data sheet.

Reliable gas supply: A gas supply used for filling a dry-pipe or preaction sprinkler system that is always available. If the air supply is reliant on electrical power, to be considered reliable, the power supply must be fed by either a secondary supply independent of the facility' primary electrical supply or from an emergency generator adequately sized to properly maintained the facility's fire protection requirements.

Selector valve: An automatic operated valve in the distribution piping between the nozzles and water supply that controls the flow of water to the protected area in a zoned application system. This valve may also be designated as a "zone valve" or "section valve" by a manufacturer.

Single fluid system: A water mist system utilizing a single piping system to supply each nozzle. Nozzles may be supplied with water or a mixture of gas and water.

Sole protection: See primary protection.

Special protection system: A protection system used for either primary or supplementary protection in accordance with either the occupancy or equipment hazard data sheet, respectively. Special protection systems are designated as either carbon dioxide, clean agent (halocarbon or inert gas), dry chemical, foam, hybrid (water and inert gas) or water mist.

Supervision: A automatic means of monitoring a system or a device status and indicating abnormal conditions.

Supplementary protection: A special protection system to supplement automatic sprinkler protection in an effort to reduce the size of a loss in an occupancy sensitive to sustained fire (e.g., computer rooms or clean rooms) or as an alternative to emergency drainage in ignitable liquid storage and use occupancies. In these cases, automatic sprinkler protection is still needed.

Test: To physically operate a device or system to verify its working condition.

Test connection: A device consisting of a manual control valve, a section of piping that allows discharge to a safe location, and a smooth-bore corrosion-resistant orifice equivalent to the simultaneous discharge of all the open nozzles on the water mist system. It is used to test the waterflow alarm mechanism and operability of a water mist system.

Total flooding system: A system designed to protect all the hazards in an enclosure.

Twin fluid system: A water mist system in which water and gas as the atomizing media are supplied to the water mist nozzle using separate piping systems.

Unloader valve: A valve design to relieve excess flow below pump capacity at a set pump pressure.

Unoccupiable enclosure or space: An enclosure or space that has dimensions and physical characteristics such that it could not be entered by a person.

Water mist: A water spray for which the Dv 0.99, for the flow weighted cumulative volumetric distribution of water droplets, is less than 1,000 microns at the minimum design operating pressure of the water mist nozzle.

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Water mist nozzle: A special purpose device containing one or more orifices designed to produce and deliver an atomized water spray meeting the definition of “water mist” or meeting the specific requirements of an FM Approved water mist fire test protocol. Nozzles can be designed to operate independently of other nozzles, as a group of nozzles, or a combination of the two.

Working pressure: The maximum pressure applied to the system components, exclusive of pressure surges

Zoned application system: A system designed to protect multiple hazards in a predetermined portion of an enclosure.

APPENDIX B DOCUMENT REVISION HISTORY

The purpose of this appendix is to capture the changes that were made to this document each time it was published. Please note that section numbers refer specifically to those in the version published on the date shown (i.e., the section numbers are not always the same from version to version).

October 2026. Interim revision. The following changes were made:

A. Revised Section 1.1 and Section 2.4 to identify the following:

1. Additional equipment hazards and occupancies suitable for HC-2 and HC-3 water mist protection (See affected data sheets)
2. Ignitable liquid use or storage in cutoff room applications as primary protection

B. Updated Section 2.4.1 (Occupancy Protection) to address:

1. Conditions for design of water mist systems
2. Water mist systems for ignitable liquid use and storage
3. Using water mist systems in areas adjacent to those being protected by automatic sprinklers

C. Updated Section 2.4.3.1 (Water Mist Nozzles) to address:

1. The clearance between automatic nozzles and incidental storage or low pile storage
2. Inclusion of guidance for skylights and heat vents
3. Nozzle temperature ratings and localized maximum ambient temperatures.

D. Updated Section 2.4.4.7 (Preaction Systems) to include:

1. The use of a double-interlock configuration
2. Confirmation of maximum water delivery time by Acceptance Test
3. Drain connections at the preaction valve to verify proper operation

E. Revised Section 2.5.2 (Pump Systems) to differentiate electrical availability for supplementary water mist system protection.

F. Removed superfluous content from Section 3.0 (Support for Recommendations).

G. Relocated Illustrative Losses to Section 3.8 of the data sheet.

January 2022. Interim revision. Editorial revisions were made. Corrected reference in Section 2.5.8.6.3 and context in Section 2.5.8.6.7.

October 2021. Interim revision. The following significant changes were made:

A. Revised Section 1.1, Hazards, to identify new categories for which water mist systems can provide primary and supplementary protection.

B. Revised Section 2.4, Protection, to identify water mist systems that are FM Approved for the following specific applications:

1. HC-2 fire hazards
2. HC-3 fire hazards

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3. Steam turbines when listed for local application in the “Combination 2D Ignitable Liquid Pool Fire & Spray Fire Protection” category

4. Tissue embossed folders and log saw booths

C. Revised Section 2.5.1, Water Supply, to clarify the criteria for an acceptable water supply to be used with a water mist system.

D. Added new Section 2.4.3.6, Preaction Systems, to clarify that, for a single interlock preaction high pressure water mist system, smoke detection is allowable if the water delivery time is met.

E. Revised Section 2.5.8.6, Water Supply, to allow the use of the following in low-pressure water mist systems:

1. FM Approved CPVC pipe in the water distribution system for wet low-pressure water mist systems.

2. FM Approved standard ductile grooved couplings with A-312 stainless steel pipe.

July 2019. Interim revision. Clarification was made in Section 3.4.3.1, *Enclosure Protection*.

April 2019. This data sheet has been completely rewritten. Major changes include the following:

A. Clarified information on non-storage and equipment hazard applications that are part of the FM Approval listing category.

B. Expanded water mist system acceptance testing guidance to allow for alternative test methods.

C. Revised guidance on working plan submittals for plan review.

D. Added recommendations on the installation of FM Approved preaction water mist systems.

E. Added recommendations for positive displacement and pneumatic-driven water mist pumps.

F. Revised recommendations taking into consideration international standards (VdS, CEN) that provide guidance on design, installation, and operation of water mist systems.

G. Expanded Support for Recommendations section to explain the performance limitations of water mist systems.

July 2013. Deleted preaction water mist systems to provide consistency with equipment that is FM Approved.

January 2013. Minor editorial changes were made.

July 2011. Minor editorial changed were made for this revision.

April 2011. Moved occupancy related recommendations to occupancy-specific data sheet.

September 2010. Replaced all references to Data Sheet 2-8N, *Installation of Sprinkler Systems (NFPA)*, with references to Data Sheet 2-0, *Installation Guidelines for Automatic Sprinklers*.

September 2006. Minor editorial changes were made for this revision.

January 2006. Clarified recommendations for when a reserve supply of agent is needed, and added three new definitions to Appendix A. Also, the water demand for light hazard occupancies is now based on area rather than number of sprinklers.

January 2005. Minor editorial changes were made for this revision.

September 2004. Section 2.2.1 was modified to allow the use of light hazard water mist systems FM Approved for open area protection.

January 2004. Minor editorial changes were made for this revision.

September 2003. Minor editorial changes were made for this revision.

January 2003. Minor editorial changes were made for this revision.

September 2002. Minor editorial changes were made for this revision.

September 2001. The following changes were made for this revision:

1. Loss experience was added.

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2. Fire test descriptions were included for FM Approved water mist systems.
3. General criteria for water mist system installation was provided.

APPENDIX C COMPARISON WITH OTHER WATER MIST SYSTEM INSTALLATION STANDARDS

There is relative agreement between this data sheet and the following standards:

- NFPA 750, *Standard on Water Mist Fire Protection Systems, 2027 Edition*

One significant area of disagreement is with the discharge time duration. For occupancy systems providing primary protection, agent supply should be adequate for the largest single hazard with a 60 minute supply as compared to a 30 minute supply in NFPA 750. For supplementary protection systems, agent supply should be adequate discharge times are defined by the FM Approvals listing.

Data Sheet 4-2, *Water Mist Systems*: Protection duration is based on whether fire scenarios are extinguished or controlled during test scenarios. If all fire scenarios are extinguished, the water supply is a multiple, usually twice, that needed to extinguish the worst fire scenario. If one or more fire scenarios are controlled (not extinguished) the duration of the agent supply is what would be recommended for automatic sprinkler protection for this occupancy.

- BS 8489, Series 1-7, *Fixed Fire Protection Systems*. Industrial and commercial watermist systems. 2016 Edition.

BS 8489, Series 1-7, provides design and installation requirements along with fire test protocols. Part 1 provides design and installation with a number of suitable occupancies for water mist system protection. These occupancies in Category I, II, and III of Table 2.4.1 are aligned with FM's Hazard Category 1 (HC-1). There are no representative fire test protocols in the BS 8489 series for occupancies that would align with FM's Hazard Category 2(HC-2) or Hazard Category 3 (HC-3). On publication of EN 14972, Part 1, the UK is expected to withdraw BS 8489.

- EN 14972, *Fixed firefighting systems – Watermist systems – Design and Installation*.

EN 14972 provides a test protocol for the protection of European Ordinary Hazard Group 3 (OH-3) fire hazards. The hazard group can be up to 4 m (13 ft) in height, depending on the combustibility of the protected materials. The EUR plastic commodity and corrugated cartons with cardboard dividers are in solid-piled or shelf configurations. The corrugated carton with cardboard dividers is similar to the FM Class 3 Commodity, but without paper cups inside the carton. Per the EN standard, the protection is applicable to automatic nozzles for unlimited floor area. The required application density for a water mist system is determined by fire testing.

FM's HC-2 and HC-3 commodities in a rack or palletized configuration are comparable to the European OH-3 hazard, and the NFPA OH-1 and OH-2 hazards.

APPENDIX D FORMS

The following forms may be used to assist in the commissioning of a water mist system:

- Contactor's Material & Test Certificate for Underground Piping (85B, 85BS, 85BR)
- Pump Acceptance Test Data (105, 105B)

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