**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-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
- 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 Global'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 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

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.

## 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.

### 2.2 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.

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

These designs are not intended for occupancies with the following conditions:

A. Ignitable liquid storage or use in excess of the quantities considered incidental in Data Sheet 3-26, *Fire Protection for Nonstorage Occupancies*; Data Sheet 7-29, *Ignitable Liquid Storage in Portable Containers*; or Data Sheet 7-32, *Ignitable Liquid Operations*.

B. 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, *Prevention and Mitigation of Combustible Dust Explosions and Fire*.)

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

D. Concealed/shielded spaces with combustible construction or content, unless in compliance with 2.4.1.2. (See Data Sheet 1-12, *Ceilings and Concealed Spaces*, or Data Sheet 3-26, *Fire Protection for Nonstorage Occupancies*.)

E. Occupancies with solid or grated mezzanines, unless in compliance with Section 2.4.1.2.

F. Occupancies with heat and/or smoke vents and other exhaust openings at ceiling level.

G. Storage amounts or areas greater than provided in incidental storage. (See Data Sheet 8-9, *Storage of Class 1, 2, 3, 4 and Plastic Commodities*.)

H. Storage amounts of any uncartoned plastic.

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

2.4.1.2 For occupancies with concealed/shielded spaces or mezzanines (grated or solid), provide protection in/below those obstructions if combustible materials are present. 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 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<br><br>- Pulp & Paper Industry; tissue embossing folders and log saw booths | Lightly loaded nonstorage and nonmanufacturing areas with ordinary combustibles. No incidental storage of plastic or ignitable liquids. No plastic construction elements.<br><br>FM Approved water mist systems for the HC-1 category are only suitable for HC-1 occupancies.<br><br>- Application of FM Approved water mist systems for HC-1 occupancies is limited to:<br>- A. wet pipe systems; do not use dry or preaction systems.<br>- B.maximum ceiling height of 16.4 ft (5 m).<br>- C. minimum 30-minute fire resistance rating of the wall and/or ceiling.<br><br>- 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.<br><br>- For protection of large or open compartments, use FM Approved water mist systems specifically listed for a ″maximum protected area - unrestricted.” | 3-26 |
| Protection of Non-Storage Occupancies, Hazard Category 2 (HC-2) | HC-2 | Nonstorage and manufacturing areas with ordinary combustibles, with plastic and ignitable liquids used or stored not in excess of incidental quantities. No plastic construction elements.<br><br>FM Approved water mist systems for the HC-2 category are suitable for HC-2 and HC-1 occupancies.<br><br>- Application of FM Approved water mist systems for HC-2 occupancies is limited to:<br><br>- A. wet pipe systems; do not use dry or preaction systems.<br><br>- B. minimum 30-minute fire resistance rating of the wall and/or ceiling.<br><br>- Do not use systems listed to protect areas and ceiling heights greater than specified in the FM Approval listing. | 3-26 |

*Table 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 3 (HC-3) | HC-3 | Nonstorage and manufacturing areas with ordinary combustibles with uncartoned plastics and ignitable liquids not used or stored in excess of incidental quantities. No plastic construction elements.<br><br>FM Approved water mist systems for the HC-3 category are suitable for HC-3, HC-2, and HC-1 occupancies.<br><br>- Application of FM Approved water mist systems for HC-3 occupancies is limited to:<br>- A. wet pipe systems; do not use dry or preaction systems.<br>- B. minimum 30-minute fire resistance rating of the wall and/or ceiling.<br>- Do not use systems listed to protect areas and ceiling heights greater than those specified in the FM Approval listing. | 3-26 |
| Protection of Data Processing Equipment Room/Halls - Above-floor Protection | Rooms/areas with forced ventilated and propagating cables:<br>- Control rooms- Data center processing equipment rooms/halls<br>- Diagnostic equipment rooms<br>- Process control rooms-Telecommunication rooms | - Not intended to provide equipment protection.<br><br>- Application of FM Approved water mist systems for data processing equipment rooms/halls is limited to:<br>- A. wet pipe systems and single interlock preaction systems.<br>- B. maximum ceiling height of 16.4 ft (5 m).<br>- C. minimum 30-minute fire resistance rating of the wall and/or ceiling. | 5-32 |
| Protection of Data Processing Equipment Room/Halls - Below-floor Protection | Concealed areas below raised floors with forced ventilation and propagating cables in:<br>- Control rooms<br>- Data center processing equipment rooms/halls<br>- Diagnostic equipment rooms<br>- Process control rooms<br>- Telecommunication rooms | | 5-32<br>5-14 |

### 2.4.2 Equipment Protection

2.4.2.1 FM Approved water mist systems may be used to provide supplementary protection of the equipment designated in Table 2. Additionally, provide a primary form of fire protection (typically an automatic sprinkler system) for protection of the building in accordance with the relevant occupancy-specific data sheet.

*Table 2. Protection of Equipment with Water Mist Systems*

| *FM Approval Listing Category* | *Equipment* | *Restrictions* | *Associated Data Sheet* |
|---|---|---|---|
| Continuous Wood Board Presses | - Continuous wood board press<br>- Industrial ovens | - Adhere to maximum opening size<br>- Interlock forced ventilation for shutdown | 7-10 |
| Protection of Combustion or Steam Turbines in Enclosures with Volumes:<br>≤9175 $ft^3$ (260 $m^3$)<br>>9175 $ft^3$ (260 $m^3$) | - Enclosures with combustion turbines<br>- Enclosures with steam turbines | - Maximum enclosure volume<br>- Ceiling height<br>- Do not extrapolate the design from a smaller tested enclosure to a larger, untested enclosure.<br><br>- 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.)<br><br>- Maximum un-enclosable opening sizes<br>- Provide protection to doorways and permanent openings based upon the dimensions specified in the FM Approved Design, Installation, Operation and Maintenance manual.<br><br>- 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.<br><br>- Interlock ventilation for shutdown. | 7-79<br>7-101 |
| Protection of Industrial Oil Cookers | - Industrial oil cookers<br>- Non-insulated conveyorized fryers<br>- Batch kettles | - Maximum width<br>- Vertical nozzle distance from cooking oil surface<br>- Maximum cooking oil depth<br>- Auto-ignition temperature of the cooking oil<br>- Excludes protection of ancillary equipment such as exhaust ducts, heaters, heat exchangers, and food processing areas. | 7-20 |

*Table 2. Protection of Equipment with Water Mist Systems (contin'd)*

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

2.4.2.2 Provide water mist systems in accordance with their FM Approval limitations and the manufacturer's DIOM manual.

### 2.4.3 Design of Water Mist Systems

#### 2.4.3.1 Water Mist Nozzles

2.4.3.1.1 Design FM Approved water mist nozzle(s) in accordance with the limitations of their Approval and the manufacturer's DIOM manual. 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 2.4.3.1.2)

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

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

2.4.3.1.3 Obstructions

2.4.3.1.3.1 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

2.4.3.1.3.2 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.

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

2.4.3.1.4 Automatic Nozzles

2.4.3.1.4.1 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).

2.4.3.1.4.2 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.

2.4.3.1.4.3 See Table 3 for the recommended temperature rating of the automatic nozzle based on the expected ambient temperature at nozzle level.

*Table 3. 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 (55) | Ordinary | Orange |
| 100 (38) | 155 (68) | Ordinary | Red |
| 150 (66) | 175 (80) | Intermediate | Yellow |
| 150 (66) | 212 (100) | Intermediate | Green |

2.4.3.1.4.4 Do not mix automatic nozzles having different nominal temperature ratings or response time index (RTI) values protecting the same hazard area.

2.4.3.1.5 Open Nozzles

2.4.3.1.5.1 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.

### 2.4.3.2 Discharge Duration

2.4.3.2.1 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

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

- 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 2.4.3.5

2.4.3.3.2 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.

2.4.3.3.3 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.

### 2.4.3.4 Connected Reserve

2.4.3.4.1 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

2.4.3.4.2 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.

### 2.4.3.5 Hydraulic Design

2.4.3.5.1 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.

2.4.3.5.2 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.

2.4.3.5.3 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.

2.4.3.5.4 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.

2.4.3.5.5 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.

2.4.3.5.6 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.

#### 2.4.3.6 Preaction Systems

2.4.3.6.1 For preaction systems, calculate the maximum water delivery time to the limit specified in the *Approval Guide* listing or occupancy-specific data sheet, whichever is shorter.

2.4.3.6.2 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.

2.4.3.6.3 For preaction water mist systems protecting a data processing equipment room with a single 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.

### 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 and Figure 4, respectively.

#### 2.5.1 Water Supply

2.5.1.1 Provide a water supply with adequate flowrate and pressure per the applicable FM Global 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

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

2.5.1.3 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. 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 1.)

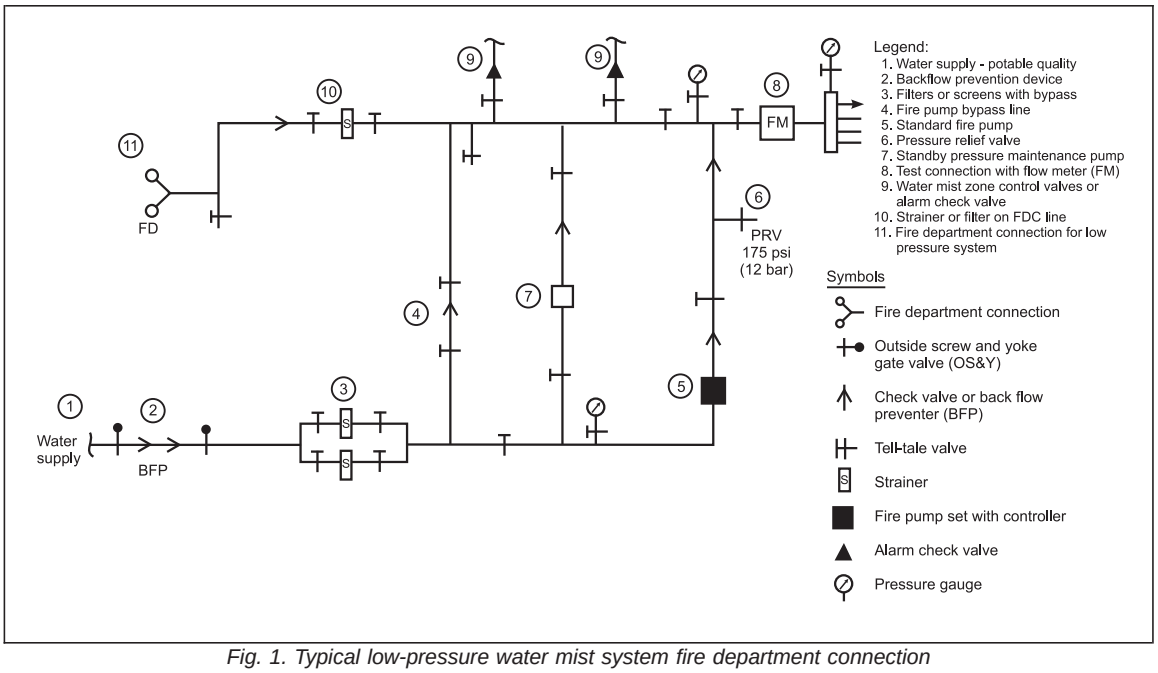


*Fig. 1. Typical low-pressure water mist system fire department connection*

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.)

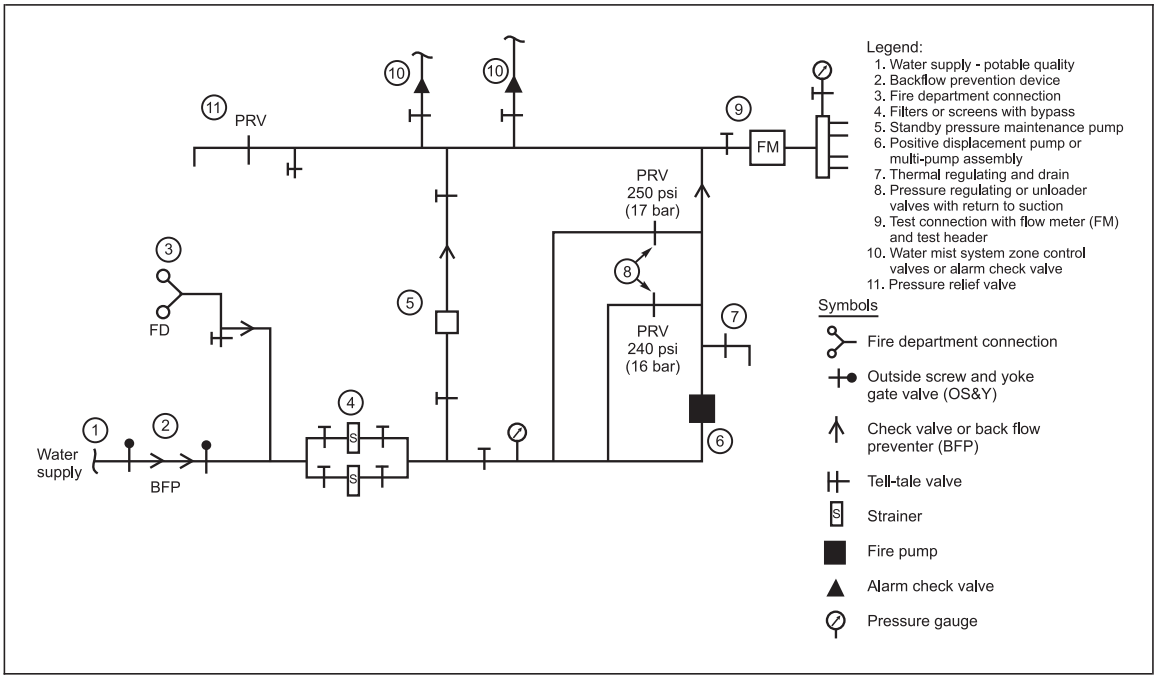


*Fig. 2. Typical high-pressure water mist system fire department connection*

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.) per the water mist system manufacturer's design, installation, operation, and maintenance manual; and Data Sheets 3-7, *Fire Protection Pumps*, and 3-10, *Fire Service Mains*.

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 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.

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.

### 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.

### 2.5.7.3 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 1 (low pressure) and Figure 2 (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:

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
- Aluminum tubing or fittings
- Cast-iron pipe or fittings
- Polymer coated steel pipe or fittings (e.g., Fendium)
- 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. A 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 150oF (66$^{o}$C) or the temperature designated in the FM Approval.

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

2.5.8.6.7 Provide piping that is when dry in the standby condition (e.g., open nozzle systems) as follows:

A. Install flushing and drainage valves/connections.

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

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.

2.5.8.6.8 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 4 or the FM Approved design, installation, operation, and maintenance manual

*Table 4. 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.

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, flush the water distribution piping using the system's normal water supply. Continue flushing for a time sufficient to ensure thorough cleaning, allowing the water to run clear. 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.

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

2.5.8.11.2 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.

2.5.8.11.3 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.

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

#### 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.

#### 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 2.5.9.3.2 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 Global.

**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 Global 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 Global 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).

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

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.

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 Global 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 and FM Global form(s) completed in accordance with the recommendations for system acceptance with specified hydrostatic pressure tests, water mist system operational and discharge tests for final acceptance. Submit the following forms (see Appendix D), as applicable:

- Contractor's Application for Acceptance of Water Mist System Installations (5560)
- Contactor's Material & Test Certificate for Underground Piping (85B, 85BS, 85BR)
- Pump Acceptance Test Data (105, 105B)

#### 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.

#### 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 in accordance with the Contractor's Application for Acceptance of Water Mist System Installations (Engineering Form 5560).

#### 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 time delay specified 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*.

### 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)
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.

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 special protection systems that use small water droplets to control or extinguish fires. Whereas conventional sprinkler protection controls, suppresses, or extinguishes a fire through wetting and cooling, water mist controls or extinguishes fire through the following mechanisms:

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

A water mist system can be classified as either a single fluid or twin fluid (water and atomizing gas) media type. The water mist system can be designated as either low pressure (less than 175 psi [12.1 bar]) or high pressure (greater than 500 psi [34.5 bar]). The hydraulic characteristics of the water mist system can be specified being as either a pre-engineered or engineered type.

Water mist systems are a supplement to sprinkler protection and are not a substitute for it unless a water mist system is specifically recommended in the appropriate occupancy specific data sheet as primary protection.

#### 3.1.1 Applications for Which Water Mist Systems are Not Recommended

Water mist systems are not suitable for protecting the following:

- Energized electrical equipment, enclosed or unenclosed (Class C)
- Storage of ignitable liquids (>110 gal [>420 L])
- Chemicals, such as cellulose nitrate, that 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
- 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 are water-based protection systems. The maximum temperature evaluated for operability of components as part of the certification for FM Approval is 130°F (54°C). Alternate temperature ranges are acceptable if identified as part of the FM Approval listing. Heating, ventilation and cooling should be maintained for normal building service areas and when installed in a separate stand-alone enclosure.

When considering the installation of a water storage tank and gas cylinders, provide enough space around the tank and cylinders so it can be removed or replaced for inspection, testing or maintenance.

### 3.3 Personnel Safety

The following considerations should be made with respect to personnel where water mist systems are used:

- Temperature/visibility. Discharge of a water mist can cause reduction in temperature and visibility. Visibility will return to pre-discharge state when the temperature in the enclosure rises above the dew point temperature.
- Wetting of surfaces. Caution is advised when walking on surfaces which may have been wetted by the

discharge. Electrical energy could be conducted across wetted surfaces. Wetting of surfaces is possible particularly if there is little heat present to evaporate the water droplets.

### 3.4 Protection

No general design method is recognized for water mist systems. Performance objectives need to be proven by fire test in the configuration and for the types of fire scenarios expected in the intended installation. Applicable tests are identified in FM Approval Standard Class Number 5560, Approval Standard for Water Mist Systems.

FM Approval testing involves the completion of a series of fire tests that replicate the type of fuel, configuration, and severity that will be found in the hazard to be protected. The Approval standard also includes functionality testing of the integral components that comprise the water mist system. The fire tests prove the water mist system will perform effectively in the event of a fire, while the functionality testing verifies the system and components will operate properly.

The only allowable scaling methodology developed by FM Global is that of a Froude-modeling-based scaling methodology. This methodology inclusive of fire tests can be used to assess the water mist protection requirements for larger or smaller enclosures that are geometrically similar to an enclosure for which the required water mist protection has been determined. The scaling methodology has been implemented in the FM Approval Standard Class Number 5560 for scale ratios up to 2.

#### 3.4.1 System Limitations

The fire tests described in Section 3.4 confirm the successful performance of a water mist system on a specific fire hazard. It is not possible though to determine system performance on fire hazards beyond the scope of the tests that have been conducted. For example, a water mist system that has demonstrated successful performance on ignitable liquid spray and pool fires associated with the Class 5560 fire test protocol for gas turbines can be installed to protect gas turbine compartments. However, the performance of this same system in a light hazard occupancy is unknown until fire testing specific to that occupancy has been conducted.

##### 3.4.1.1 System Configuration

Additionally, fire testing is conducted using the anticipated system configuration and limitations, as stated by the system manufacturer. This includes but is not limited to maximum nozzle spacing, protected enclosure height, enclosure volume, and maximum area of enclosure openings. Performance of the system beyond these tested limitations is unknown.

For instance, extrapolation of a water mist system design from a smaller tested compartment to a larger, untested compartment will not result in equivalent performance. For example, if fire testing was done on a compartment 10,000 $ft^3$ (283 $m^3$) in volume, it cannot be assumed that a 20,000 $ft^3$ (568 $m^3$) volume compartment could be successfully protected using twice the number of nozzles and twice the amount of water or gas.

##### 3.4.1.2 Interlocks

To the greatest extent possible, water mist system installations must align with the ambient conditions in which they were fire tested. This includes consideration of any auxiliary interlock functions that must occur to ensure effective fire control or extinguishment. Examples of auxiliary functions include power disconnect, fuel shut off, HVAC control, damper closure, door closure and similar devices.

The interaction of the water mist system with auxiliary functions and environmental control systems should be carefully evaluated to determine which systems should be shut down and which should continue to operate when the water mist system is activated. For example, the Class 5560 fire test protocol for machinery spaces only includes natural ventilation. Any forced ventilation could result in excessive loss of water vapor and combustion products, reducing the performance capability of a water mist system. Hence, any forced ventilation systems should be interlocked to shut down prior to water mist system activation.

For additional information on the impact of ventilation (no ventilation, natural ventilation, and forced ventilation), see the Journal of Fire Protection Engineering article “Examination of Performance of Water Mist Fire Suppression Systems under Ventilated Conditions.”

### 3.4.2 Occupancy Protection

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

Water mist can be considered as primary protection if recommended in the occupancy specific data sheet. Other applications for equipment protection generally require automatic sprinkler protection in addition to the water mist system for adequate protection.

To provide a water mist system that is FM Approved for an HC-1, HC-2, or HC-3 category, a thorough review and assessment of the occupancy hazard needs to be conducted for the presence of the conditions identified in Section 2.4.1.1. This is because the presence of these conditions may necessitate the use of a water mist system that is FM Approved for a different category (e.g., enclosures with machinery), or may determine a water mist system cannot be provided as protection at all.

Nonstorage and certain manufacturing occupancies are where water mist systems can be used as an alternative to automatic sprinkler systems. Fires are controlled rather than extinguished, requiring water discharge durations equivalent to an automatic sprinkler system.

Nonstorage Hazard Category 1 (HC-1) occupancies, such as offices and hotels, are examples of where water mist system protection for light hazard occupancies (LHO) is acceptable. “Light Hazard” is an occupancy classification that has traditionally been used by the National Fire Protection Association (NFPA) and others in the fire protection and loss prevention industry.

Nonstorage Hazard Category 2 (HC-2), such as utility rooms and supermarkets, are examples from Data Sheet 3-26, *Fire Protection for Nonstorage Occupancies*, for which the HC-2 hazard is represented by the Class 2 Commodity in a standard rack configuration of two tiers high. While the nonstorage Hazard Category co;203 (HC-3), such as storerooms, is represented by the cartoned meat tray (Cartoned Expanded Plastic [CEP] commodity) in the palletized configuration of one pallet load high. The fuel array tested was two pallet-loads wide, and four pallet-loads long. “Ordinary hazard (Group 1)” and “Ordinary hazard (Group 2)” are occupancy classifications that have traditionally been used by the NFPA, and “Ordinary Hazard 3 (OH-3)” in European fire protection and loss prevention industry are similar to the hazard classification designations used by FM Global.

To confirm the efficacy of water mist protection of the fire hazards in the aforementioned higher categories sanctioned by CEN and NFPA, FM Global conducted a fire test program in 2016 and 2018. Water mist sprays selected for this evaluation were based on the droplet propensities in fire plume penetration, vaporization, and surface deposition. This evaluation affirmed the expectation that spray characteristics greatly influenced the fire suppression result. The tests showed that the primary factor for water mist suppression of solid combustible fires in open environments was fuel wetting, not localized oxygen depletion. Furthermore, in addition to the application density requirement, the median droplet size in the spray had to be sufficiently large to ensure droplet depositing on the combustible surface for wetting. Overall, the required water mist application density was found to be comparable to that of the sprinkler protection to obtain a comparable fire suppression result for the intended fire challenge.

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

There are two design methods for data processing equipment rooms/halls, below raised floor protection:

- Area of coverage
- Local application

The “area of coverage” design method is used when, at the time of the installation, it is unknown where the cable trays will be located. The nozzles are installed to protect the entire area below the raised floor.

The “local application” design method is used when, at the time of the installation, it is known where the cable trays will be located. The nozzles are installed in direct proximity to the cable trays.

### 3.4.3 Equipment Protection

#### 3.4.3.1 Enclosure Protection

Water mist has proven to be effective in extinguishing high heat release rate fires in enclosures, including rooms or compartments containing gas turbines, indoor transformers, and similar equipment with an ignitable

liquid fire hazard in lieu of providing automatic sprinklers for protection of the hazard. Automatic sprinkler protection, though, is still to be provided for those areas outside the water-mist protected enclosure (i.e., the building).

These systems are fire tested with openings present in the enclosure. The openings are intended as a fault condition to prove the water mist system performance under limited natural ventilation. The intent is that the systems are installed with all openings being closed via interlocks/dampers when the water mist system is activated to provide a sealed enclosure.

If unclosable openings are present in an enclosure they may be able to 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 is important to the performance of the system as 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 thus providing cooling and reducing the oxygen concentration in the enclosure. 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 as opposed to openings near ground level.

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

- Data Sheet 5-23, *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, *Ignitable Liquid Storage Tanks*

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.

#### 3.4.3.2 Local Application

Local application systems can extinguish ignitable liquid pool and spray fires. Critical features are nozzle spacing and height above the hazard, as well as containment of the ignitable liquid (e.g., via curbs or dikes). Local application systems work largely by flame cooling, with inerting providing less of a contribution as for enclosure fires.

This application of a water mist system is similar to a local application carbon dioxide system. Automatic sprinkler protection at ceiling level is usually needed as well.

### 3.4.4 Design of Water Mist Systems

Water mist systems consist of specialized equipment designed specifically by the manufacturer to be part of this type of special protection system.

Water mist system components include, but are not limited to, 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 pipe support
- Actuation controls
- Check valves
- Discharge alarms
- Pressure gauges/transducers
- Drain valves
- Relief valves
- Regulators

Water mist systems are listed in the Fire Protection volume of the *Approval Guide* under Fixed Extinguishing Systems. The Water Mist Systems sections are categorized to the type of occupancy, hazard or hazard enclosure type with the critical limitations to be used in the application of the protection.

Some water mist systems are deluge-type special protection systems and therefore must be paired with compatible detection and fire alarm control units. The following components are listed in the Electrical Signaling section in 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)

**3.4.4.3 Obstructions to discharge from nozzle**

3.4.4.3.1 Obstructions will affect the performance of water mist protection. The impact of the obstruction will vary according to the type of spray technology and the type of application. Water mist nozzles have a wide range of projection distances, spray velocity and spray patterns.

3.4.4.3.2 Spray from nozzles that impinge too close on obstructions will not fully atomize, and a portion of the water mass will be removed from suspension. Such losses diminish the extinguishing effectiveness of total flooding or local application systems. For combustibles where prewetting is an important factor in preventing fire growth, obstructions to spray development prevent wetting of unburned materials and diminish the performance of the water mist system.

3.4.4.3.3 Additional nozzles may be required to overcome the presence of obstructions and ensure adequate system performance when obstructions and maximum coverage distances to obstructions are not evaluated as part of the FM Approval.

**3.4.4.4 Discharge Duration**

3.4.4.4.1 For most applications, particularly those where water mist serves as supplementary protection to automatic sprinklers, a limited agent supply is provided. If the fire has not been extinguished before the water or gas is exhausted, the fire will continue to grow. The fire testing conducted by FM Approvals examines the time to extinguish test fires. The quantity of water and gas supplied is based on these extinguishment times, including an appropriate safety factor.

3.4.4.4.2 The occupancy specific data sheet may also provide a discharge duration, based on the expected fire hazard, that exceeds the duration listed in the water mist system manufacturer's design, installation, operation, and maintenance manual. If a data sheet allows the use of water mist as primary protection and the water mist system has been FM Approved for that application, the duration of agent supply must be the same as required for automatic sprinkler protection.

3.4.4.4.3 If water discharge continues after the compressed gas supply has been exhausted, it is not effective for fire suppression. If the system has been FM Approved for intermittent discharge, the quantity required is for the actual time of discharge.

**3.4.4.5 Hydraulic Design**

3.4.4.5.1 A pre-engineered system simply means the system is limited to very specific combinations of pipe sizes and lengths, including the total number of tees (flow splits), elbows, and nozzles, and does not involve flow calculations. Typically, pre-engineered systems are restricted to balanced piping configurations (i.e., 50-50 flow splits).

3.4.4.5.2 An engineered system is a designed/flow-calculated system that normally involves the use of a proprietary flow calculation program. The flow calculation program is evaluated/verified through testing as part of the FM Approval process for each fire equipment manufacturer's system. Output Reports with "errors" from the hydraulic calculation program are not within the limitations of the FM Approved specification for Plan acceptance.

3.4.4.5.3 The hydraulic pressure loss for a single fluid water mist system can be calculated Hazen-Williams equation for working pressure not exceeding 175 psi (12 bar). For systems with working pressures exceeding 175 (12 bar) the Darcy-Weisbach equation is used.

### 3.4.4.6 Preaction Systems

Water mist systems in the preaction configuration are evaluated with a maximum water delivery time as to the impact on performance to extinguish a fire as part of the FM Approval listing (e.g., Protection of Data Processing Equipment Rooms/Halls; Above-Floor Protection and Below-Floor Protection). The maximum water delivery time is identified as part of the FM Approval listing. Other occupancy categories for which a preaction configuration is to being proposed for installation but not evaluated as part of the FM Approval listing may provide inadequate fire protection. This is due to the size of fire growth prior to the application of water mist as compared to it being provided as a wet system in accordance with its FM Approval listing.

## 3.5 Equipment and Process

Typical low-pressure and high-pressure water mist systems are identified in Figure 3 and Figure 4.

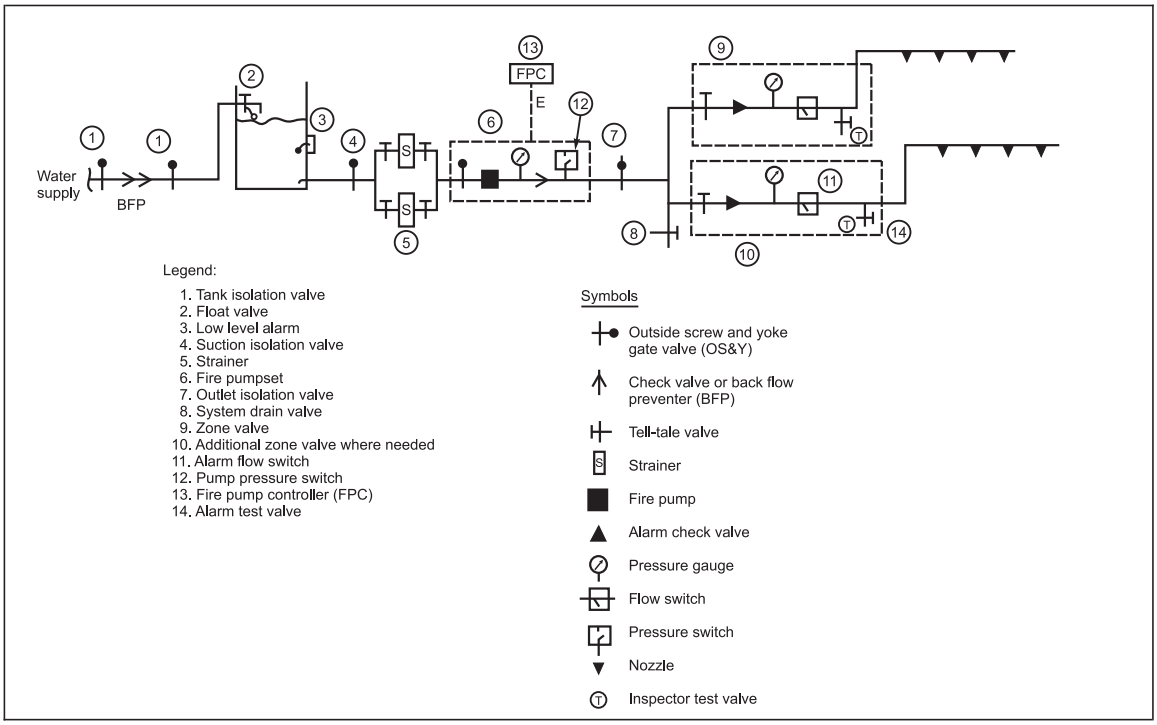


*Fig. 3. Schematic of low-pressure water mist system (pump driven)*

### 3.5.1 Water Supply

#### 3.5.1.1 Water Supply Storage Container

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

#### 3.5.1.2 Strainers

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

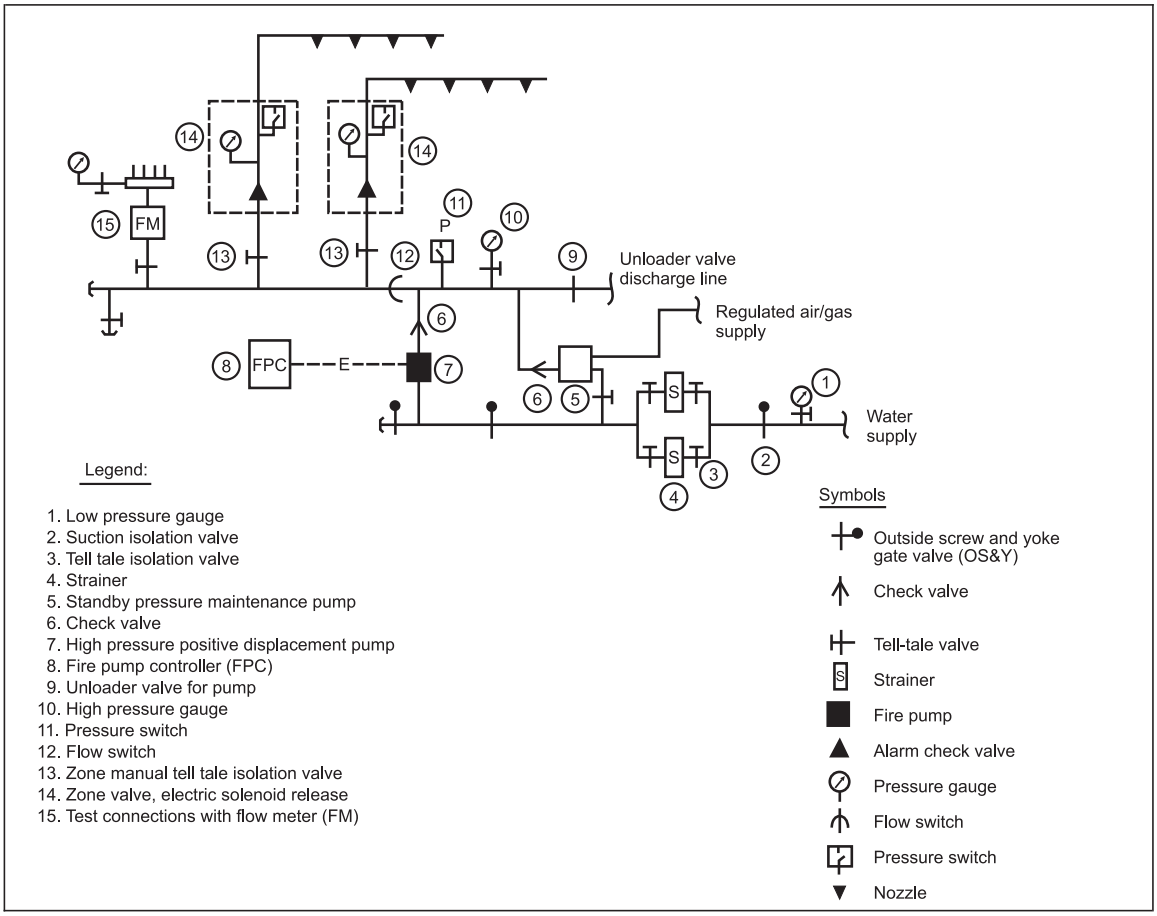


*Fig. 4. Schematic of high-pressure water mist system (pump driven)*

### 3.5.4 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.

### 3.5.5 Pressure Safety Devices

Pressure unloader valves are typically used with a positive displacement pump with a variable demand piping system (e.g. automatic nozzles). An unloader valves opens at a pre-set pressure which allows the unused portion of the pump discharge to bypass the distribution system. Using a unloader valve allows for the positive displacement pump to be graphical represented as a horizontal line in the pump curve.

### 3.5.6 Valves

When selector valves are used for multi-hazard protection, the effect of migrating water mist media into adjacent zones could activate unwanted releases with standard smoke detection. Care needs to be given to match detection devices to the environment in both normal and release conditions.

### 3.5.7 Test Connections

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

### 3.5.8 Distribution System

3.5.8.1 Pipe and tubing are used interchangeably as part of the distribution system terminology. Pipes though typically accommodate applications with nominal sizes for the large flow of liquids and a low internal pressure. With higher pressures the wall thickness (Schedule) of the pipe increases along with the weight per unit length due to the materials of construction. Tubing is generally used in applications with smaller rates of flow with medium to high internal pressure. The stability of the tubing is dependent upon high strength materials of construction which allows for a reduced wall thickness and weight per unit length. The usage of either pipe or tubing will be specified as part of the manufacturer's FM approved design, installation, operation and maintenance manual.

3.5.8.2 Teflon tape or the water mist system manufacturer's thread locker compounds at the pipe joints may be used to prevent leakage from the pipe joints. It is essential that pipe sealants, Teflon tape or lubricants not be allowed to enter into the pipe network. Applying sealant, tape or lubricant, only to the pipe threads reduces the possibility of these substances entering the pipe network and plugging small orifices in control devices or discharge nozzles, the possibility of such material entering the pipe network is greatly reduced.

3.5.8.3 Using installation equipment to connect pipe or tubing that is not rated for their material of construction could lead to leaks of the distribution system.

3.5.8.4 Galvanized steel pipe and fittings or aluminum tubing and fittings are not recommended for the water supply line in water mist systems. Small orifice nozzles have the potential for blockage due to corrosion, water quality and flaking of pipe coatings. Current standards for galvanized piping cannot ensure the internal coating will not flake and obstruct nozzles and strainers. Hence it is critical to select water mist system pipe or tubing that exhibits minimal corrosion. This will reduce the possibility of a blockage to the small orifices in the open nozzle by degradation of the internal pipe coating from corrosion.

3.5.8.5 Using compatible pipe materials will limit the occurrence of galvanic corrosion between piping, fittings and different materials of construction that can promote leakage.

3.5.8.6 Piping Support

The piping should be supported and braced to restrict movement due to 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.

3.5.8.7 Pressure Test of Distribution Piping

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

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 include requirements on:

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

### 3.5.9 Operation and Control of Systems

#### 3.5.9.1 Actuation

For large hazard areas and/or where access may be limited, consider installing additional manual actuation devices both local to, and remote from the emergency mechanical manual actuating device of the water mist (water and gas) agent supply.

Auxiliary interlock functions include any functions that must occur to ensure effective control or extinguishment of fire based upon limitations of the water mist systems. Examples of auxiliary functions may be power disconnect, fuel shut off, HVAC control, damper closure, door closure and similar devices.

The interaction of the water mist system with auxiliary functions and environmental control systems should be carefully evaluated to determine which systems should be shut down and which should continue to operate

when the water mist system is activated. For example, fuel supplies, lubrication oils, ignition sources, and ventilation systems should be evaluated to determine their impact on the performance of the water mist system and the equipment being protected.

#### 3.5.9.2 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.

#### 3.5.9.3 Alarms

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

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 discharge of the system only for time sufficient to allow evacuation of personnel from areas within the spaces most remote from the exits.

### 3.6 Acceptance of the Water Mist Systems

#### 3.6.1 Commissioning and Integrated Testing

Water mist systems are complex special protection systems which may include both active and passive fire protection equipment and systems, along with critical support equipment to protect the hazard or occupancy. A total commissioning and integrated test program may be warranted to assist in the quality control for operational functionality of the equipment or occupancy. The following documents provide guidance in the development of a program to verify that integrated fire protection and life safety systems perform as intended:

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

#### 3.6.2 Acceptance Test Plan

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

#### 3.6.3 Acceptance Testing

In order to guarantee the water mist system is designed and installed properly for the application for which it was intended, it is imperative that an operational test be conducted. Most water mist system equipment is installed at the job site. In order to make sure all the correct equipment has been installed properly and in the correct arrangement, an acceptance test must be performed that indicates operability as specified in the manufacturer's FM Approved design, installation, operation and maintenance manual. Acceptance Testing also, makes sure all components are installed in their proper orientation and pressure settings. It is advisable to note the performance of the system at its acceptance test and then compare the results of annual testing to flag any potential problems.

#### 3.6.4 Documentation

The documentation recommended to be kept on file by the client is to allow for verification of proper operation of the water mist system over it's intended life cycle to provide protection should the installing contractor or manufacturer of the water mist system no longer directly support the product, it is no longer is FM Approved, or there be a need to modify the protection being provided.

### 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 errors) are corrected

B. Any unanticipated failures (e.g., due to design/manufacturing process deficiencies or overstresses or aging) or other issue causing the component or system not meet its design intent with respect to functionality and performance.

## 4.0 REFERENCES

### 4.1 FM Global

Data Sheet 2-81, *Fire Protection System Inspection*
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

Class 5560, *Approval Standard for Water Mist Systems*

### 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, Manufacturer, Selection, Application and Installation*.

National Fire Protection Association (NFPA). NFPA 3, *Recommended Practice for Commissioning and Integrated Testing of Fire Protection and Life Safety Systems*.

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### 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, 2017.

National Fire Protection Association (NFPA). *Standard on Water Mist Fire Protection Systems.* NFPA 750, 2019.

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.

**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.

**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 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, dry chemical, foam, halon 1301, hybrid 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.

**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 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

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.
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, 2019 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 Approval 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 1 are aligned with FM Global'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 Global'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 Global 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 Global'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:

- Contractor's Application for Acceptance of Water Mist System Installation
- Contactor's Material & Test Certificate for Underground Piping (85B, 85BS, 85BR)
- Pump Acceptance Test Data (105, 105B)