Section Number **Page Number**

INTRODUCTION

Fike Protection Systems, Division of Fike Corporation, is proud to present the Fike Micromist® Fire Suppression System to protect the following hazardous areas:

- Machinery Spaces, up to 9,175 ft^3 (260 m^3), housing hazards such as oil pumps and / or reservoirs, fuel filters, gear boxes, drive shafts, lubrication skids, internal combustion engine test cells, or spaces with incidental storage of flammable liquids

- Turbine Generator Enclosures up to 9,175 ft^3 (260 m^3) housing gas turbines / generator units

NOTE: For each of these applications, the protected space must be equipped with: Automatic door closures, ventilation system and automatic fuel shutdown. Lubrication supply should be shutoff as soon as possible. The Micromist® System storage space temperature must be maintained between 40° and 130°F (4.4° and 54.4°C). It is recommended that all, non-emergency, electrical power to the protected space be interrupted at the time of system discharge.

Upon receiving an activation signal, the Fike Micromist® Fire Suppression System provides 10 minutes of active protection for Machinery Spaces. For Turbine Generator Enclosures, the Fike Micromist® Fire Suppression System provides 20 minutes of active protection.

The Fike Micromist® Fire Suppression System is an alternative fire-extinguishing system that is effective on many types of fires. It is effective for use on Class B flammable liquid fires. Micromist® Systems are pre-engineered systems consisting of nitrogen tank(s), a water storage tank, and a piping system with a network of discharge nozzles.

Micromist® Systems **CAN** be used to protect an area having a flammable liquid present, provided it is a Flammability Class of 1, 2 or 3 as defined by NFPA 325. Examples of Class 1,2 and 3 flammable liquids are:

- Fuels such as #2 Diesel Fuel, Gasoline, Kerosene, Mineral Spirits and Jet Fuels (4, 5 & 6)
- Oils such as Lubricating, Hydraulic Oil & Fluid, Transformer and Crude.

The flammability class of a liquid is determined by the "flash point" and "boiling point" of the liquid. If the "flash point" is below 73°F (22.8°C), and the "boiling point" at or above 100°F (37.8°C), it is considered a Class 3 or less flammable liquid and can be protected by The Fike Micromist® Fire Suppression System.

Fike Micromist® Systems **CANNOT** be used to protect an area with a Class 4 flammable liquid as defined by NFPA 325. Examples of Class 4 flammable liquids are: Methane, Propane, Natural Gas, Butane and Hydrogen. **Exception: Natural gas and Propane driven Turbine Generator units may be protected providing the fuel source is shut down prior to discharge.**

The Fike Micromist® Fire Suppression Systems must be installed in a location where the ambient temperature is maintained within +40°F to +130°F (4.4°C to 54.4°C) and must be protected from inclement weather.

Fike Micromist® Fire Systems must be designed and installed within the limitations established by Factory Mutual (FM) approvals, NFPA 750, "Standard for the Installation of Water Mist Fire Protection Systems" and this manual, P/N 06-153, which complies with these requirements and limitations.

This manual will assist the systems designer to properly design a Fike Micromist® Fire Suppression System. In addition, the authority having jurisdiction over the installed Fike Micromist® System will be able to easily confirm that all design parameters have been met. Finally, those individuals responsible for the installation and / or maintenance of the Fike Micromist® Fire Suppression System will find this manual a useful tool to help clarify their responsibilities.

1.0 EQUIPMENT

A Fike Micromist® Fire Suppression System is an intermediate pressure, 175 to 500 psi (11,207 to 3,447 kPa), system that uses a fine water spray to control a fire. The fine spray extinguishes a fire by cooling the flame and fire plume, displacing oxygen with water vapor and reducing the amount of radiant heat.

1.1 SYSTEM USE

Fike Micromist® Fire Suppression System can be used for a wide range of performance objectives including:

- Fire Extinguishment
- Fire Suppression
- Fire Control
- Temperature Control
- Exposure Protection

1.2 SYSTEM LIMITATIONS

Fike Micromist® Fire Suppression System SHALL NOT be used for direct application to materials, or products, that react with water to produce violent reactions or significant amounts of hazardous products. These materials include:

- Reactive metals, such as Sodium, Potassium, Magnesium, Titanium, Lithium, Zirconium, Uranium and Plutonium.
- Metal Alkoxides, such as Sodium Methoxide
- Metal Amides, such as Sodium Amide
- Carbides, such as Calcium Carbide
- Halides, such as Benzoyl Chloride
- Hydrides, such as Lithium Aluminum Hydride
- Oxyhalides, such as Phosphorus Oxybromide
- Silanes, such as Trichlormethyl Silane
- Sulfides, such as Phosphorus Pentasulfide
- Cyanates, such as Methylisocyanate

Fike Micromist® Fire Suppression System SHALL NOT be used for direct application to liquefied gases at cryogenic temperatures, such as liquefied natural or propane gases, which boil violently when heated by water.

1.3 PERSONNEL SAFETY

For fire situations, suitable safeguards SHALL be provided to ensure prompt, and complete evacuation of, and prevent entry into, hazardous atmospheres and also to provide for prompt rescue of persons trapped within a protected space. Safety items, such as personnel training, caution and/or advisory warning signs, discharge alarms and lights, self-contained breathing apparatus (SCUBA), evacuation plans and fire drills shall all be considered.

1.4 SYSTEM OPERATION

The Fike Micromist® Fire Suppression System extinguishes a fire by delivering a controlled, cyclic supply of water to a network of nozzles, specifically designed to protect either a machinery space or turbine generator enclosure.

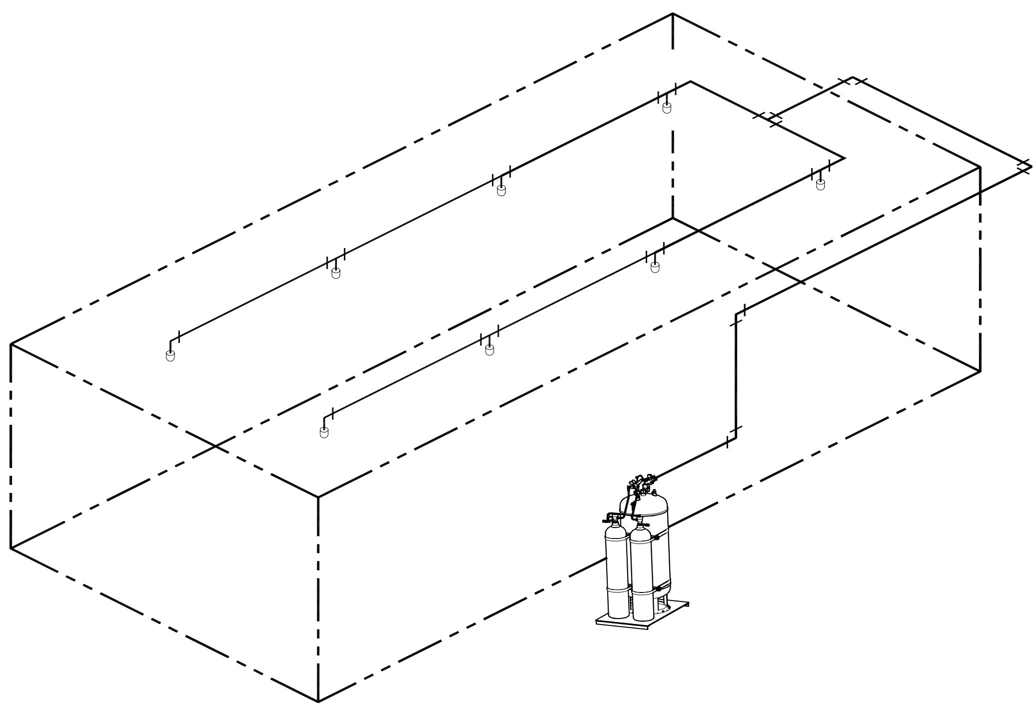
Upon activation, and throughout the active protection period, the Fike Cheetah® Control Panel sends signals to both high and low pressure side solenoids, to provide and control the required cyclic supply of water.

The high pressure side of the system consists of the Nitrogen Tank Assembly(s), pressurized to 1,850 – 1,980 psi @ 70°F (12,893 – 13,652 kPa @ 21°C), and a solenoid with control components. The nitrogen is used as the driving force to propel the water from the Water Container thru the piping network to the discharge nozzles.

A factory preset pressure regulator is used to reduce the high pressure from the Nitrogen Tank Assembly(s) to maintain 320 psi (2,206 kPa) in the Water Storage Container, during active protection.

The low pressure side of the system consists of a galvanized Water Storage Container, normally at atmospheric pressure, miscellaneous components and the Water Valve Assembly. The Water Valve Assembly, consisting of an air actuator, ball valve and solenoid, with control components, is used to cycle the flow of water from the container.

The Nozzle Assemblies receive the water thru the pre-engineered piping network. The nozzles create a fine water mist by the impingement of the water on the edge of a plate. The fine mist produced is directed into the protected space by nozzle placement.



Typical Fike Micromist® Fire Suppression System for Machinery Spaces

1.5 SYSTEM STRUCTURE

70 GALLON (265 LITRE) MICROMIST® SYSTEM

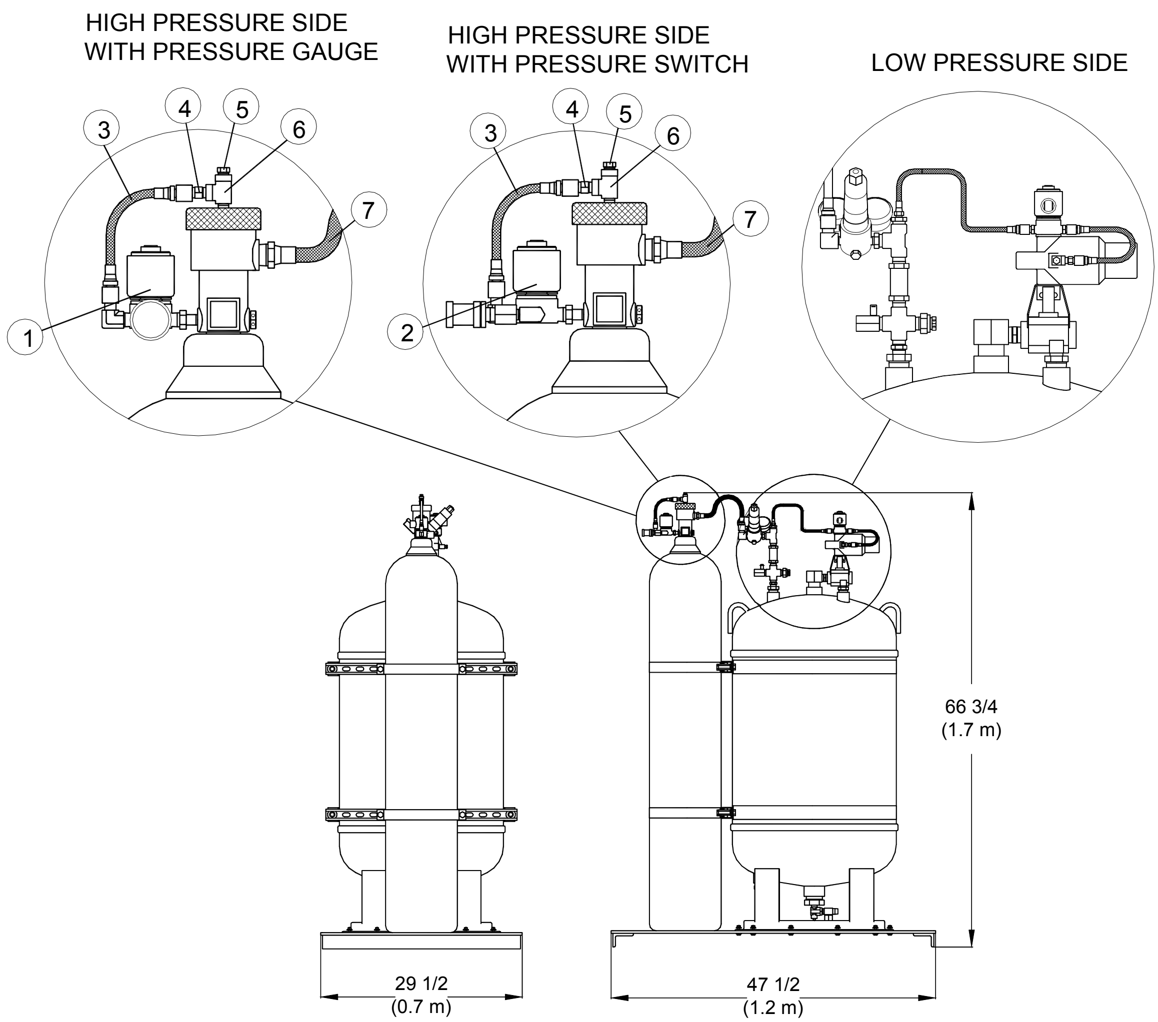
107 GALLON (405 LITRE) MICROMIST® SYSTEM

1.5.1 70 GALLON (265 LITRE) MICROMIST® SYSTEM

The 70 gallon (265 Litre) Micromist® system is shipped with all major components pre-assembled. Note: A 70 gallon (265 Litre) Micromist® system may be purchased with either a pressure gauge, or pressure switch, control valve assembly for monitoring the nitrogen tank pressure.

The following drawing shows the overall dimensions of the system and the location of the system components that are to be assembled in the field.

1) 73-007 Assembly, Control Valve W / Pressure Gauge
2) 73-005 Assembly, Control Valve W / Pressure Switch
3) CO2-1290 Hose, Braided ¼" (8mm) JIC Ends 7½" (19.1cm) long, SS / Brass
4) 02-4543 Connector ¼" (8mm) x 1/8" (4mm), Brass
5) 02-4521 Orifice 1/8" (4mm), Brass
6) 02-4537 Tee, Run 1/8" (4mm), Brass
7) 02-4606 Hose, Braided ½" (15mm) NPT x ½" (15 mm) JIC 12" (30.5cm) Long, SS / Brass

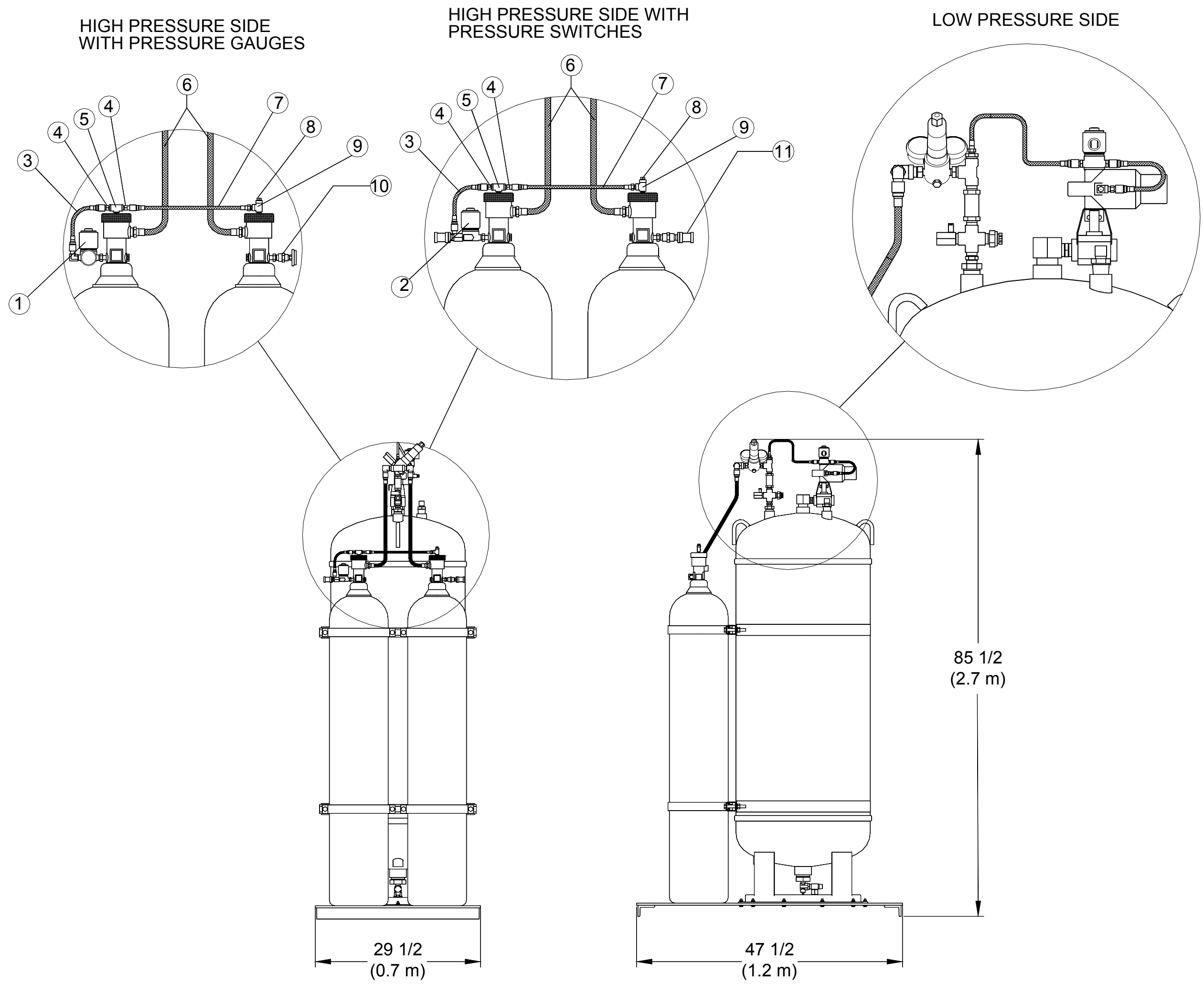


1.5.2 107 GALLON (405 LITRE) MICROMIST® SYSTEM

The 107 gallon (405 Litre) Micromist® system is shipped with all major components pre-assembled. Note: A 107 gallon (405 Litre) Micromist® system may be purchased with either pressure gauge, or pressure switch, control valve assemblies for monitoring the nitrogen tank pressure.

The following drawing shows the overall dimensions of the system and the location of the system components that are to be assembled in the field.

1)	73-007	Assembly, Control Valve W / Pressure Gauge
2)	73-005	Assembly, Control Valve W / Pressure Switch
3)	CO2-1290	Hose, Braided ¼” (8mm) JIC Ends 7½” (19.1cm) long, SS / Brass
4)	02-4543	Connector ¼” (8mm) x $^{1}/_{8}$” (4mm), Brass
5)	02-4539	Tee, Branch $^{1}/_{8}$” (4mm), Brass
6)	02-4533	Hose, Braided ½” (15mm) NPT x ½” (15mm) JIC 23” (58.4cm) Long, SS / Brass
7)	02-4538	Hose, Braided $^{1}/_{8}$” (4mm) NPT x ¼” (8mm) JIC 13½” (34.3cm) Long, SS / Brass
8)	02-4521	Orifice $^{1}/_{8}$” (4mm), Brass
9)	02-4537	Tee, Run $^{1}/_{8}$” (4mm), Brass
10)	73-009	Assembly, Pressure Gauge (Tank 2)
11)	73-008	Assembly, Pressure Switch (Tank 2)



1.5.3 HIGH PRESSURE SIDE OF SYSTEM

The high pressure sides of both the 70 gallon (265 Litre) and 107 gallon (405 Litre) Micromist® systems consist of all the parts up to the regulator. These parts include the following:

- Nitrogen Tank Assembly(s) consisting of 4,100 in^3 (67.2 Litre) spun steel cylinder(s), with a D.O.T. rating of 3AA-2300, and Fike Nitrogen Valve Assembly(s), pressurized to 1,850 – 1,980 psi @ 70°F (12,893 – 13,652 kPa @ 21°C).
- Solenoid Control Assembly containing a pressure gauge, or pressure switch, to control the cycling of pressure in the Nitrogen Tank Assembly(s)
- High pressure fittings and hoses to supply Nitrogen to the regulator as well as the pilot port(s) of additional Fike Nitrogen Valve Assembly(s), as required.

1.5.4 REGULATOR

The brass regulator is rated for a maximum inlet pressure of 3,000 psi (20,684 kPa) and is pre-set to supply an outlet pressure of 320 psi (2,206 kPa) to the Water Storage Container. Inlet and outlet gauges are supplied for monitoring nitrogen pressures during operation.

1.5.5 LOW PRESSURE SIDE OF SYSTEM

The low pressure side of the 70 gallon (265 Litre) and 107 gallon (405 Litre) Micromist® systems consist of all the parts after the regulator. These parts include the following:

- Water Storage Container, 70 or 107 gallon (265 or 405 Litre), galvanized steel tank, exterior painted red, with a D.O.T. rating of 4BA-500.
- Water Valve Assembly consisting of an air actuator, ball valve, solenoid, fittings and hoses.
- Liquid level switch to assure a proper level of water in the Water Storage Container. This switch is a normally open, SPST switch, that closes when the water drops below the predetermined level.
- Components to deliver pressure to water storage tank and air actuator, as listed below:

  1) Rupture disc assembly to protect the water storage container from over-pressurization. The rupture disc is designed for a specified burst pressure of 500 psi @ 72°F (3,447 kPa @ 22°C).
  2) ½” (15mm) check valve to keep water out of regulator and air actuator.
  3) ½” (15mm) vent valve for air discharge when refilling tank.
  4) ½” (15mm) cross for connecting the above 3 items to the tank.
  5) ½” (15mm) tee to direct air to tank and hoses connected to air actuator.
  6) Adapters to connect regulator to tee, cross to tank and hoses to Water Valve Assembly.
  7) Drain / fill valve attached to bottom of tank using 2” (50mm) x ½” (15mm) adapter.
  8) Inline filter attached to drain / fill valve to collect contaminants when filling the Water Storage Container.
  9) 1” (25mm) plug used in galvanizing process.
  10) Siphon tube attached to water valve assembly to assure drawing the water from the bottom of the Water Storage Container.

1.5.6 MOUNTING STRUCTURE

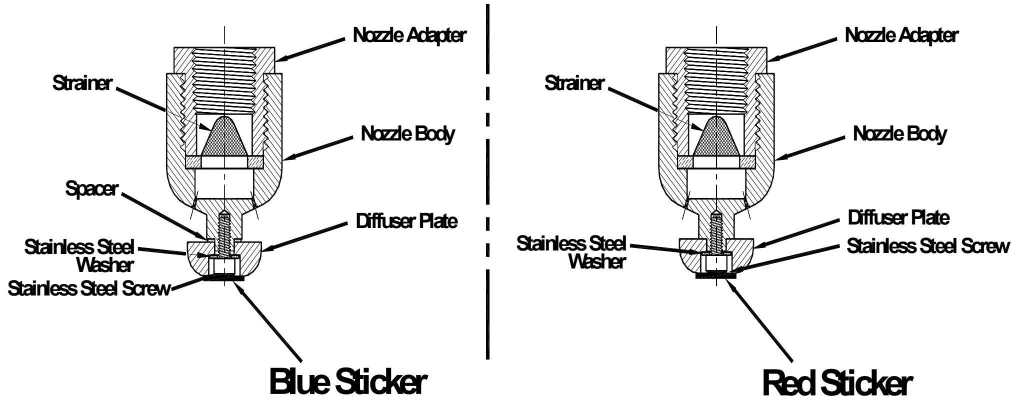
Each Fike Micromist® Fire Suppression System is factory pre-assembled and attached to a welded steel mounting skid. The Water Storage Container is attached to the Nitrogen Tank Assembly(s) with mounting straps and Uni-strut bracket. This pre-assembled and mounted structure makes it easy to install the Micromist® system by minimizing the amount of assembly required in the field.

1.5.7 NOZZLE ASSEMBLIES

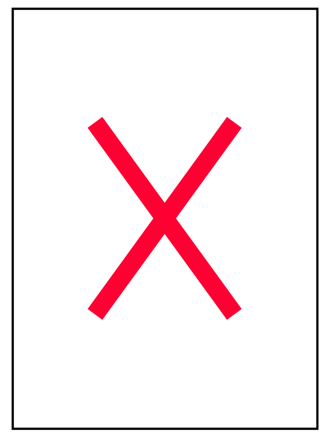
There are two different Fike Micromist® Fire Suppression System Nozzle Assemblies, as shown below. The Nozzle Assembly with a blue sticker on the end is for use with Machinery Space systems while a red sticker is on the end of the Nozzle Assembly for use with Turbine Generator Enclosure systems.

Machinery Space Nozzle
P/N 73-0024

Turbine Generator Enclosure Nozzle
P/N 73-0023



Each nozzle has small holes angled so that the water stream, under pressure, will impinge upon the edge of the diffuser plate which causes the stream to break into a fine mist. The nozzles for Machinery Spaces and Turbine Generator Enclosures are identical except that the Machinery Space Nozzle has a spacer located between the nozzle body and the diffuser plate. This spacer causes the water stream to hit the diffuser plate at a slightly different angle resulting in an increase in the size of the fine water droplets delivered to the fire.

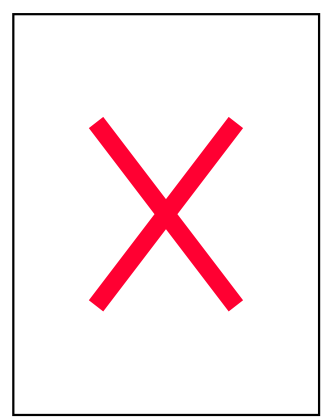


Both of the above Micromist® System Nozzles have a nominal flow rate of 2.1 gallons/minute (7.9 l./min.). The nozzle adapter, that holds the strainer within the nozzle body, is threaded with a ½" NPT (15 mm) female pipe thread.

1.6 CONTROL PANEL

The Cheetah® Fire Detection and Control System is a microprocessor based analog addressable system. The system is capable of controlling up to 240 unique zones of operation with applications ranging from fire alarm, clean agent suppression, sprinkler/preaction, carbon dioxide and Micromist®.

The basic system consists of a controller with two signaling line circuits capable of supporting up to 254 addressable points, a 5.0 amp power supply, 4.0 amps of power limited auxiliary power, two (2) notification appliance circuits, three Form-C dry contacts.



Programming the Cheetah® Fire Control System, per Section 4, Paragraph 4.9 of this manual, results in a cyclic application of water mist into the protected area as follows:

- For Machinery Spaces: The mist is directed into the protected area for 40 seconds, then turned off for 40 seconds. This on/off cycle is repeated four times. After the fourth mist, the system pauses for 60 seconds, then checks to determine if the alarm condition still exists. If there is still an alarm condition, four more on/off cycles are applied.

- For Turbine Generator Enclosures: The mist is directed into the protected area for 30 seconds, then turned off for 40 seconds. This on/off cycle is repeated eight times. After the eighth misting, the system pauses for 160 seconds, then checks to determine if the alarm condition still exists. If there is still an alarm condition, eight more on/off cycles are applied.

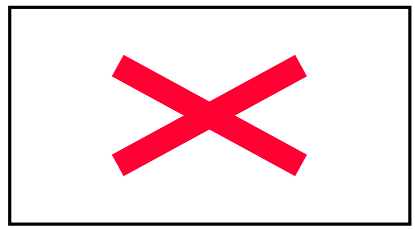
1.7 CONTROL ACCESSORIES

The control accessories required for the operation of the Fike Micromist® Fire Suppression System are described in the following paragraphs.

1.7.1 DETECTION

The recommended detector for Fike Micromist® Fire Suppression Systems is a vertical, "stick" type, thermal detector. It is used to detect the presence of heat exceeding the detector's set-point. The recommended thermal detectors are constructed from Type 300 stainless steel and have a hazardous location rating of Class I, Groups A, B, C and D; Class II, Groups E, F and G. The detector is normally open, closing on a temperature rise. The detector electrical Rating is 5.0 amps @ 125 VAC and 2.0 amps @ 24 VDC (Resistive). The following table lists the available part numbers and their temperature set-points.

Part Number	Temperature Set-point
60-021	190°F (87.8°C)
60-018	225°F (107.1°C)
60-038	275°F (134.8°C)
60-022	325°F (162.6°C)
C60-007	450°F (231.9°C)

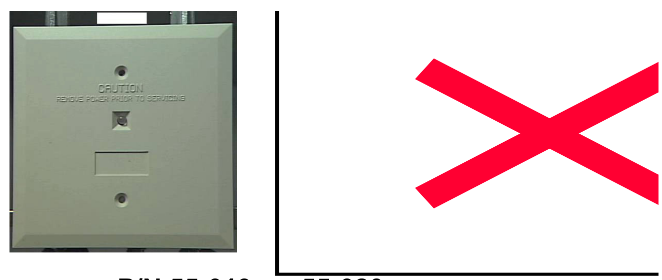


1.7.2 CONTROL MODULES

The Control Modules listed below can be used in the Fike Micromist® Fire Suppression System Controls.

1.7.2.1 FAST RESPONSE CONTACT MODULE (FRCM)

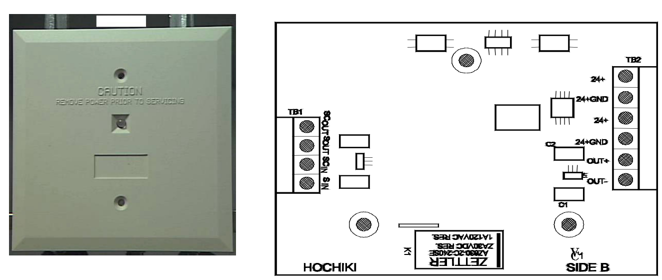
The Fast Response Contact Module (FRCM) is used to monitor the status of dry contacts for a wide range of applications. The module uses an interrupt driven digital protocol to ensure reliable operation. FRCM's come in two different styles depending on the application. The shrink wrapped style, P/N 55-020, is not shown.



P/N 55-019, or 55-020

1.7.2.2 SUPERVISED OUTPUT MODULE (SOM)

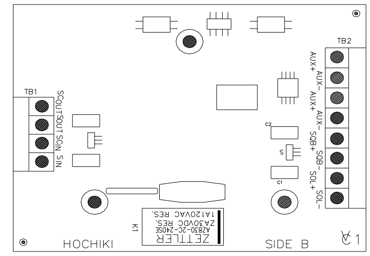
The Supervised Output Module (SOM) is used to operate notification appliances. The SOM provides one Class B circuit rated for 2.0 amps @ 24 VDC. The SOM maintains important operating parameters in nonvolatile RAM to ensure fast reliable operations.



P/N 55-021

1.7.2.3 SOLENOID RELEASING MODULE (SRM)

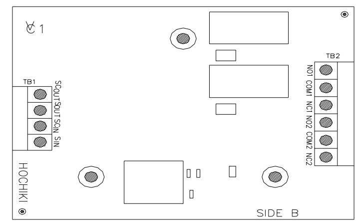
The Solenoid Releasing Module (SRM) operates a wide variety of suppression systems including Clean Agent, Carbon Dioxide, Micromist® and Sprinkler Pre-action. The SRM can operate solenoids rated up to 2.0 amps @ 12 VDC or 24 VDC, or up to six (6) FM-200 Agent Release Modules. The SRM maintains important operating parameters in non-volatile RAM to ensure fast reliable operations. The SRM can also be programmed for City Tie Service. (NFPA 72 auxiliary)



P/N 55-022

1.7.2.4 DUAL RELAY MODULE (R2M)

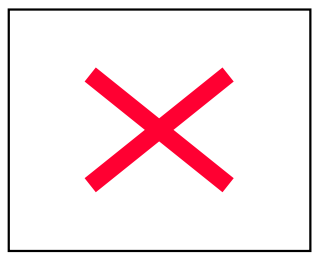
The Dual Relay Module, (R2M) provides two independently configured SPDT relays rated for 2 amps @ 24 VDC. The R2M maintains important operating parameters in non-volatile RAM to ensure fast reliable operations.

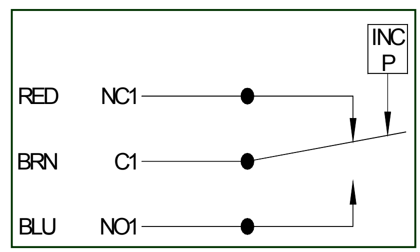


P/N 55-023

1.7.3 PRESSURE SWITCH

The Pressure Switch is used to monitor the nitrogen tank pressure. In the event that the supply pressure becomes less than 1580 psi a signal is sent to the Cheetah panel to alert the user of the problem. The Switch is activated at 1580 psi and reset when the supply tank(s) are filled above 1800 psi. The unit has a contact current capacity of 7 amps with an inductance of 4 amps when used with up to 28 VDC. The unit meets or exceeds NEMA type 1 and 2 requirements.





P/N 02-4550

1.8 MANUAL ACTIVATION

All Fike Micromist® Fire Suppression Systems **SHALL** have a manual release station provided at every point of egress from the protected space. These stations can be placed inside, or outside, each exit door. Location is subject to the approval of the Authority Having Jurisdiction (AHJ) for the specific project. Manual station(s) shall be wired to a Fast Response Contact Module (FRCM) in the Cheetah® Control Panel.

1.9 PIPING NETWORK

The piping or tube used for a Fike Micromist® Fire Suppression System shall have a corrosion resistance at least equivalent to piping specified in the following table (excerpted from N.F.P.A. 750).

Materials and Dimensions	Standard
Copper Tube (Drawn, Seamless) Copper tube shall have a wall thickness of Type K, L or M	
Standard Specification for Seamless Copper Tube*	ASTM B 75
Standard Specification for Seamless Copper Water Tube*	ASTM B 88
Standard Specification for General Requirements for Wrought Seamless Copper & Copper-Alloy Tube	ASTM B 251
Stainless Steel	
Standard Specification for Seamless & Welded Austenitic Stainless Steel Tubing for General Service	ASTM B 269
Standard Specification for Seamless & Welded Austenitic Stainless Steel Tubing (Small-Diameter) for General Service	ASTM A 632
Standard Specification for Welded, Unannealed Austenitic Stainless Steel Tubular Products	ASTM A 778
Standard Specification for Seamless & Welded Ferritic/Standard Stainless Steel Tubing (Small-Diameter) for General Service	ASTM A 779 / A789M

*Denotes tube suitable for bending in accordance with ASTM Standards.

Fittings shall have a minimum-rated working pressure equal to or greater than 325 psi at 130°F (54°C).

2.0 DESIGN

This manual section outlines the design a Fike Micromist® Fire Suppression System. Included are the detailed steps necessary to design systems for both Machinery Spaces and Turbine Generator Enclosures with volumes of up to 9,175 ft^3 (260 m^3).

NOTE: For each of these applications, the protected space must be equipped with: Automatic door closures, ventilation system and automatic fuel shutdown. Lubrication supply should be shutoff as soon as possible. The Micromist® System storage space temperature must be maintained between 40° and 130°F (4.4° and 54.4°C).

2.0.1 ELECTRICAL CLEARANCES

As used in this manual, "**Clearance**" is the air distance between the Fike Micromist® equipment, including piping and nozzles, and unenclosed or uninsulated live electrical components at other than ground potential. The minimum clearances provided are for the purpose of electrical clearance under normal conditions; they are not intended for use as "safe" distances during Micromist® System operation.

- All system components **SHALL** be located to maintain minimum clearances from unenclosed and uninsulated, energized electrical components in accordance with NFPA 70, National Electrical Code. Refer to NFPA 750, Paragraphs 1-6.2.2, 1-6.2.3, 1-6.2.4 and A-1-6.2.1 (for further information) and table A-1-6.2.1 (for clearance data).

2.1 SYSTEM SELECTION

The first step in designing a Fike Micromist® Fire Suppression System is to select which design concept is to be used. This is based purely on the type of equipment located in the area to be protected.

2.1.1 MACHINERY SPACE

A Machinery Space System is for an enclosure housing machinery such as oil pumps or reservoirs, cleaning processes, gear boxes, drive shafts, lubrication skids, diesel engine emergency generators, internal combustion engine test cells, or machinery spaces with incidental storage of flammable liquids.

- Refer to Paragraph 2.2 for design calculation details for Machinery Spaces.

2.1.2 TURBINE GENERATOR ENCLOSURE

A Turbine Generator Enclosure System is for an enclosure housing compartmentalized gas turbine / generator unit(s) used for power generation. The turbine may use natural gas, or propane gas, as a fuel source. Note that any fuel source **SHALL** be shutdown prior to discharge of The Micromist® System.

- Refer to Paragraph 2.3 for design calculation details for Turbine Generator Enclosures.

2.2 SYSTEM DESIGN – MACHINERY SPACES

The Fike Micromist® Fire Suppression System, for Machinery Spaces, is designed to provide an active system response for a period of 10 minutes. The system is pre-engineered and consists of nitrogen tank(s), a Water Storage Tank, and a piping system with a network of discharge nozzles.

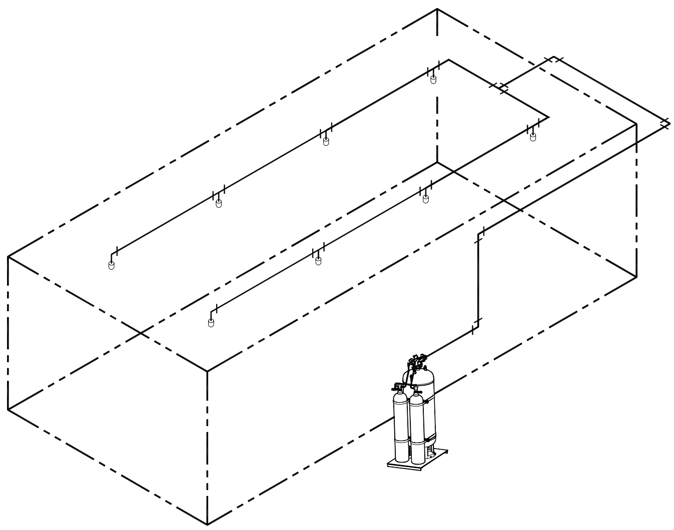
Machinery Space protection utilizing a Fike Micromist® Fire Suppression System, is limited to a maximum volume of 9,175 ft^3 (260 m^3). The volume of the protected space is determined by multiplying: length x width x height.

- Volume = length x width x height

2.2.1 NOZZLE LAYOUT

This section covers the method used to determine the number of Micromist® Nozzles required and their location in the protected space. The following are the nozzle placement requirements:

- Maximum spacing between nozzles is 8 feet (2.44 m)
- Maximum distance between the wall and a nozzle is 4 feet (1.22 m)
- Maximum distance between the Ceiling and a nozzle is 1 foot (0.30 m)
- Spacing between the nozzles can be less than 8 feet (2.44 m)
- Water mist nozzles are arranged in a rectangular grid.



Typical Fike Micromist® Fire Suppression System, for Machinery Spaces

2.2.1.1 DETERMINE NOZZLE GRID

To determine how many nozzles are needed for the length of the room, divide the length of the room by the maximum spacing between nozzles. Round the result up to the next higher whole number.

- Number of nozzles along length dimension = length ÷ Maximum spacing between nozzles (8' – 0")

To determine the number of nozzles required for the width of the room, divide the width of the room by the maximum spacing between nozzles. Round the result up to the next higher whole number.

- Number of nozzles along width dimension = width ÷ Maximum spacing between nozzles (8' – 0")

2.2.1.2 DETERMINE NOZZLE SPACING

To determine the nozzle spacing (actual distance between nozzles), for the length of the grid, divide the room length by its required number of nozzles. Nozzle spacing from the end wall to the nearest nozzle is up to half the distance between nozzles.

- Distance between nozzles for length dimension = length ÷ number of nozzles along length dimension
- Distance between nozzles and end wall = distance between nozzles for length dimension ÷ 2

To determine the distance between nozzles for the width of the grid, divide the room width by its required number of nozzles. Nozzle spacing from the side wall to the nearest nozzle for the width of the room is up to half the distance between nozzles.

- Distance between nozzles for width dimension = width ÷ number of nozzles along width dimension
- Distance between nozzles and side wall = distance between nozzles for width dimension ÷ 2

2.2.2 SYSTEM SIZE SELECTION

The proper Water Supply Tank must be selected in order to assure that the system has sufficient water to provide active protection for the protected Machinery Space for 10 minutes.

- 70 Gallon (265 Liter) Micromist® Systems are used for nozzle grids containing 6 or less nozzles.
- 107 Gallon (405 Liter) Micromist® Systems are used for nozzle grids containing 7 to 9 nozzles.

Machinery Spaces that require 10, or more, nozzles require 2, or more, Micromist® Systems to achieve the correct water supply for the number of nozzles per system. Each system has independent piping networks, although they are controlled by a single Cheetah Control Panel. Note: If the systems piping layouts are not identical, each layout **MUST** be calculated separately per Paragraph 2.2.3.1 below. The maximum protected volume cannot exceed 9,175 ft^3 (260 m^3).

2.2.3 PIPING NETWORK

This section covers the calculations required to design the piping for a Fike Micromist® Fire Suppression System for Machinery Spaces. It is intended to give the systems designer the information required to complete a preliminary piping layout. Strict adherence to the system limitations listed in this section is **MANDATORY**. Pipe installation **SHALL NOT** begin until the piping layout has been properly calculated.

2.2.3.1 PIPING LAYOUT

The layout of the nozzle piping is an important part of the design of the system. The piping layout **MUST BE** designed to provide water to each nozzle in the Fike Micromist® Fire Suppression System at a pressure of 310 psi ± 15 psi (2,137 kPa ± 103 kPa).

- The minimum allowable pressure condition is achieved by designing the piping layout to maintain a maximum pressure drop of 20 psi (138 kPa) from the Water Supply Tank to the farthest nozzle.

- The maximum allowable pressure condition is achieved by designing the piping layout to maintain a maximum net pressure rise of 5 psi (34.5 kPa). This increase will occur only when the final calculation from elevation changes results a negative value exceeding the calculated pressure drop of the system.

When the correct maximum pressure drop to the farthest nozzle is maintained, all nozzles have sufficient pressure and flow to perform within system design limitations.

Stainless steel pipe or tubing is recommended for use with The Fike Micromist® Fire Suppression System. Galvanized or black steel pipe may also be used for the piping network. The nozzle piping layout does not need to be a balanced system. The selection of the exact pipe route, connecting the nozzles to one another is left to the discretion of the systems designer. There are several different “correct” piping layouts for every enclosure. Refer to the Sample Problem, Section 3, Paragraph 3.1.5, for examples of four possible piping networks. Once the nozzle piping network has been planned, the pipe routing connecting the nozzle network to the Water Storage Tank must be selected.

2.2.3.2 DETERMINING PIPE SIZE

The proper size of each section of piping must be determined for the entire piping network. Working with the piping layout planned per Paragraph 2.2.3.1, determine the smallest, logical, pipe size for each section of the piping network using the process described below.

The piping layout chosen and estimated pipe sizes selected at this time are then used as a preliminary piping network design. Calculations **MUST** be made on this preliminary design to confirm that the maximum pressure drop from the Water Storage Tank to any nozzle is less than 20 psi (138 kPa).

- The nozzle with the maximum pressure drop will usually be the farthest distance away from the Water Storage Tank.

- If there is any doubt as to which nozzle has the most pressure drop, you **MUST** perform the calculations for each nozzle in the piping network.

NOTE: This is extremely important because it confirms whether or not the preliminary piping network parameters result in adequate pressure to all the nozzles.

A. Start with the nozzle farthest from the Water Storage Tank to determine the equivalent pipe length for each section of pipe back to the Water Storage Tank. In order to do this, the following information must be known for each section of the piping network:

- Pipe size and length
- Number and type of fittings in the section of pipe.
- Number of nozzles supplied by the section of pipe

The equivalent length for a section of pipe is determined by adding the straight length of pipe to the equivalent length of all the fittings in the section. The tables below give the equivalent lengths of pipe for fittings that may be found in each section of the piping network.

Equivalent Lengths of 300 lb. (135 kg) Threaded Pipe Fittings and Bends											
ENGLISH UNITS – ft						METRIC UNITS – m					
Pipe U.S.	Union (AAR)	Elbows 45°	Elbows 90°	Tee Thru	Tee Side	Pipe Metric	Union (AAR)	Elbows 45°	Elbows 90°	Tee Thru	Tee Side
1/2"	0.4	0.8	1.7	1.0	3.4	15 mm	0.12	0.24	0.52	0.30	1.04
3/4"	0.5	1.0	2.2	1.4	4.5	20 mm	0.15	0.30	0.67	0.43	1.37
1"	0.6	1.3	2.8	1.8	5.7	25 mm	0.18	0.40	0.85	0.55	1.74
1-1/4"	0.8	1.7	3.7	2.3	7.5	32 mm	0.24	0.52	0.13	0.70	2.29

Equivalent Lengths of Tube Fittings and Bends											
ENGLISH UNITS – ft						METRIC UNITS – m					
Tube Size	90° Elbow	45° Bend	90° Bend	Thru Tee	Side Tee	Tube Size	90° Elbow	45° Bend	90° Bend	Thru Tee	Side Tee
1/2"	2.0	0.5	0.5	0.8	2.0	1/2"	0.61	0.15	0.15	0.24	0.61
5/8"	2.5	0.5	1.0	1.0	2.5	5/8"	0.76	0.15	0.30	0.30	0.76
3/4"	3.0	0.5	1.0	1.4	3.0	3/4"	0.91	0.15	0.30	0.43	0.91
1"	4.5	0.5	1.0	1.8	4.5	1"	1.37	0.15	0.30	0.55	1.37
1-1/4"	5.0	1.0	2.0	2.3	5.0	1-1/4"	1.52	0.30	0.61	0.70	1.52

2.2.3.2 DETERMINING PIPE SIZE – Continued

NOTE: The thickness of the pipe or tubing wall shall be calculated in accordance with ASME B31.1 Power Piping Code. For Micromist® use an internal pressure of 320 psi (2,206 kPa). Mechanical fittings used with stainless steel tubing must be designed for that purpose and have a minimum pressure rating of 320 psi (2,206 kPa).

B. Using these equivalent lengths of pipe, calculate the pressure drop for all the pipe in the longest piping run of the network.

To determine the total pressure drop for the longest piping run in the system, multiply the equivalent lengths for each of the different nozzle flows by their corresponding pressure drop factors. These factors are listed in the tables below.

Pressure Drop Factors based on "PIPE" size and Number of Nozzles Supplied									
Pressure Drop Per Foot of Equivalent Length of "Schedule 40 Pipe", (psi)									
Pipe Size	1 Nozzle	2 Nozzles	3 Nozzles	4 Nozzles	5 Nozzles	6 Nozzles	7 Nozzles	8 Nozzles	9 Nozzles
1/2"	0.02	0.08	0.18	0.31	0.47	0.66	0.90	1.16	1.47
3/4"	---	0.02	0.04	0.07	0.11	0.16	0.21	0.27	0.34
1"	---	---	---	0.02	0.03	0.05	0.06	0.08	0.10
1-1/4"	---	---	---	---	---	0.01	0.02	0.02	0.03
Pressure Drop Per Meter of Equivalent Length of "BSP Pipe", (psi)									
Pipe Size	1 Nozzle	2 Nozzles	3 Nozzles	4 Nozzles	5 Nozzles	6 Nozzles	7 Nozzles	8 Nozzles	9 Nozzles
15 mm	0.066	0.262	0.591	1.017	1.542	2.165	2.953	3.806	4.823
20 mm	---	0.066	0.131	0.230	0.361	0.525	0.689	0.886	1.115
25 mm	---	---	---	0.066	0.098	0.164	0.197	0.262	0.328
32 mm	---	---	---	---	---	0.033	0.066	0.066	0.098

Pressure Drop Factors based on "TUBE' size and Number of Nozzles Supplied									
Pressure Drop Per Foot of Equivalent Length of Stainless Steel "Tubing", (psi)									
Tube Size	1 Nozzle	2 Nozzles	3 Nozzles	4 Nozzles	5 Nozzles	6 Nozzles	7 Nozzles	8 Nozzles	9 Nozzles
1/2"	0.16	0.55	1.14	1.92	2.87	---	---	---	---
5/8"	0.04	0.15	0.31	0.52	0.78	1.08	1.42	1.81	2.25
3/4"	0.02	0.07	0.14	0.24	0.35	0.49	0.65	0.83	1.02
1"	---	0.02	0.03	0.06	0.09	0.12	0.16	0.20	0.24
1-1/4"	---	---	0.01	0.02	0.02	0.03	0.04	0.06	0.07
Pressure Drop Per Meter of Equivalent Length of Stainless Steel "Tubing", (psi)									
Pipe Size	1 Nozzle	2 Nozzles	3 Nozzles	4 Nozzles	5 Nozzles	6 Nozzles	7 Nozzles	8 Nozzles	9 Nozzles
1/2"	0.525	1.804	3.740	6.299	9.416	---	---	---	---
5/8"	0.131	0.492	1.017	1.706	2.559	3.543	4.659	5.938	7.382
3/4"	0.066	0.230	0.459	0.787	1.148	1.608	2.133	2.723	3.346
1"	---	0.066	0.098	0.197	0.295	0.394	0.525	0.656	0.787
1-1/4"	---	---	0.033	0.066	0.066	0.098	0.131	0.197	0.230

2.2.3.2 DETERMINING PIPE SIZE – Continued

C. Add the pressure drop due to any changes in elevation to determine the total pressure drop for the piping run.

The pressure change due to a drop or rise in elevation is calculated by multiplying the length of the elevation change by 0.43 psi/ft (1.41 psi/m). Rises, in elevation, increase the pressure drop in a system, and are considered positive. Drops, in elevation, decrease the pressure drop in a system, and are considered negative.

D. Verify that the total pressure drop for the longest piping run is within the design limits. If this pressure drop is greater than 20 psi (138 kPa), the preliminary piping network MUST be changed to reduce the equivalent length. Increasing pipe sizes and / or reducing the number of fittings are possible steps that may result in an acceptable pressure drop.

2.2.4 DETECTOR REQUIREMENTS
The specific detector requirements for each system are different due to the variables that make each system unique. It is because of these differences that only general guidelines are listed here. It is the responsibility of the systems designer to determine the precise location and quantity of detectors required for each individual protected enclosure.

2.2.4.1 DETECTOR TYPES
The Fike Micromist® Fire Suppression System is intended for use with thermal detectors. Refer to Equipment, Section 1, Paragraph 1.7.1, for detector details.

2.2.4.2 DETECTOR QUANTITY
The number of detectors may vary dependant upon the size, shape and contents of the protected enclosure. However, in general, a minimum of two (2) detectors are required for any enclosure 10 ft x 10 ft (3 m x 3 m) or larger.

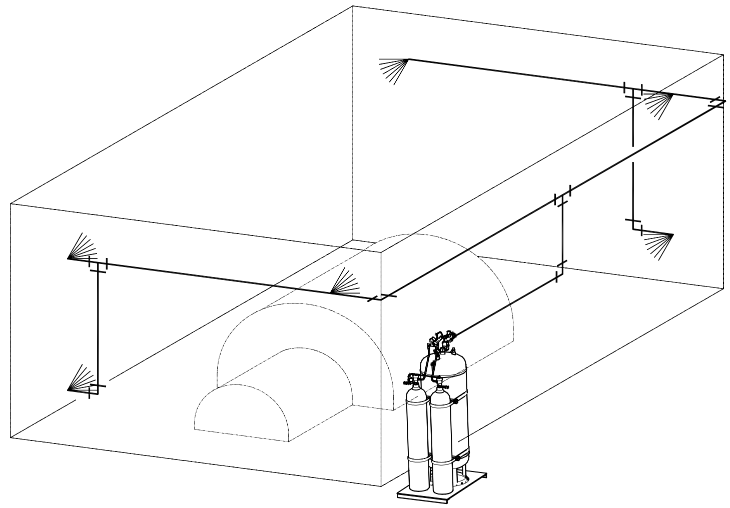
2.3 SYSTEM DESIGN – TURBINE GENERATOR ENCLOSURES
The Fike Micromist® Fire Suppression System, for Turbine Generator Enclosures, is designed to provide an active system response for a period of 20 minutes. The turbine may use natural gas, or propane gas, as a fuel source. Note that any fuel source **SHALL** be shutdown prior to discharge of The Micromist® System. The system is pre-engineered and consists of nitrogen tanks and a Water Storage Tank. There is also a piping system with a network of discharge nozzles mounted on the end walls of the enclosure. The nozzle discharge is parallel to the axis of the turbine generator.

Turbine Generator Enclosure protection utilizing a Fike Micromist® Fire Suppression System, is limited to a maximum volume of 9,175 ft^3 (260 m^3). The volume of the protected space is determined by multiplying: length x width x height.

- Volume = length x width x height

2.3.1 NOZZLE LAYOUT
The nozzle layout for all Fike Micromist® Systems Turbine Generator Enclosures is predetermined. All systems are pre-engineered, with the number of nozzles and their positioning as shown in the following paragraphs.

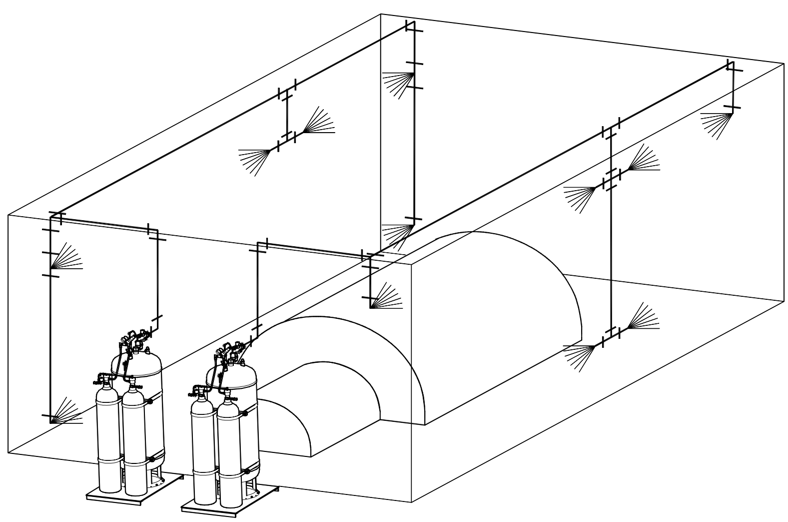
2.3.1.1 DETERMINE NOZZLE PIPING ARRANGEMENT
The nozzle grid is determined by the length of the Turbine Generator Enclosure. If the enclosure is 24 feet long, or less, the nozzle grid consists of six (6) nozzles positioned as shown below.



The opposite end wall also has two nozzles near the top corners of the wall. However, the nozzle near the bottom corner is diagonally opposite the nozzle near the bottom corner of the opposite end wall.

One end wall of the enclosure has two nozzles near the top corners of the wall and one nozzle near one of the bottom corners.

If the Turbine Generator Enclosure is longer than 24 feet, the nozzle grid consists of twelve (12) nozzles positioned as shown below.



At the midpoint of both side walls, near the ceiling, are two (2) nozzles, each pointing to an end wall. Two (2) more are near the floor, diagonally opposite the nozzles near the floor by the end wall. These also point to both end walls.

Nozzles on the end walls are near both of the top corners of the wall and one (1) near a bottom corner. Both end walls have the same nozzle sites. All end wall nozzles are directly across the enclosure from each other.

- NOTE: Turbine Generator Enclosure protection utilizing a Fike Micromist® Fire Suppression System, is limited to a maximum volume of 9,175 ft^3 (260 m^3). This limitation applies to all Turbine Generator Enclosures regardless of the length of the side walls.

2.3.1.2 DETERMINE NOZZLE SPACING

The nozzles are located a specific distance from the ceiling, floor and adjacent side walls. The following formula is used to determine the distance from the ceiling down to the upper nozzles. The same formula is used to determine the distance from the floor up to the bottom nozzles.

- Distance from ceiling or floor to adjacent nozzle = 0.26 x height = d1

Note: The units of d_1 are the same as height. (For example, if height is measured in ft, d_1 is in ft.)

The following formula is used to determine the distance from the adjacent wall to the corresponding nozzles.

- Distance from the side wall to adjacent nozzle = 0.17 x width = d2

Note: The units of d_2 are the same as width. (For example, if width is measured in ft, d_2 is in ft.)

Refer to Sample Problem, Section 3, Paragraph 3.2.3 for an illustration showing d_1 and d_2.

- Distance from the end wall to the center nozzles is = 0.5 x length

2.3.2 SYSTEM SIZE SELECTION

- The Fike Micromist® Fire Suppression System for Turbine Generator Enclosures 24 feet long or less utilize one (1), 107 Gallon (405 Liter) Micromist® System.

- Turbine Generator Enclosures greater than 24 feet long utilize two (2), 107 Gallon (405 Liter) Micromist® Systems.

2.3.3 PIPING NETWORK

This section covers the piping calculations required to design a Fike Micromist® Fire Suppression System for Turbine Generator Enclosures and is intended to give the systems designer the information required to complete a preliminary piping layout. Strict adherence to the system limitations listed in this section is **MANDATORY**. Pipe installation **SHALL NOT** begin until the piping layout has been calculated using the following procedure.

2.3.3.1 PIPING LAYOUT

For Turbine Generator Enclosures the number of nozzles is fixed at six (6) per Micromist® System. The location of the nozzles with regard to their distance from the walls, floor and ceiling is also fixed, by design based on the dimensions of the enclosure. The piping system supplying the nozzles however, is not fixed. The same rule applies for Turbine Generator Enclosure piping systems as does with Machinery Spaces (refer to Paragraph 2.2.3.1).

- The piping layout **MUST BE** designed to provide water to each nozzle in the Fike Micromist® Fire Suppression System at a pressure of 310 ± 15 psi (2,137 ± 103 kPa). This assures that each of the nozzles perform as designed. This is done by maintaining a maximum pressure drop from the Water Supply Tank to the farthest nozzle of no more than 20 psi (138 kPa).
- The maximum allowable pressure condition is achieved by designing the piping layout to maintain a maximum net pressure rise of 5 psi (34.5 kPa). This increase will occur only when the final calculation from elevation changes results a negative value exceeding the calculated pressure drop of the system.

When the correct maximum pressure drop to the farthest nozzle is maintained, all nozzles have sufficient pressure and flow to perform within system design limitations. Stainless steel tubing, stainless steel pipe or copper tubing is recommended for use with The Fike Micromist® Fire Suppression System. (For detailed description, refer to Equipment, Section 1, Paragraph 1.9.)

All the nozzles are interconnected with a nozzle piping distribution network that is connected to the Water Supply Tank.

2.3.3.2 DETERMINING PIPE SIZE
To determine the proper size of the piping for the entire piping network, select the smallest logical size for each pipe section in the piping network. The same method is used to determine the total pressure drop for Turbine Generator Enclosures as was used for Machinery Spaces. Refer to Paragraph 2.2.3.2 for the step by step explanation of the procedure and the tables of equivalent lengths and pressure drop factors.

Experience dictates the nozzle used for the maximum pressure drop calculation for Turbine Generator Enclosures is the one on the end wall, farthest from the Water Storage Tank and at the ceiling level. Even though the nozzle just below is actually farther away, there is a pressure increase at the lower nozzle location due to the elevation drop. Therefore, the upper nozzle has more pressure drop than the lower. Refer to Sample Problem, Section 3, Paragraph 3.2.4 for an illustration of an example showing the “Selected Nozzle” location.

- If there is any doubt as to which nozzle has the most pressure drop, you **MUST** perform the calculations for each nozzle.

- Calculations **MUST** be made to confirm that the maximum pressure drop from the Water Storage Tank to any nozzle is less than 20 psi (138 kPa).

NOTE: This is extremely important because it confirms whether or not the piping network parameters result in adequate pressure at all system nozzles.

A. Determine the equivalent length for each section of pipe by adding the length of the pipe to the equivalent length value of all fittings in that section.

NOTE: The thickness of the pipe or tubing wall shall be calculated in accordance with ASME B31.1 Power Piping Code. For Micromist® use an internal pressure of 320 psi (2206 kPa). Mechanical fittings used with stainless steel tubing must be designed for that purpose and have a minimum pressure rating of 320 psi (2,206 kPa).

B. Calculate the total of the pressure drops for the piping system. This is done by multiplying the equivalent lengths for each of the different nozzle flows by their corresponding pressure drop factors. Refer to Paragraph 2.2.3.2 for the tables of Pressure Drop Factors.

C. Add the pressure drop from any changes in elevation to determine the total pressure drop for the piping run. The pressure change due to a drop or rise in elevation is calculated by multiplying the length of the elevation change by 0.43 psi/ft (1.41 psi/m). Rises in elevation, increase the pressure drop in a system, and are considered to be positive numbers. Drops in elevation, decrease the pressure drop in a system, and are considered to be negative numbers.

D. Verify that the total pressure drop for the piping run to the nozzle with the maximum pressure drop is within the design limits. If this pressure drop is greater than 20 psi (138 kPa), the preliminary piping network **MUST** be changed to reduce the equivalent length. Increasing pipe sizes and / or reducing the number of fittings are possible steps that may result in an acceptable pressure drop.

2.3.4 DETECTOR REQUIREMENTS

The specific detector requirements for each system are different due to the variables that make each system unique. It is because of these differences that only general guidelines are listed here. It is the responsibility of the systems designer to determine the precise location and quantity of detectors required for each individual protected enclosure.

2.3.4.1 DETECTOR TYPES

The Fike Micromist® Fire Suppression System is intended for use with thermal detectors. Refer to Equipment, Section 1, Paragraph 1.7.1, for detector details.

2.3.4.2 DETECTOR QUANTITY

The number of detectors may vary dependant upon the size, shape and contents of the protected enclosure. However, in general, a minimum of two (2) detectors are required for any enclosure 10 ft x 10 ft (3 m x 3 m) or larger.

3.0 SAMPLE PROBLEM

This section of the manual gives step by step examples of the process and calculations used in the design of Fike Micromist® Fire Suppression Systems. This design process results in a pre-engineered system designed to comply with all the guidelines and limitations discussed in the previous sections. Sample calculations are given to cover the design of systems for both Machinery Spaces and Turbine Generator Enclosures.

3.1 SAMPLE PROBLEM – MACHINERY SPACE

Example: A machinery space, 28 ft (8.53m) long x 13 ft (3.96m) wide x 15 ft (4.57m) high

3.1.1 DETERMINING HAZARD VOLUME

Verify the protected volume of the Machinery Space is within design limits.

- The volume is determined by multiplying: length x width x height.
- Volume = 28 ft x 13 ft x 15 ft = 5,460 ft^3 (8.53 m x 3.96 m x 4.57 m = 154.61 m^3)

The volume of the enclosure is within design limits because it is less than the 9,175 ft^3 (260 m^3) maximum protected volume allowed for The Fike Micromist® Fire Suppression System.

3.1.2 DETERMINING NOZZLE GRID

To determine how many nozzles are needed for the length and width of the room, divide the length and width of the room by 8 ft (2.44 m), the maximum spacing allowed between nozzles. Round the result up to the next higher whole number.

ENGLISH UNITS	METRIC UNITS
LENGTH: 28 ft ÷ 8 = 3.5 Number of nozzles required for this length = **4**	LENGTH: 8.53 m ÷ 2.44 = 3.5 Number of nozzles required for this length = **4**
WIDTH: 13 ft ÷ 8 = 1.625 Number of nozzles required for this width = **2**	WIDTH: 3.96 m ÷ 2.44 = 1.62 Number of nozzles required for this length = **2**

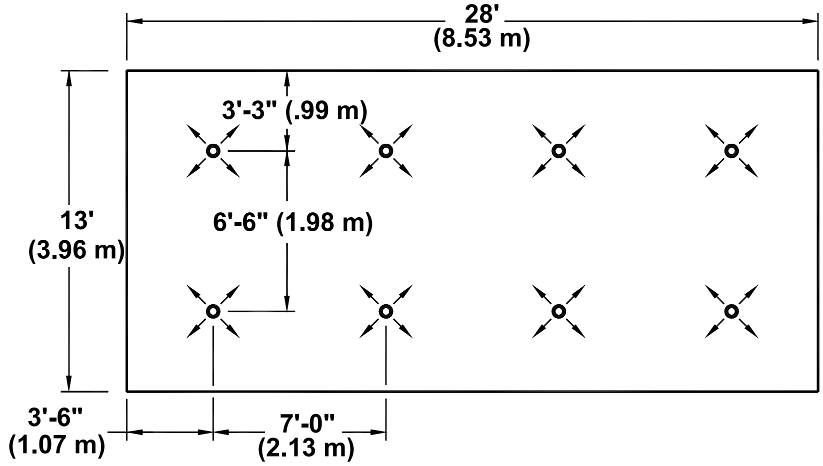
Therefore, the required nozzle grid is 4 x 2 nozzles or 8 nozzles total.

3.1.3 DETERMINING NOZZLE SPACING

To determine the required distance between nozzles, the nozzle spacing, for the length / width of the grid, take the room length / width and divide it by the number of nozzles required for the length / width. Nozzle spacing from the wall to the nearest nozzle for the length / width of the room would be ½ of the nozzle spacing.

Example of nozzle spacing calculation: From our example with a nozzle grid of 4 x 2.

ENGLISH UNITS	METRIC UNITS
LENGTH: Nozzle spacing is 28 ft ÷ 4 = **7.0 ft** Spacing from wall to nozzle is 7.0 ÷ 2 = **3.5 ft**	LENGTH: Nozzle spacing is 8.53 m ÷ 4 = **2.13 m** Spacing from wall to nozzle is 2.13 ÷ 2 = **1.07 m**
WIDTH: Nozzle spacing is 13 ft ÷ 2 = **6.5 ft** Spacing from wall to nozzle is 6.5 ÷ 2 = **3.25 ft**	WIDTH: Nozzle spacing is 3.96 m ÷ 2 = **1.98 m** Spacing from wall to nozzle is 1.98 ÷ 2 = **0.99 m**



Nozzle spacing layout for Machinery Space example system

3.1.4 DETERMINING THE TOTAL SYSTEM SIZE

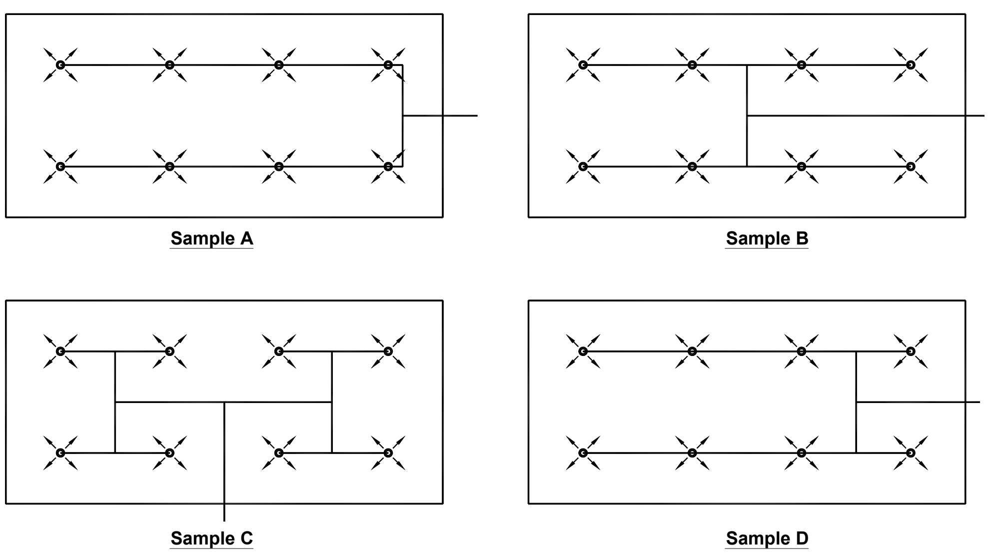
The size and number of Micromist® Systems required to protect a Machinery Space is based on the number of nozzles required.

- Nozzle grids containing 6 or less nozzles require a 70 Gallon (265 Liter) Micromist® System.
- Nozzle grids containing 7 to 9 nozzles require a 107 Gallon (405 Liter) Micromist® System.

Our example has 8 nozzles. Therefore, a 107 Gallon (405 Liter) Micromist® System is required.

3.1.5 DETERMINING PIPING LAYOUT

After the number, and location, of the nozzles has been determined, they must be connected with a piping network that provides the nozzles with the proper flow of water at the proper pressure. There are several different “correct” layouts for every enclosure. The following figure shows four possible piping networks for our example.

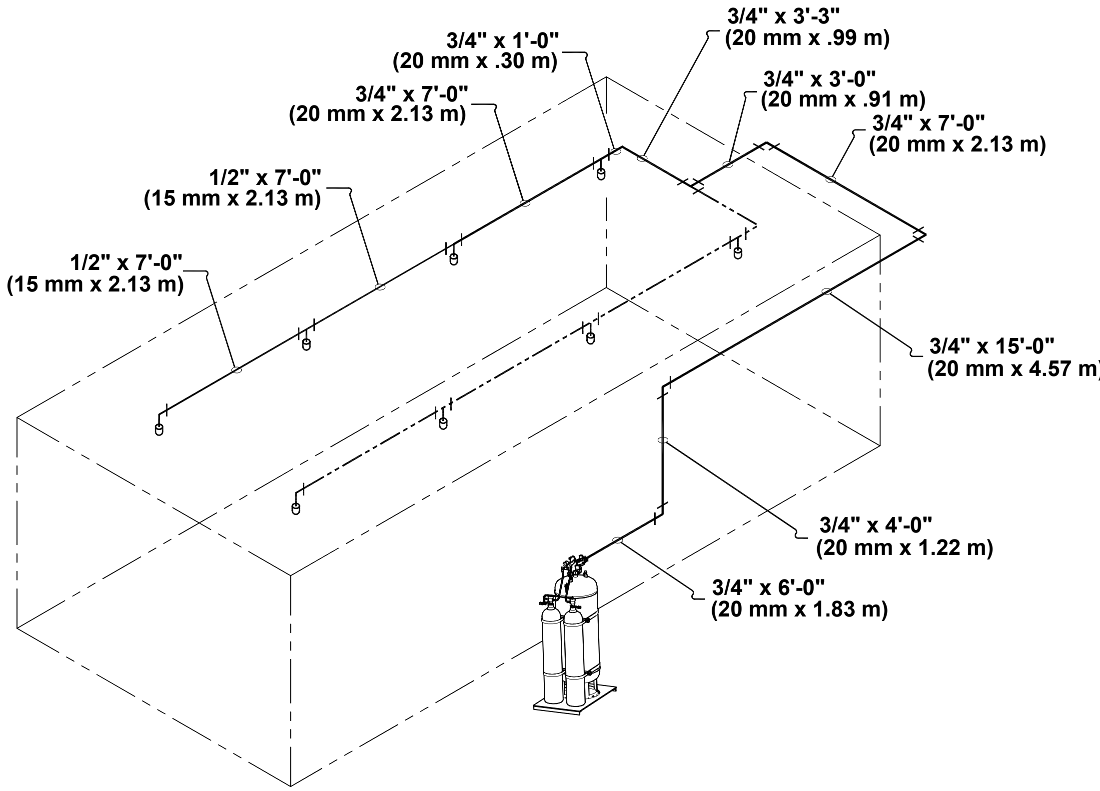


Possible piping layouts

Once the piping layout has been chosen, the network must be connected to the water storage tank. For this example, we have selected the piping layout “Sample A” above.

3.1.6 DETERMINING PIPE SIZE

The pipe size for the entire piping system is first estimated, then calculated to assure proper pressure will be supplied to the nozzles. Choose the pipe type and estimate pipe sizes for each section of piping. For our example, Schedule 40 pipe was selected with the lengths and sizes as shown in the following figure.



Example of Machinery Space Nozzle Piping System

Starting at the nozzle farthest from the Water Storage Tank, determine the equivalent length of each section of pipe. The equivalent length for a section of pipe is determined by adding the straight length of pipe to the equivalent length of all the fittings in the section.

The section of pipe supplying the last nozzle consists of a 7’-0” (2.13 m) length of ½” (15 mm) pipe as well as a ½” (15 mm) thru tee and a ½” (15 mm) 90° elbow. Therefore, the equivalent length for this first pipe section is:

ENGLISH UNITS			METRIC UNITS		
Single Nozzle Flow			Single Nozzle Flow		
7’-0” of ½” pipe	=	7.0 ft	2.13 m of 15 mm pipe	=	2.13 m
1pc. ½” 90° elbow	=	1.7 ft	1pc. 15 mm 90° elbow	=	0.52 m
1pc. ½” thru tee	=	1.0 ft	1pc. 15 mm thru tee	=	0.30 m
Total	=	9.7 ft	Total	=	2.95 m

Note: The thru tee is counted in this section because the water flowing thru this tee supplies a single nozzle.

3.1.6 DETERMINING PIPE SIZE (CONTINUED)

Proceed to the next section of pipe. This section is supplying two (2) nozzles. This section has a 7'-0" (2.13 m) length of ½" (15 mm) pipe and a ¾" (20 mm) thru tee. Therefore, our equivalent lengths are:

ENGLISH UNITS			METRIC UNITS		
Two (2) Nozzle Flow			Two (2) Nozzle Flow		
7'-0" of ½" pipe	=	7.0 ft	2.13 m of 15 mm pipe	=	2.13 m
1pc. ¾" thru tee	=	1.4 ft	1pc. 20 mm thru tee	=	0.43 m

Note: In the two nozzle flow we did not total the equivalent lengths since they are for different sizes of pipe.

Our next section of pipe is for the three (3) nozzle flow:

ENGLISH UNITS			METRIC UNITS		
Three (3) Nozzle Flow			Three (3) Nozzle Flow		
7'-0" of ¾" pipe	=	7.0 ft	2.13 m of 20 mm pipe	=	2.13 m
1pc. ¾" thru tee	=	1.4 ft	1pc. 20 mm thru tee	=	0.43 m
Total	=	8.4 ft	Total	=	2.56 m

The next pipe section has four (4) nozzle flow. The pipe is a 1'-0" (.30 m) length of ¾" (20 mm) pipe and a 3'-3" (.99 m) section of ¾" (20 mm) pipe. Fittings consist of a ¾" (20 mm), 90° elbow and a ¾" (20 mm) side tee. The equivalent lengths are:

ENGLISH UNITS			METRIC UNITS		
Four (4) Nozzle Flow			Four (4) Nozzle Flow		
4'-3" of ¾" pipe	=	4.3 ft	1.29 m of 20 mm pipe	=	1.29 m
1pc. ¾" 90° elbow	=	2.2 ft	1pc. 20 mm 90° elbow	=	0.67 m
1pc. ¾" side tee	=	4.5 ft	1pc. 20 mm side tee	=	1.37 m
Total	=	11.0 ft	Total	=	3.33 m

The last section of pipe is for eight (8) nozzle flow:

ENGLISH UNITS			METRIC UNITS		
Eight (8) Nozzle Flow			Eight (8) Nozzle Flow		
35'-0" of ¾" pipe	=	35.0 ft	10.67 m of 20 mm pipe	=	10.67 m
4pc. ¾" 90° elbows	=	8.8 ft	4pc. 20 mm 90° elbows	=	2.68 m
Total	=	43.8 ft	Total	=	13.35 m

Now, calculate the total pressure drop for the piping system. The equivalent lengths calculated above are each multiplied by their appropriate pressure drop factor, found in paragraph 2.2.2.2 of the Design Section. This calculation is shown below.

ENGLISH UNITS				METRIC UNITS			
Total Pressure Drop				Total Pressure Drop			
½" @ 1 nozzle flow	– 9.7' x 0.02	=	0.20	15mm @ 1 nozzle flow	– 2.95m x 0.066	=	0.20
½" @ 2 nozzle flow	– 7.0' x 0.08	=	0.56	15mm @ 2 nozzle flow	– 2.13m x 0.262	=	0.56
¾" @ 2 nozzle flow	– 1.4' x 0.02	=	0.03	20mm @ 2 nozzle flow	– 0.43m x 0.066	=	0.03
¾" @ 3 nozzle flow	– 8.4' x 0.04	=	0.34	20mm @ 3 nozzle flow	– 2.56m x 0.131	=	0.34
¾" @ 4 nozzle flow	– 11.0' x 0.07	=	0.77	20mm @ 4 nozzle flow	– 3.33m x 0.230	=	0.77
¾" @ 8 nozzle flow	– 43.8' x 0.27	=	11.83	20mm @ 8 nozzle flow	– 13.35m x 0.886	=	11.83
	Total Pressure Drop, psi	=	13.73		Total Pressure Drop, psi	=	13.73

The final consideration is the pressure drop/rise due to elevation changes. Pressure is changed 0.43 psi per foot (1.41 psi per meter) of drop/rise. The net elevation change in our example is a 4.0 foot (1.22 m) rise. This results in a pressure rise of 4.0 ft x 0.43 = 1.72 psi (1.22 m x 1.41 = 1.72 psi). This value is added to the Total Pressure Drop determined above to find a total system pressure drop. The Total Pressure Drop, from the Water Storage tank to the farthest nozzle is 13.73 psi, from above, plus the 1.72 psi, from the rise, equals 15.45 psi (106.5 kPa).

Therefore, our example system meets the requirement of a total pressure drop less than 20 psi (138 kPa).

3.1.7 DETERMINING PRESSURE DROP FOR STAINLESS STEEL TUBING

The same methods are used to determine the total pressure drop for stainless steel tubing as was used for Schedule 40 pipe. The equivalent lengths for tubing fittings, bends and pressure drop factors are different. These factors are found in Design, Section 2, Paragraph 2.2.2.2.

3.2 SAMPLE PROBLEM – TURBINE GENERATOR ENCLOSURES

Example: A Turbine Generator Enclosure, 22 ft (6.71m) long x 18 ft (5.49m) wide x 12 ft (3.66m) high

3.2.1 DETERMINING HAZARD VOLUME

The first calculation required in the design of a Fike Micromist® Fire Suppression System for Turbine Generator Enclosures is to determine the volume of the space being protected.

- Check length and width to confirm enclosure dimensions do exceed the maximum of 24 ft. (7.32m).

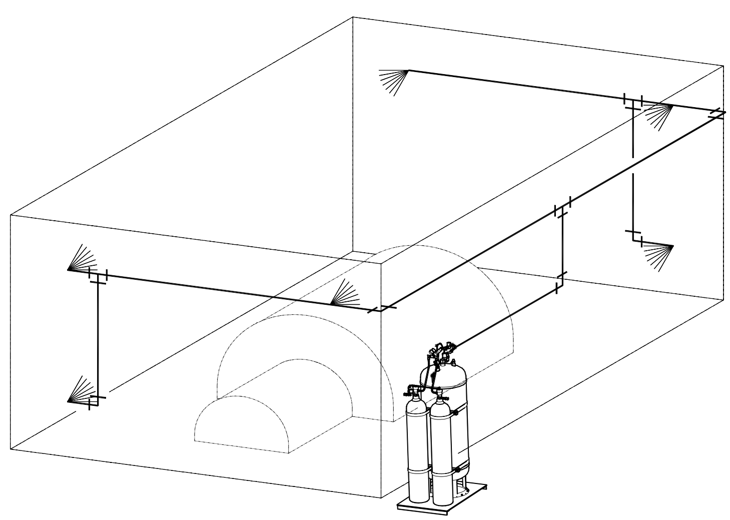
The 22 ft (6.71m) length and 18 ft (5.49m) width are both less than maximum allowable enclosure dimensions.

- The volume is determined by multiplying: length x width x height.
- Volume = 22 ft x 18 ft x 12 ft = 4,752 ft3 (6.71m x 5.49m x 3.66m = 134.83 m3)

The volume of the enclosure is less than the 9,175 ft^3 (260 m^3) maximum protected volume allowed for The Fike Micromist® Fire Suppression System.

3.2.2 DETERMINING NOZZLE GRID

The nozzle grid for Turbine Generator Enclosures is predetermined. All Fike Micromist® Systems for Turbine Generator Enclosures consist of six nozzles.

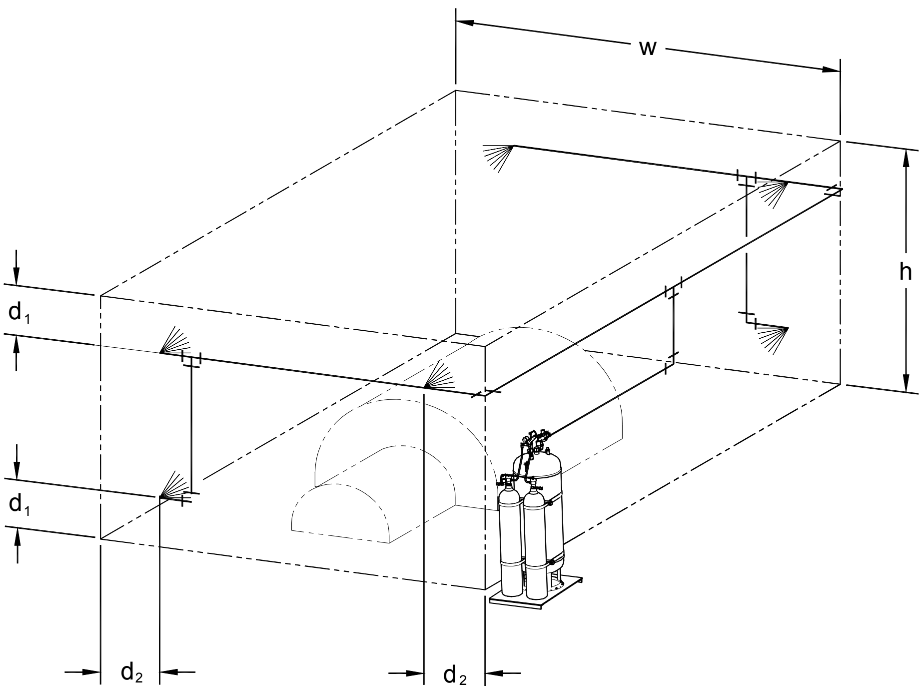


One end wall of the enclosure has two nozzles near the top corners of the wall and one nozzle near one of the bottom corners.

The opposite end wall also has two nozzles near the top corners of the wall, however, the nozzle near the bottom corner is diagonally opposite the nozzle near the bottom corner of the opposite end wall.

3.2.3 DETERMINING NOZZLE SPACING

Calculate the distance from the ceiling down to the upper nozzles. The same formula is used to determine the distance from the floor up to the bottom nozzles.



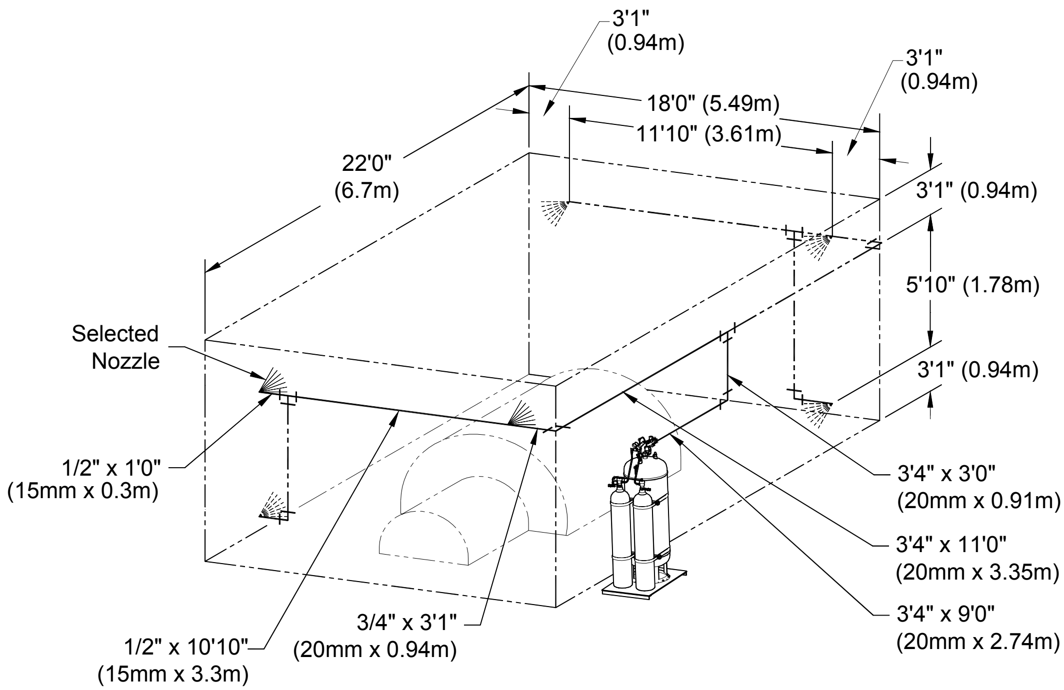
ENGLISH UNITS	METRIC UNITS
Distance: ceiling to upper nozzle and floor to lower nozzle	Distance: ceiling to upper nozzle and floor to lower nozzle
d_1 = 0.26 x h	**d_1 = 0.26 x h**
d_1 = 0.26 x 12ft = 3.12ft ≅ 3'-1"	d_1 = 0.26 x 3.66m = 0.95m ≅ 0.94m

Calculate the distance from the wall to adjacent nozzles.

ENGLISH UNITS	METRIC UNITS
Distance: Wall to adjacent nozzle	Distance: Wall to adjacent nozzle
d_2 = 0.17 x w	**d_2 = 0.17 x w**
d_2 = 0.17 x 18ft = 3.06ft ≅ 3'-1"	d_2 = 0.17 x 5.49m = 0.93m ≅ 0.94m

3.2.4 DETERMINING PIPING NETWORK

Calculations must be made to verify that the water will be delivered to the nozzles at the correct pressure.



Example of Turbine Generator Nozzle Piping System

In the example Turbine Generator Enclosure above, the enclosure is 22 ft (6.71m) long by 18 ft (5.49m) wide by 12 ft (3.66m) high. We determined the distance from the ceiling down to the upper nozzles and the floor up to the lower nozzles is 3.12 ft or approximately 3'-1" (0.94m). Also, the distance from the adjacent wall to the nozzles is 3.06 ft or approximately 3'-1" (0.94m). It is now possible to determine our piping system sizing to supply these nozzles. The figure above illustrates a possible piping arrangement for our example enclosure.

3.2.5 DETERMINING PIPE SIZE

The same method is used to determine the total pressure drop for turbine generator enclosures as was used for machinery spaces.

In the example shown above, the selected nozzle, or the nozzle to be calculated will be one that is on the end wall near the Water Storage Tank, but farthest from the tank. The lower nozzle is actually farther away, however, there will be a pressure increase gained at this nozzle due to the elevation drop to the nozzle. Therefore, the upper nozzle will have the greater pressure drop. If you are uncertain as to which nozzle is the worst case, you must perform the calculations for each nozzle.

Refer to section 2.2.3.2 for the table of Equivalent Lengths of Threaded Pipe Fittings and Bends for the values used in the calculations below. This calculation is made in order to determine the equivalent length of the piping that connects the selected nozzle to the Water Storage Tank. The equivalent length for a section of pipe is determined by adding the straight length of pipe to the equivalent length of all the fittings in the section. Begin with the section of pipe directly connected to the selected nozzle and proceed with the calculations for each pipe section all the way to the Water Storage Tank. The first section of pipe supplying the selected nozzle consists of a 1'-0" (0.30m) length of ½" (15 mm) pipe as well as a ½" (15 mm) thru tee and a ½" (15 mm) 90° elbow.

3.2.5 DETERMINING PIPE SIZE (Continued)

The equivalent pipe length for the first pipe section is tabulated below:

ENGLISH UNITS	METRIC UNITS
Single Nozzle Flow	Single Nozzle Flow
1'-0" of ½" pipe = 1.0 ft	0.30 m of 15 mm pipe = 0.30 m
1pc. ½", 90° elbow = 1.7 ft	1pc. 15 mm, 90° elbow = 0.52 m
1pc. ½" thru tee = 1.0 ft	1pc. 15 mm thru tee = 0.30 m
Total = 3.7 ft	Total = 1.12 m

Note: The thru tee is counted in this section because the water flowing thru it supplies a single nozzle.

Now proceed to the next section of pipe. This section is supplying two (2) nozzles and consists of a 10'-10" (3.30 m) length of ½" (15 mm) pipe as well as a ¾" (20 mm) thru tee. Therefore, our equivalent lengths are:

ENGLISH UNITS	METRIC UNITS
Two (2) Nozzle Flow	Two (2) Nozzle Flow
10'-10" of ½" pipe = 10.8 ft	3.30 m of 15 mm pipe = 3.30 m
1pc. ¾" thru tee = 1.4 ft	1pc. 20 mm thru tee = 0.43 m

Note: In the two (2) nozzle flow we did not total the equivalent lengths since they are for different sizes of pipe.

Our next section of pipe is for the three (3) nozzle flow:

ENGLISH UNITS	METRIC UNITS
Three (3) Nozzle Flow	Three (3) Nozzle Flow
14'-1" of ¾" pipe = 14.1 ft	4.29 m of 20 mm pipe = 4.29 m
1pc. ¾" 90° elbow = 2.2 ft	1pc. 20 mm 90° elbow = 0.67 m
1pc. ¾" side tee = 4.5 ft	1pc. 20 mm side tee = 1.37 m
Total = 20.8 ft	Total = 6.33 m

The last section of pipe is for six (6) nozzle flow:

ENGLISH UNITS	METRIC UNITS
Six (6) Nozzle Flow	Six (6) Nozzle Flow
12'-0" of ¾" pipe = 12.0 ft	3.66 m of 20 mm pipe = 3.66 m
1pc. ¾" 90° elbows= 2.2 ft	1pc. 20 mm 90° elbows = 0.67 m
Total = 14.2 ft	Total = 4.33 m

To determine the pressure drop for the piping system, we multiply the equivalent lengths for each of the different nozzle flows by their corresponding pressure drop factors.

The pressure drop for each nozzle flow in our example is calculated below:

ENGLISH UNITS	METRIC UNITS
Pressure Drop	Pressure Drop
½" @ 1 nozzle flow – 3.7' x 0.02 = 0.07	15mm @ 1 nozzle flow – 1.12m x 0.066 = 0.07
½" @ 2 nozzle flow – 10.8' x 0.08 = 0.86	15mm @ 2 nozzle flow – 3.30m x 0.262 = 0.86
¾" @ 2 nozzle flow – 1.4' x 0.02 = 0.03	20mm @ 2 nozzle flow – 0.43m x 0.066 = 0.03
¾" @ 3 nozzle flow – 20.8' x 0.04 = 0.83	20mm @ 3 nozzle flow – 6.33m x 0.131 = 0.83
¾" @ 6 nozzle flow – 14.2' x 0.16 = 2.27	20mm @ 6 nozzle flow – 4.33m x 0.525 = 2.27
Pressure Drop, psi = 4.06	Pressure Drop, psi = 4.06

3.2.5 DETERMINING PIPE SIZE (Continued)

The final consideration is the change in system pressure due to elevation.

- Pressure is changed + 0.43 psi per foot (+ 1.41 psi per meter) of decrease in elevation
- Pressure is changed - 0.43 psi per foot (- 1.41 psi per meter) of increase of elevation.

The net elevation change to the selected nozzle in our example is an increase of elevation of 3’ 4” (1.02 m). This results in a pressure drop, (3.3 ft x -0.43 psi/ft = -1.42 psi or 1.01 m x -1.41 psi/m = -1.42 psi). This value is added to the Pressure Drop determined above. The Pressure Drop from the example is 4.06 psi. Since pressure drops are negative values, the Total System Pressure Drop = (-4.06) psi + (-1.42) psi = -5.48 psi (37.8 kPa). This is the Total System Pressure Drop, from the Water Storage tank to the selected or worst case nozzle.

Therefore, our example system meets the requirement of a total pressure drop less than 20 psi (138 kPa).

3.2.6 DETERMINING PRESSURE DROP FOR STAINLESS TUBING

The same method is used to determine the total pressure drop for stainless steel tubing as was used for pipe. The only difference is the equivalent lengths and pressure drop factors. The tables in Design, Section 2, Paragraph 2.2.3.2, list the equivalent lengths for tubing, bends, fittings and the pressure drop factors for various sizes of tubing.

4.0 SYSTEM INSTALLATION

Each Fike Micromist® Fire Suppression System installation must be completed in accordance with NFPA 750, this manual, and all other applicable codes, regulations, and standards and to the Authority Having Jurisdiction (AHJ).

NOTE: For complete detailed instructions of the installation, refer to the Micromist® System Assembly Installation Drawings. These drawing numbers are listed below:

- 73-001 – Micromist® System Ass'y. Installation Drawing, 70 Gallon (265 Liter) w/ Pressure Switch
- 73-002 – Micromist® System Ass'y. Installation Drawing, 107 Gallon (405 Liter) w/ Pressure Switch
- 73-010 – Micromist® System Ass'y. Installation Drawing, 70 Gallon (265 Liter) w/ Pressure Gauge
- 73-011 – Micromist® System Ass'y. Installation Drawing, 107 Gallon (405 Liter) w/ Pressure Gauge

4.1 STORAGE CONTAINERS

The Fike Micromist® Fire Suppression System is factory pre-assembled and mounted on a welded steel mounting skid. The Water Container is attached to the Nitrogen Tank Assembly(s) with mounting straps and Uni-strut bracket. These pre-assembled and mounted components simplify the installation of the Micromist® System by minimizing the amount of assembly required in the field.

4.2 DISCHARGE PIPING CONNECTIONS

The Fike Micromist® System is designed and pre-assembled so that it may be quickly and easily connected to the piping network of the system. The water valve outlet of the Micromist® System is connected to the piping through the use of standard pipe and fittings.

4.3 PIPING NETWORK MATERIALS

The thickness of the pipe or tubing wall shall be calculated in accordance with ASME B31.1 Power Piping Code. For water mist use an internal pressure of 320 psi (2,206 kPa). Only FM approved rigid pipe hangers are to be used when installing the piping systems.

CAUTION: The following SHALL NOT be used for any Fike Micromist® Fire Suppression System installation:

- Nonmetallic or cast-iron pipe or fittings
- Black or galvanized pipe

4.3.1 TUBING AND PIPE

Tubing and pipe, used in intermediate pressure Micromist® Systems (175 to 500 psi or 1,207 to 3,447 kPa), **SHALL** be of noncombustible material having physical and chemical characteristics such that its deterioration under stress can be predicted with reliability. Acceptable materials are Schedule 40 stainless steel pipe and stainless steel or copper tubing. (For detailed description, refer to Equipment, Section 1, Paragraph 1.9.)

Stainless steel or copper tube bending is permitted when bends conform to the following criteria:

- No kinks, ripples, distortions, reductions in diameter, or noticeable deviations from round allowed
- Minimum radius of any bend shall be six (6) pipe diameters
- Bends must be made mechanically using a Swagelok® Tubing bender or equivalent

All pipe, tube and fittings should be reamed, blown clear, and swabbed with a solvent to remove dirt, and cutting oils before assembly.

4.3.1.1 RECOMMENDED TUBE FITTINGS
Stainless steel tubing is to be connected using approved mechanical fittings such as the Swagelok® Tube Fittings as listed below or approved equivalent.

Swagelok® Part Numbers for Various Fittings						
Fitting	Description	1/2"	5/8"	3/4"	1"	1 1/4"
Tee	All tube fittings	SS-810-3	SS-1010-3	SS-1210-3	SS-1610-3	SS-2000-3
90° Elbow	All tube fittings	SS-810-6	SS-1010-6	SS-1210-6	SS-1610-6	SS-2000-6
Union	All tube fittings	SS-810-9	SS-1010-9	SS-1210-9	SS-1610-9	SS-2000-9
Connector	Tube fitting to ½" Male NPT	SS-810-1-8	SS-1010-1-8	SS-1210-1-8	SS-1610-1-8	
Adapter	½" Tube stub to ½" Male NPT	SS-8-TA-1-8				
Adapter	½" Tube stub to ½" Female NPT	SS-8-TA-7-8				
Reducer	½" Tube Fitting to Tube stub		SS-810-R-10	SS-810-R-12	SS-810-R-16	SS-810-R-20
Reducer	5/8" Tube Fitting to Tube stub			SS-1010-R-12	SS-1010-R-16	SS-1010-R-20
Reducer	¾" Tube Fitting to Tube stub				SS-1210-R-16	SS-1210-R-20
Tube Cap	To cap a tube	SS-810-C	SS-1010-C	SS-1210-C	SS-1610-C	SS-2010-C
Tube Plug	To plug a port	SS-810-P	SS-1010-P	SS-1210-P	SS-1610-P	SS-2010-P

4.3.2 FITTING MATERIALS
Approved fittings for Fike Micromist® System distribution piping **SHALL** be as follows:
- 300 Lb. Mallable Iron – Black or Galvanized
- 300 Lb. Ductile Iron – Black or Galvanized
- 150 Lb. Stainless Steel
- Stainless Steel Compression-type Tube Fittings

4.3.3 SIZE REDUCTIONS
A one-piece reducing fitting will be used whenever a change is made in the pipe size. However, hexagonal or face bushings will be permitted for reducing the size of openings of fittings when standard fittings of the required size are not available.

4.3.4 PIPE JOINTS
All threads used in joints and fittings **SHALL** conform to ANSI B1.20.1 (Pipe Threads, General Purpose). Thread lubricant/sealant **SHALL** be applied to the male threads only.

Where stainless steel tubing is joined with compression-type fittings, the manufacturer's pressure/temperature ratings for the fitting **SHALL** not be exceeded.

4.4 INSTALLING MAIN DISCHARGE PIPING

Each pipe section shall be cleaned internally after preparation, and before assembly, by means of swabbing with a suitable nonflammable cleaner. Teflon® tape shall be used on all threaded joints.

The piping system should be securely supported, and should not be subject to mechanical, chemical, vibration, or other damage. Pipe hangers shall be spaced at intervals not exceeding those listed in the following table:

Maximum Hanger Spacing and Rod Sizing					
English Units			**Metric Units**		
Pipe Size NPT in.	**Max Spacing ft.**	**Rod Size in. dia.**	**Pipe Size BSP mm.**	**Max Spacing m.**	**Rod Size mm.**
½	5	3/8	**15**	1.50	10
¾	6	3/8	**20**	1.80	10
1	7	3/8	**25**	2.10	10
1¼	9	3/8	**32**	2.75	10
1½	9	3/8	**40**	2.75	10

Uni-strut® may be used to support the Micromist® System piping network. Install at intervals, as noted in the hanger spacing table. Piping can be secured using Uni-strut® pipe clamps or Swagelok® tube clamps. (Consult local suppliers for details.)

NOTE: ANSI B31.1 shall be consulted for guidance in this matter.

All system piping shall be installed in strict accordance to system plans. If any piping changes are necessary, the system **MUST** be recalculated to assure all design criteria are still complied with.

4.5 NITROGEN VALVE CONNECTIONS

The Fike Micromist® Fire Suppression System is factory pre-assembled and attached to a welded steel mounting skid. It is shipped pre-assembled and mounted to reduce the amount of assembly required in the field. For protection during shipment the attachments to the air valve(s) have been removed and a safety shipping cap placed over the air valve.

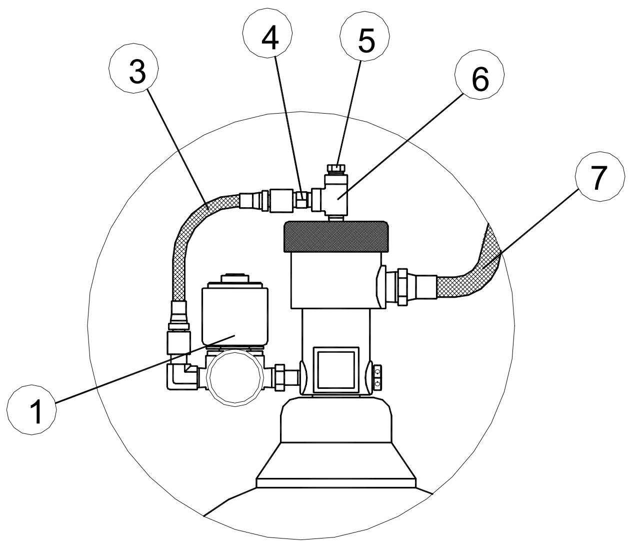
Note: Whenever the Nitrogen cylinder is handled, moved or transported, in an manner, the safety shipping cam **MUST** be in place to avoid injury to personnel or damage to equipment.

4.5.1 70 GALLON (265 LITRE) NITROGEN VALVE CONNECTIONS

When the Fike Micromist® System has been positioned in its final location, the protective cap on the air valve must be removed. The following are the steps required to make the air valve connections. The numbers in the instructions refer to the numbers in the following parts list and figure.

1)	73-007	Assembly, Control Valve W / Pressure Gauge
2)	73-005	Assembly, Control Valve W / Pressure Switch
3)	CO2-1290	Hose, Braided ¼" (8mm) JIC Ends 7½" (19.1cm) long, SS / Brass
4)	02-4543	Connector ¼" (8mm) x $^1/_8$" (4mm), Brass
5)	02-4521	Orifice $^1/_8$" (4mm), Brass
6)	02-4537	Tee, Run $^1/_8$" (4mm), Brass
7)	02-4606	Hose, Braided ½" (15mm) NPT x ½" (15 mm) JIC 12" (30.5cm) Long, SS / Brass

Note: Item number 2 is not shown in the figure. A Micromist® System may have either a pressure gauge (1) or a pressure switch (2), not both.



70 Gallon (265 Litre) Air Valve Connections

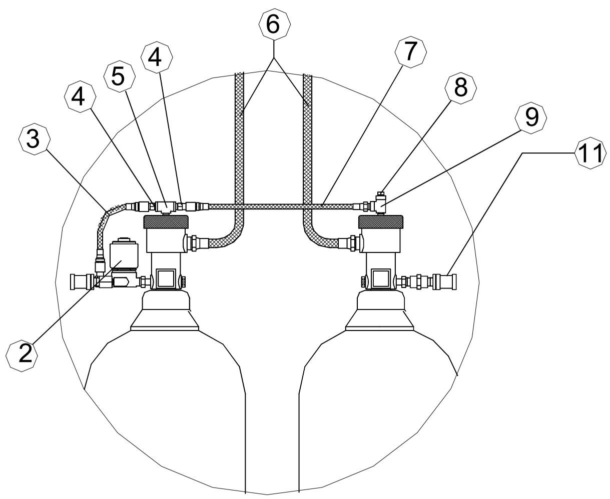
Step 1. Connect the Orifice (5) to one end of the Run Tee (6)
Step 2. Attach Connector (4) to center port of the Run Tee (6)
Step 3. Attach the assembled Run Tee (6) to the top of the Nitrogen Valve
Step 4. **CRITICALLY IMPORTANT:** Install Teflon® tape pipe sealant on the Control Valve Assembly (1) or (2) connector and thread into the fill valve port on the side of the Nitrogen Valve. Failure to use Teflon® tape on this connection will result in the threads being damaged, or stripped off the connector, rendering the connector unfit for service.
Step 5. Carefully align and turn the assembly into the Nitrogen Valve approximately five (5) turns until the assembly is snug. **Some Nitrogen leakage will be observed.** Continue tightening until the leakage stops and assembly is oriented as shown in the figure above.
Step 6. Attach the 7½" long Braided Hose (3) to the Control Valve Assembly (1) or (2) and the Connector (4)
Step 7. Connect the 12" long Braided Hose (7) between discharge port of the Nitrogen Valve on the Nitrogen Tank and the pressure regulator on the Water Storage Tank

4.5.2 107 GALLON (405 LITRE) NITROGEN VALVE CONNECTIONS

When the Fike Micromist® System has been positioned in its final location, the protective caps on both air valves must be removed. The following are the steps required to make the air valve connections. The numbers in the instructions refer to the numbers in the following parts list and figure.

1)	73-007	Assembly, Control Valve W / Pressure Gauge
2)	73-005	Assembly, Control Valve W / Pressure Switch
3)	CO2-1290	Hose, Braided ¼” (8mm) JIC Ends 7½” (19.1cm) long, SS / Brass
4)	02-4543	Connector ¼” (8mm) x $^{1}/_{8}$” (4mm), Brass
5)	02-4539	Tee, Branch $^{1}/_{8}$” (4mm), Brass
6)	02-4533	Hose, Braided ½” (15mm) NPT x ½” (15mm) JIC 23” (58.4cm) Long, SS / Brass
7)	02-4538	Hose, Braided $^{1}/_{8}$” (4mm) NPT x ¼” (8mm) JIC 13½” (34.3cm) Long, SS / Brass
8)	02-4521	Orifice $^{1}/_{8}$” (4mm), Brass
9)	02-4537	Tee, Run $^{1}/_{8}$” (4mm), Brass
10)	73-009	Assembly, Pressure Gauge (Tank 2)
11)	73-008	Assembly, Pressure Switch (Tank 2)

Note: Items number 1 and 10 are not shown in the figure. A Micromist® System may have either pressure gauges (1) and (10) or pressure switches (2) and (11), not both.



107 Gallon (405 Litre) Air Valve Connections

Step 1. Attach a Connector (4) to both sides of the Branch Tee (5)

Step 2. Attach the assembled Branch Tee (5) to the top of the air valve on the left Nitrogen Tank

Step 3. **CRITICALLY IMPORTANT:** Install Teflon® tape pipe sealant on the Control Valve Assembly (1) or (2) connector and thread into the fill valve port on the side of the left Nitrogen Valve. Failure to use Teflon® tape on this connection will result in the threads being damaged, or stripped off the connector, rendering the connector unfit for service.

Step 4. Carefully align and turn the assembly into the Nitrogen Valve approximately five (5) turns until the assembly is snug. **Some Nitrogen leakage will be observed.** Continue tightening until the leakage stops and assembly is oriented as shown in the figure above.

Step 5. Attach the 7½” long Braided Hose (3) to the Control Valve Assembly (1) or (2) and the Connector (4)

Step 6. Connect the Orifice (8) to one end of the Run Tee (9)

Step 7. Attach the assembled Run Tee (9) to the top of the Nitrogen Valve on the right Nitrogen Tank, as shown

Step 8. Connect the 13½” long Braided Hose (7) between the Connector (4) on the left Nitrogen Tank to the Run Tee (9) on the right Nitrogen Tank

Step 9. **CRITICALLY IMPORTANT:** Install Teflon® tape pipe sealant on the Pressure Gauge Assembly (10) or Pressure Switch Assembly (11) connector and thread into the fill valve port on the side of the right

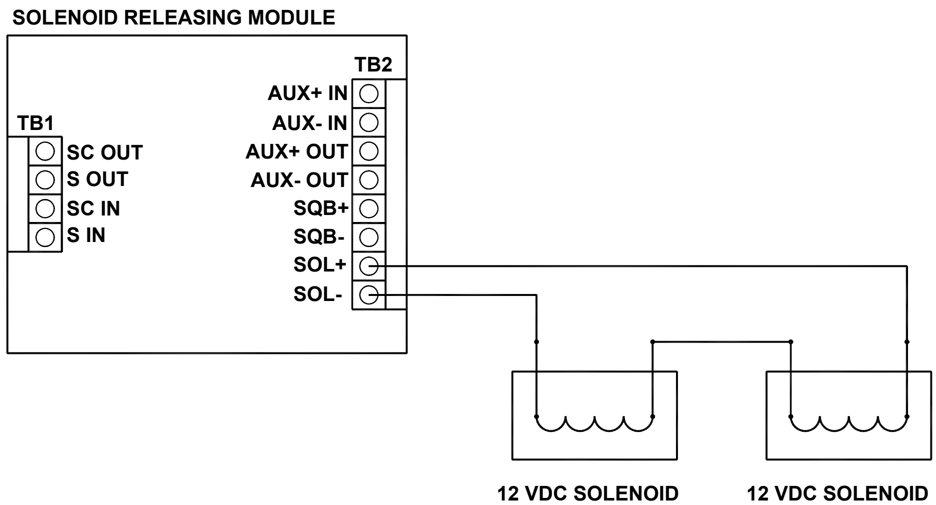
Nitrogen Valve. Failure to use Teflon® tape on this connection will result in the threads being damaged, or stripped off the connector, rendering the connector unfit for service.

Step 10. Carefully align and turn the assembly into the Nitrogen Valve approximately five (5) turns until the assembly is snug. **Some Nitrogen leakage will be observed.** Continue tightening until the leakage stops and assembly is oriented as shown in the figure above.

Step 11. Connect the 23" long Braided Hoses (6) between the air valves on the Nitrogen Tanks and the Tee at the pressure regulator on the Water Storage Tank

4.6 SOLENOID VALVE CONTACTS

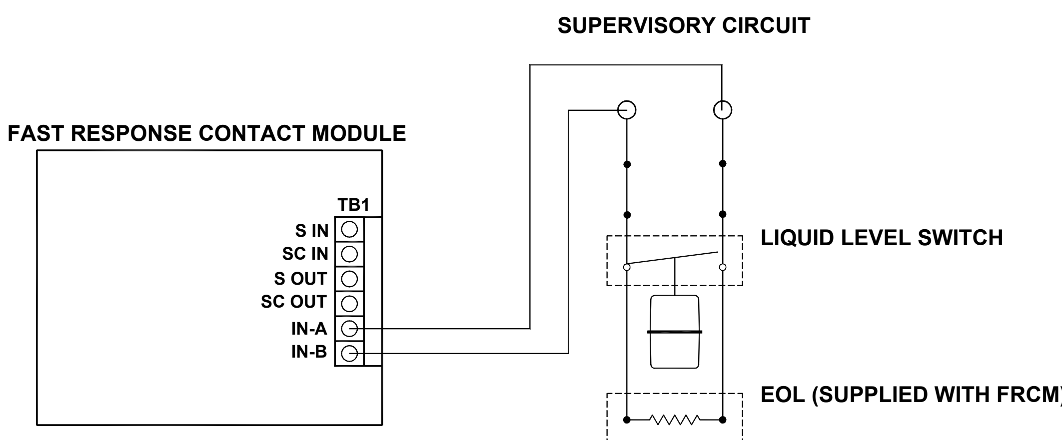
Two solenoids are used in a Fike Micromist® Fire Suppression System. The solenoid valves are 12 Volt DC devices, wired in series back to an SRM (solenoid releasing module) in the control panel. The figure below illustrates the wiring diagram for the solenoids.



Wiring Diagram for Solenoids

4.7 LIQUID LEVEL SWITCH

The liquid level switch is a SPST switch, whose contacts are normally in the open position when the tank is full (switch in the up position). The switch is supervised by the control panel. When the water level drops below the level of the float, the contacts close. This sends an indication to the control panel. The figure below illustrates the wiring diagram for the liquid level switch.



Wiring Diagram for Liquid Level Switch

4.8 WATER TANK FILL PROCEDURE

Before the system can be placed into operation, the water tank(s) must be filled. The drain/fill valve in the bottom of the water tank is a 90° ball valve with a ½" NPT (15mm) female outlet. If using a water hose to fill the tank, first attach a hose adapter to the inline filter attached to the drain/fill valve. A water hose can now be connected to the water tank. Open the vent valve located in the cross at the top of the water tank(s).

Turn water on and fill the tank. The water tank should be filled until water is observed at the vent valve. Shut off the water supply, close the drain/fill valve, and last, close the vent valve. The water tank is now full and operational.

4.9 PROGRAMMING THE CHEETAH® CONTROL PANEL

The following are the step by step instructions for programming the Cheetah® Control Panel. Refer to the Cheetah® Installation, Operation and Maintenance Manual, P/N 06-148, for complete configuration instructions.

- For Machinery Spaces: The mist is directed into the protected area for 40 seconds, then turned off for 40 seconds. This on/off cycle is repeated four times. After the fourth mist, the system pauses for 60 seconds, then checks to determine if the alarm condition still exists. If there is still an alarm condition, four more on/off cycles are applied.
- For Turbine Generator Enclosures: The mist is directed into the protected area for 30 seconds, then turned off for 40 seconds. This on/off cycle is repeated eight times. After the eighth misting, the system pauses for 160 seconds, then checks to determine if the alarm condition still exists. If there is still an alarm condition, eight more on/off cycles are applied.

4.9.1 ADDRESS ALL DEVICES

- Detectors, FRCM's, SRM's and SOM's

4.9.2 SELECT ZONE NUMBER FOR MICROMIST® FIRE SUPPRESSION SYSTEM

4.9.3 SET UP CHEETAH® TO CYCLE THE SRM

- From the main menu screen, press enter.
- Select F2 to enter the password, enter password (default is 10,000), press enter
- Press escape to return to the menu
- Press F6 to configure (Press ACK to silence trouble)
- Press F2 to configure zones
- Use +/- keys to select the zone number
- Arrow over and select SUP for suppression zone
- Arrow over and select detection type. (sinrel) Note: sinrel means single sensor release
- Arrow and use +/- keys to set remainder of information. See example below

```
ZONE:001        SUP-SINREL

DELAY   MAN:10   AUT:030
ABORT:2   MR:Y    ENAB:E
```

<u>Note: ENAB must be "E".</u>

- Press F2 to configure for Micromist® operation.

4.9.3.1 SET UP CHEETAH® FIRMWARE VERSION 3.20

- Use +/- keys to select **"VARIABLE"**, press enter. Screen will appear as below.

```
WATER MIST ZONE TYPE:
        VARIABLE
NUMBER OF SHOTS:2
PRESS ENTER:  CYCLE
```

Note: Number of shots must be "2".

- Press enter.
- Use +/- and arrow keys to change cycle times.

For Machinery Spaces, the screen should read	For Turbine Generator Spaces, the screen should read
CYCLE ON TIME: 037S CYCLE OFF TIME: 043S NUMBER OF CYCLES: 04 POST: 020S TOTAL: 063S	CYCLE ON TIME: 027S CYCLE OFF TIME: 043S NUMBER OF CYCLES: 08 POST: 120S TOTAL: 163S

- Press escape 3 times to return to the menu.
- Press F1 to configure devices.
- Use arrow and use +/- keys to select SRM loop/address number.

For Machinery Spaces, the screen should read	For Turbine Generator Spaces, the screen should read
1-001 SRM ST:WMST F2-ZONES DEV:12VSOL TIME:037S ENAB:E	1-001 SRM ST:WMST F2-ZONES DEV:12VSOL TIME:027S ENAB:E

- Press F2 and use +/- keys to select the proper zone number.
- Press enter to save.

Note: Anytime cycle times are changed, SRM's MUST be reconfigured.

4.9.3.2 SET UP CHEETAH® FIRMWARE VERSION 4.00 AND HIGHER

- Use +/- keys to select either "MACHINE" or "TURBINE", as applicable, press enter.

For Machinery Spaces, the screen should read	For Turbine Generator Spaces, the screen should read
WATER MIST ZONE TYPE: MACHINE NUMBER OF SHOTS: 2 PRESS ENTER: CYCLE	WATER MIST ZONE TYPE: TURBINE NUMBER OF SHOTS: 2 PRESS ENTER: CYCLE

Note: Number of shots must be "2".

- Press escape 2 times to return to the menu.
- Press F1 to configure devices.
- Use arrow and use +/- keys to select SRM and WMST loop/address number.

For Machinery Spaces, the screen should read	For Turbine Generator Spaces, the screen should read
1-001 SRM ST:WMST F2-ZONES DEV:12VSOL TIME:037S ENAB:E	1-001 SRM ST:WMST F2-ZONES DEV:12VSOL TIME:027S ENAB:E

- Press F2 and use +/- keys to select the proper zone number.
- Press enter to save.
- Press escape 2 times to return to the menu.

Note: Anytime cycle times are changed, SRM's MUST be reconfigured.

5.0 FINAL SYSTEM CHECKOUT

The checkout procedures outlined in this section are intended to be a minimum requirement for the extinguishing portion of the system. Additional procedures may be required by the Authority Having Jurisdiction (AHJ).

The control portion of the system should be thoroughly checked out according to the manufacturer's recommendations and the Authority Having Jurisdiction (AHJ).

5.1 HAZARD AREA CHECK

A thorough review of the hazard area is just as important as the proper operation of system components. Certain aspects about the hazard may have changed, or been overlooked, that could affect overall system performance. The following points should be thoroughly checked.

5.1.1 AREA CONFIGURATION

The area dimensions should be checked against those shown on the system plan(s). If the area volume has changed, a recalculation of the volume is necessary to be sure that the area volume is still within the system limitations of 9,175 ft^3 (260 m^3).

The area should be checked to determine that objects such as movable partitions, have not been placed in such a manner that they block the effective operation of a nozzle(s).

5.1.2 AREA SECURITY

The hazard area should be checked to be sure that all doors entering the area have automatic door closures and are working properly. Check to be sure that the ventilation shutdown system has been installed and is working and that the shutdown system for fuel and lubrication supplies are properly installed.

5.2 CONTAINERS

Check to make sure that all containers and brackets are securely fastened. The vent valve on the water storage tank must be **CLOSED**. Make sure that all hose connections on the containers are properly installed and are tight. Check the drain/fill valve to be sure that it is closed.

The pressure gauge(s), if provided, on the gas cylinder(s) should be checked to assure they indicate 1,850 – 1,980 psi @ 70°F (12,893 – 13,652 kPa @ 21°C). The electrical connections to the solenoid valve(s) must be checked to assure they are properly connected.

5.3 DISCHARGE PIPING

The discharge piping should be checked to see that it is securely supported and free from any lateral movement. All joints should be checked for mechanical tightness. Discharge piping shall be pressure tested, as outlined in NFPA 750, latest edition.

5.4 NOZZLES

Check to see that all nozzles are installed in the proper locations, according to system plans. Make sure that large objects have not been placed in front of the nozzles, which would block the water discharge pattern.

5.5 AUXILIARY FUNCTIONS

Operation of auxiliary functions, such as door closures, damper closures, air handling shutdown, etc., should be verified when the control system is activated, both manually and automatically.

5.6 CONTROL PANEL

The operation of the control panel **MUST** be checked by performing the Control Panel check, as detailed in the Cheetah® Installation, Operation and Maintenance Manual P/N 06-148, Chapter 7.

6.0 SYSTEM MAINTENANCE

The following maintenance procedures, at the intervals indicated, are meant to be a minimum requirement for Fike Micromist® Systems. The following procedures do not preclude those required by NFPA 750 and the authority having jurisdiction. More frequent service intervals may be necessary if systems are installed in more severe service applications. This section does not cover maintenance and service procedures for the electrical and control portions of the system. Consult the appropriate manuals for those procedures.

6.1 DISCHARGE PIPING

- **Every six (6) months:**
  Check the system discharge piping for corrosion and damage. Check all piping supports to make sure they are tight and the pipe securely supported.

- **Every year:**
  Same as six (6) month inspection. Also, blow out the piping with compressed air or nitrogen and check for obstructions.

6.2 DISCHARGE NOZZLES

- **Every six (6) months:**
  Check to see that nozzle orifices are clear and unobstructed, and that orifices are not showing signs of corrosion.

6.3 NFPA 750 INSPECTION, MAINTENANCE AND TESTING FREQUENCIES

The following is excerpted from NFPA 750, "Standard for the Installation of Water Mist Fire Protection Systems".

INSPECTION FREQUENCIES

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

MAINTENANCE FREQUENCIES

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

TESTING FREQUENCIES

Item	Activity	Frequency
Control equipment (functions, fuses, interfaces, primary power, remote alarm) (unsupervised)	Test	Quarterly
Remote alarm annunciation	Test	Annually
Batteries	Test	Semiannually
Pressure relief valve	Manually operate	Semiannually
Control equipment (functions, fuses, interfaces, primary power, remote alarm) (supervised)	Test	Annually
Water level switch	Test	Annually
Detectors (other than single use or self-testing)	Test	Annually
Release mechanisms (manual and automatic)	Test	Annually
Control unit/programmable logic control	Test	Annually
Section valve	Function test	Annually
Water	Analysis of contents	Annually
Pressure cylinders (normally at atmospheric pressure)	Pressure cylinder (discharge if possible)	Annually
System	Flow test	Annually
Pressure cylinders	Hydrostatic test	5 – 12 years
Automatic nozzles	Test (random sample)	20 years

6.4 RECHARGING OF NITROGEN CYLINDERS

The following is the procedure for recharging nitrogen cylinder(s) supplied with The Micromist® Fire Suppression System Packages.

6.4.1 RECHARGE PROCEDURE

- Install a Fike Nitrogen Fill Valve Assembly (P/N 73-012), with straight-threaded female threads in the larger diameter threads on the inlet of the Fike Micromist® System Valve.
- Attach the cylinder equipped with the Nitrogen Fill Valve Assembly, to a pigtail on the nitrogen-fill manifold.
- Allow flow of nitrogen gas into the Fike cylinder. Fill the cylinder to the indicated pressure, using pressure gauge, temperature monitoring device, and appropriate, approved fill chart giving correct final pressure(s) for cylinder (gas) temperature(s). Refer to paragraph 6.4.3 for an approved fill chart.
- Stop pump, shut off nitrogen inlet to manifold and open the quarter-turn ball valve in Nitrogen Fill Valve Assembly to vent the pressure in the supply hose.
- Confirm that the Fike cylinder valve has shut off. Note: Valve failure will be indicated by the cylinder dropping in temperature (as nitrogen flows out, the cylinder will cool to an easily detectable degree). Also, if any cylinder valve fails to shut off, the manifold system will be relatively slow to drop to atmospheric pressure. Mark any cylinders whose valve fails to shut off.
  WARNING: Be sure that the system pressure is sufficiently near atmosphere so that the pigtail will not "whip" when released from the cylinders. Such whipping action can cause serious injury or death.
- Leak check the cylinder, particularly at the neck where the valve threads into the cylinder; and leak check the valve, particularly at the safety assemblies and other joints. Mark and reject any cylinder found defective.
- Disconnect the cylinder from the manifold pigtail and the Fike Nitrogen Fill Valve Assembly. Install the Safety Shipping Cap on the cylinder. Be sure the cylinder is secured according to OSHA recommendations.

6.4.2 QUALITY ASSURANCE

- At least two (2) hours after recharging, and preferably the next day, check the settled pressure as follows:
  1) Use reliable gauge and check the pressure in the Fike cylinder.
  2) After determining the temperature of the cylinder, check the nominal pressure using the following fill chart. For a cylinder filled to nominal pressure of 1,920 psi (13,238 kPa), the allowable range **SHALL** be:
     a) No more than 45 psi (310.3 kPa) over the nominal, and
     b) No more than 55 psi (379.2 kPa) under the nominal.
- The pressure in all Fike cylinders **MUST** fall within the above listed limits.

6.4.3 NITROGEN CYLINDER FILL CHART

The following is a fill chart showing temperature vs. pressure for 100% Nitrogen.

Micromist® Nitrogen Cylinder Fill Chart							
Temperature		Pressure		Temperature		Pressure	
Degrees F	Degrees C	PSI	KPa	Degrees F	Degrees C	PSI	KPa
10	-12.2	1633	11,259	72	22.2	1930	13,307
12	-11.1	1642	11,321	74	23.3	1939	13,369
14	-10.0	1652	11,390	76	24.4	1949	13,438
16	-8.9	1661	11,452	78	25.6	1958	13,500
18	-7.8	1671	11,521	80	26.7	1968	13,569
20	-6.7	1680	11,583	82	27.8	1977	13,631
22	-5.6	1690	11,652	84	28.9	1987	13,700
24	-4.4	1700	11,721	86	30.0	1997	13,769
26	-3.3	1709	11,783	88	31.1	2006	13,831
28	-2.2	1719	11,852	90	32.2	2016	13,900
30	-1.1	1728	11,914	92	33.3	2025	13,962
32	0.0	1738	11,983	94	34.4	2035	14,031
34	1.1	1748	12,052	96	35.6	2044	14,093
36	2.2	1757	12,114	98	36.7	2054	14,162
38	3.3	1767	12,183	100	37.8	2063	14,224
40	4.4	1776	12,245	102	38.9	2073	14,293
42	5.6	1785	12,307	104	40.0	2083	14,362
44	6.7	1796	12,383	106	41.1	2092	14,424
46	7.8	1805	12,445	108	42.2	2102	14,493
48	8.9	1815	12,514	110	43.3	2111	14,555
50	10.0	1824	12,576	112	44.4	2121	14,624
52	11.1	1834	12,645	114	45.6	2130	14,686
54	12.2	1843	12,707	116	46.7	2140	14,755
56	13.3	1853	12,776	118	47.8	2150	14,824
58	14.4	1863	12,845	120	48.9	2159	14,886
60	15.6	1872	12,907	122	50.0	2169	14,955
62	16.7	1882	12,976	124	51.1	2178	15,017
64	17.8	1891	13,038	126	52.2	2188	15,086
66	18.9	1901	13,107	128	53.3	2197	15,148
68	20.0	1910	13,169	130	54.4	2207	15,217
70	21.1	1920	13,238				

Final density is 0.3359 Lb.-Moles / ft^3 = 0.0752 SCF / in^3 = 9.4098 Lb. / ft^3 (150.73 Kg. / m^3)

6.5 POST FIRE MAINTENANCE

Following the event of a fire, there are several procedures that must be followed before the system may be considered ready for return to service. These procedures outlined below are to be performed after the it is confirmed that the fire has been extinguished and the area has been cleaned.

- Control Panel must be reset. Refer to the Cheetah® Installation, 0peration and Maintenance Manual, P/N 06-148, for detailed instructions.
- Water Storage Container must be completely flushed and refilled.
- Nitrogen cylinder(s) must be recharged and/or replaced.
- Nozzles / screens must be checked / cleaned, or replaced, to assure free flow of water through all nozzle orifices.
- Piping network must be examined to assure that all connections and mounting brackets are tight and undamaged.
- Mechanically and/or fire damaged components must be replaced.

•

7.0 PARTS LIST

The following is a list of the Fike Micromist® Fire Suppression System Packages. Each Micromist® package includes water and Nitrogen cylinder(s), control valves, water level indicator, nitrogen cylinder pressure gauge(s) or switch(es), solenoid actuators for both air and water cylinders, all necessary bracketing and the mounting skid.

7.1 MICROMIST® SYSTEM PACKAGES

Fike Micromist® Fire Suppression System Packages are available in two (2) sizes. Each size may be purchased with a choice of either explosion proof pressure switches or pressure gauges as indicated below:

7.1.1 MICROMIST® SYSTEM PACKAGES WITH EXPLOSION PROOF PRESSURE SWITCH(ES)

Part Number	Description
73-001	70 Gallon (265 liter) Micromist® System
73-002	107 Gallon (405 liter) Micromist® System

7.1.2 MICROMIST® SYSTEM PACKAGES WITH PRESSURE GAUGE(S)

Part Number	Description
73-010	70 Gallon (265 liter) Micromist® System
73-011	107 Gallon (405 liter) Micromist® System

7.2 MICROMIST® NOZZLES

Micromist® nozzle assemblies utilize a ½" NPT female connection and include a nozzle screen. There are two (2) types of nozzle assemblies. Selection depends on the type of enclosure being protected as indicated below:

7.2.1 MICROMIST® NOZZLE ASSEMBLIES

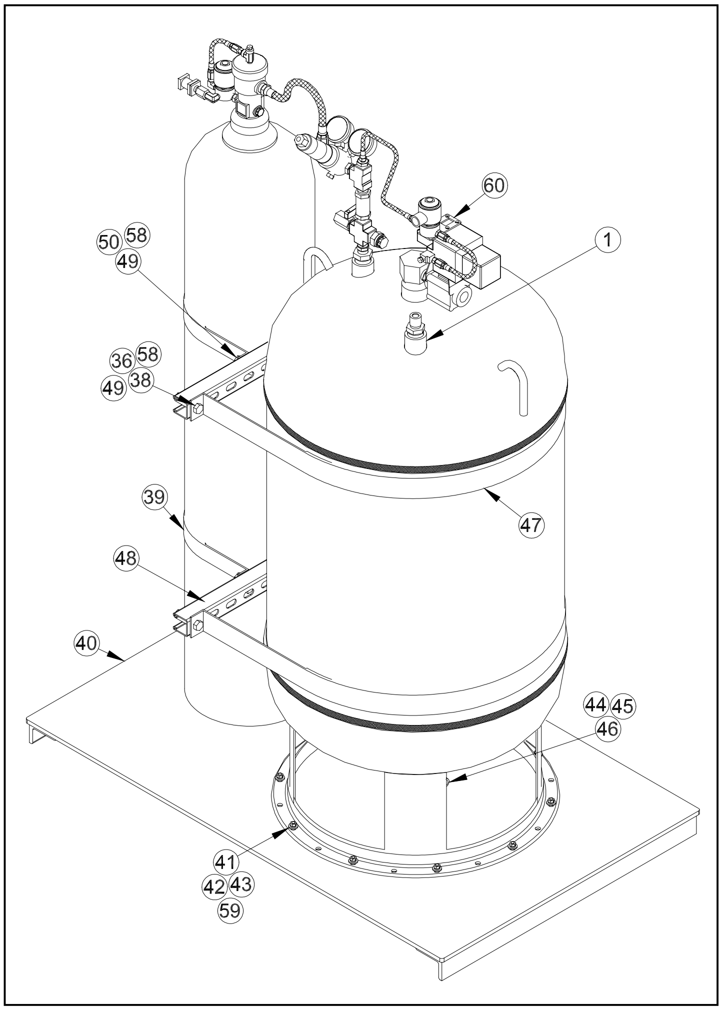
Part Number	Description
73-0023	Nozzle Assembly for Turbine Generator Enclosures
73-0024	Nozzle Assembly for Machinery Spaces

7.3 MICROMIST® SYSTEM SPARE PARTS

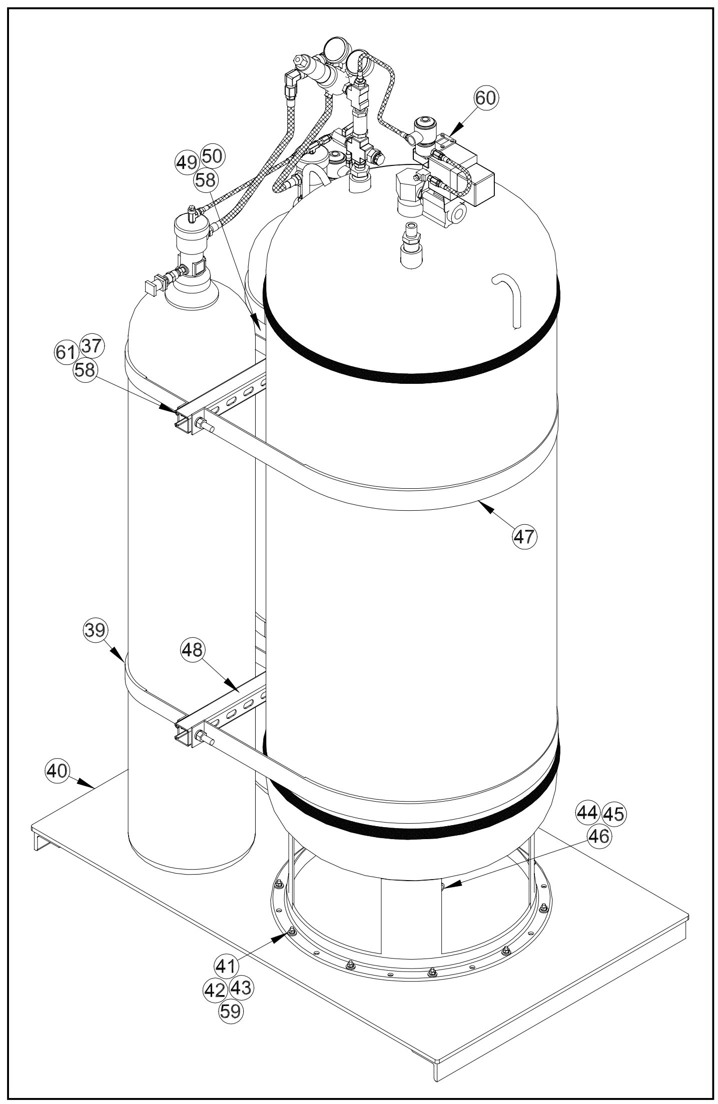
The following Micromist® spare parts are shown in the drawings found at the end of this parts list. Each spare part is listed with an "item number". This "item number" corresponds to the balloon numbers shown in the drawings.

Item Number	Part Number	Description
1	02-4236	Liquid Level Indicator
2	02-4472	Water Valve
3	C02-1279	Hose, 1/4" JIC to 1/4" JIC X 9" Long
4	02-4530	Nipple, 1/4" NPT to 1/4" JIC
5	C02-1254	Solenoid Valve, 12 VDC
6	02-4538	Hose, 1/8" NPT to 1/4" JIC X 13-1/2" Long
7	02-4522	Water Valve Orifice
8	02-4540	Hex Nipple, 1/2" NPT
9	73-0040	Rupture Disc Assembly for Water Cylinder
10	02-4571	Check Valve, 1/2" NPT
11	02-4541	Tee, 1/2" NPT
12	02-4531	Bushing, 1/2" NPT to 1/8" NPT
13	02-4574	Pressure Regulator
14	02-4606	Hose, 1/2" NPT to 1/2" JIC, 12" Long
15	02-4573	Elbow, 1/4" NPT to 1/2" JIC
16	02-4572	Hex Nipple, 1/2" NPT to 1/4" NPT
17	02-4527	Cross, 1/2" NPT
18	02-4526	Vent Valve for Water Cylinder
19	02-4566	Bushing, 1" NPT to 1/2" NPT
20	73-0032	Water Cylinder, 70 Gallon
21	02-4528	Hex Nipple, 3/4" NPT
22	73-0034	Water Valve Adapter
23	C02-1290	Hose, 1/4" JIC to 1/4" JIC X 7-1/2" Long
24	02-4542	1/8" NPT Run Tee, Low Pressure
25	02-4535	Nipple, 1/8" NPT to 1/4" JIC
26	73-0046	Siphon Tube, 70 Gallon System
27	73-0010	Nitrogen/Air Valve Assembly
28	C85-1092	Connector, Valve to Solenoid
29	02-4602	Elbow, 1/8" Brass Street, High Pressure
30	02-4550	Pressure Switch
31	02-4576	Coupling, 1/8" NPT to 1/4" NPT, High Pressure
32	C02-1280	Elbow, 90 - Solenoid Valve to Hose
33	02-4543	Nipple, 1/8" NPT to 1/4" JIC, High Pressure
34	02-4521	Orifice, Air Valve
35	02-4537	Tee, Run, 1/8" NPT, High Pressure
36	02-4231	Nut Coupler, 1/2"-13UNC
37	02-4598	Bolt, 1/2"-13UNC X 3-1/2" Lg.
38	02-4373	Washer, 1/2"
39	C70-213	Mounting Strap, Nitrogen Cylinder
40	73-0039	Mounting Skid

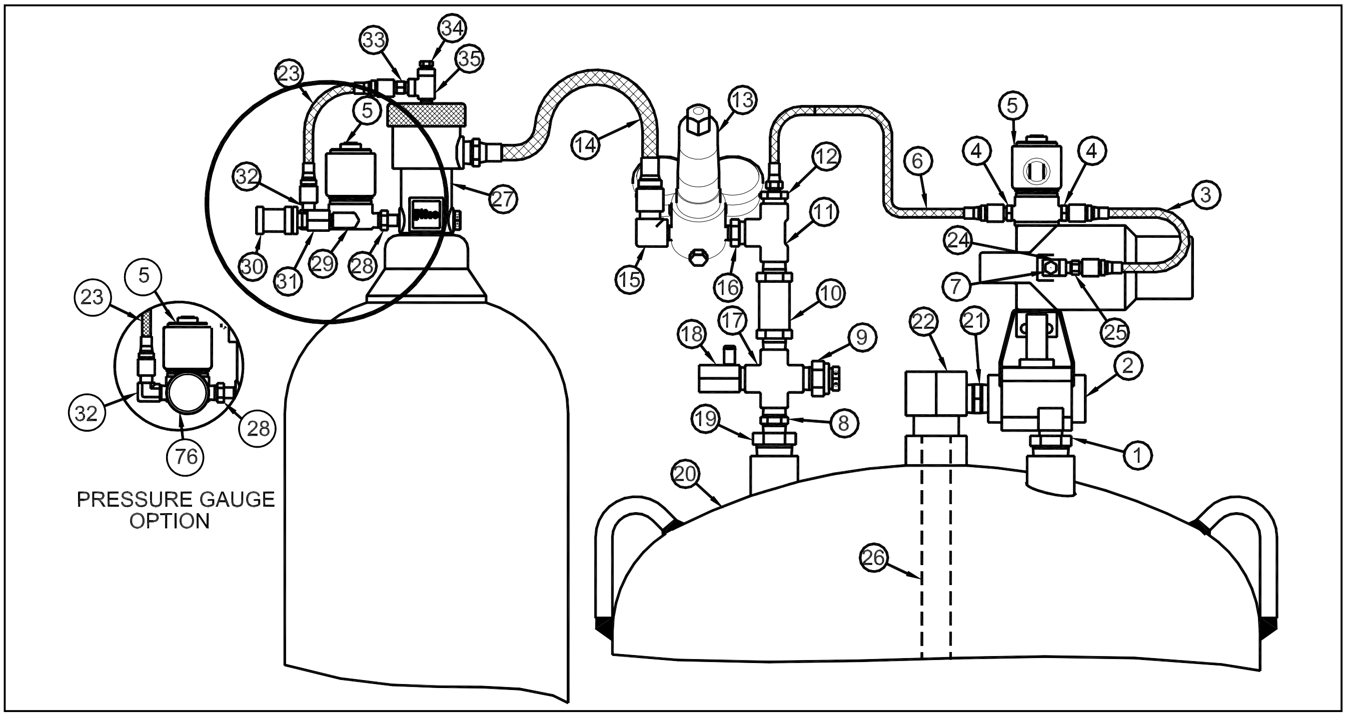
Item Number	Part Number	Description
41	02-4583	Bolt, 1/4"-20 UNC X 1-1/4" Lg. - SST
42	02-4582	Nut, 1/4"-20 UNC - SST
43	02-4580	Washer, 1/4" - SST
44	02-4235	Drain Valve for Water Tank
45	02-4552	Bushing, 2" NPT to 1/2" NPT
46	02-4585	Filter, Inline, 1/2" NPT
47	70-1384-R	Mounting Strap, Water Cylinder
48	73-0051	Uni-strut®, 28"
49	02-4230	Bolt, 1/2"-13UN X 1-1/2" Lg.
50	02-4218	Nut, 1/2"-13UNC Uni-strut®
51	02-4533	Hose, Air Valve to Regulator, 107 Gallon
52	02-4536	Tee, 1/2" NPT, High Pressure
53	02-4539	Tee, Branch, 1/8" NPT, High Pressure
54	73-0027	Water Cylinder, 107 Gallon
55	73-0049	Siphon Tube, 107 Gallon System
56	02-4532	Elbow, 1/2" NPT to 1/2" JIC, High Pressure
57	02-4575	Nipple, 1/2" NPT to 1/4" NPT, High Pressure
58	02-4372	Lock Washer, 1/2"
59	02-4581	Lock Washer, 1/4" - SST
60	73-0035	Solenoid Bracket
61	C02-1209	Nut, 1/2"-13UNC
62	C02-1277	O-Ring for Pilot Valve
63	C85-1093	Pilot Valve Assembly
64	C02-1273	Spring for Main Valve Seal
65	C85-1087	Main Valve Seal Assembly
66	C85-1077	Main Valve Retainer
67	C02-1175	O-Ring Piston Retainer
68	C02-1282	O-Ring for Top Cap
69	C02-1276	O-Ring (Top / Large) for Piston
70	C02-1150	O-Ring (Bottom / Small) for Piston
71	C85-1094	Safety Disc Nut
72	C85-1002	Safety Disc
73	C02-1289	Washer for Main Valve Seal Retainer
74	C02-1015	Safety Disc Washer
75	02-4600	Coupling, 1/4" NPT, High Pressure
76	C02-1257	Pressure Gauge
77	02-4603	Coupling, 1/4" NPT x 1/8" Brass, High Pressure
Not Shown	D3632-1	Rupture Disc for Water Cylinder
Not Shown	02-4590	Plug, 1" NPT
Not Shown	73-012	Nitrogen Fill Valve Assembly



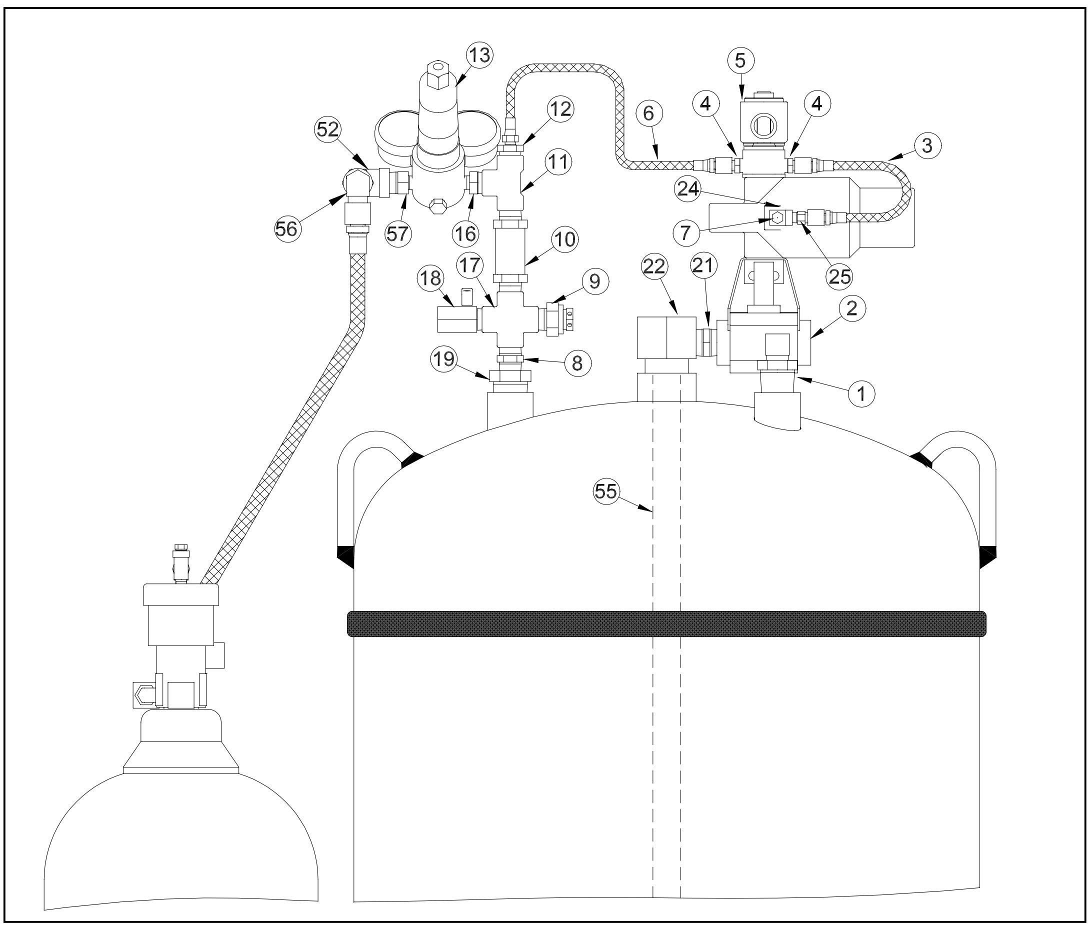
Overall View
of
70 Gallon (265 liter)
Micromist® System



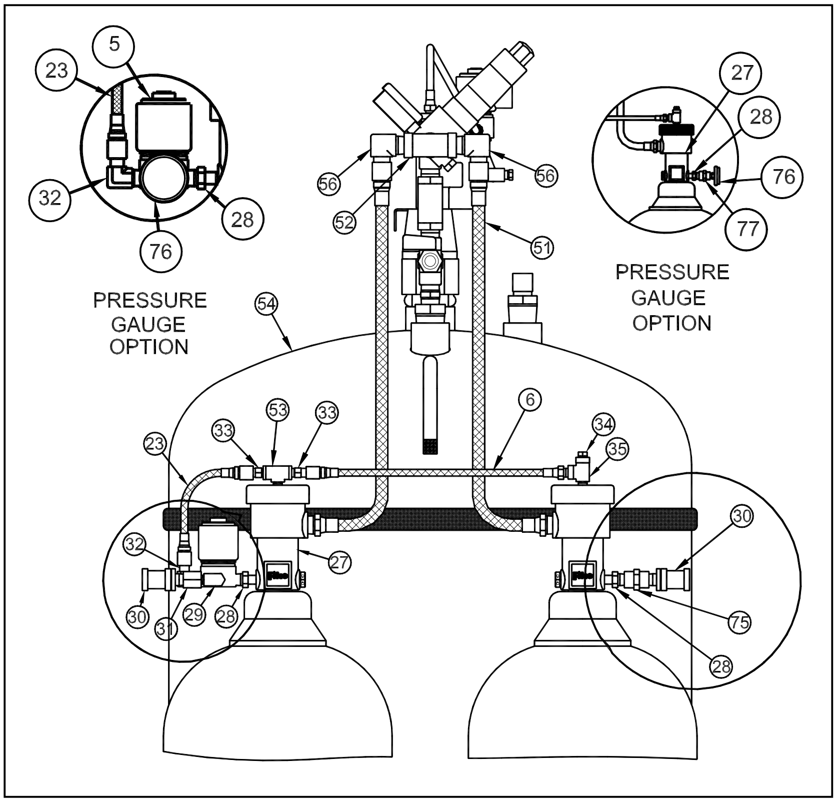
Overall View
Of
107 Gallon (405 liter)
Micromist® System



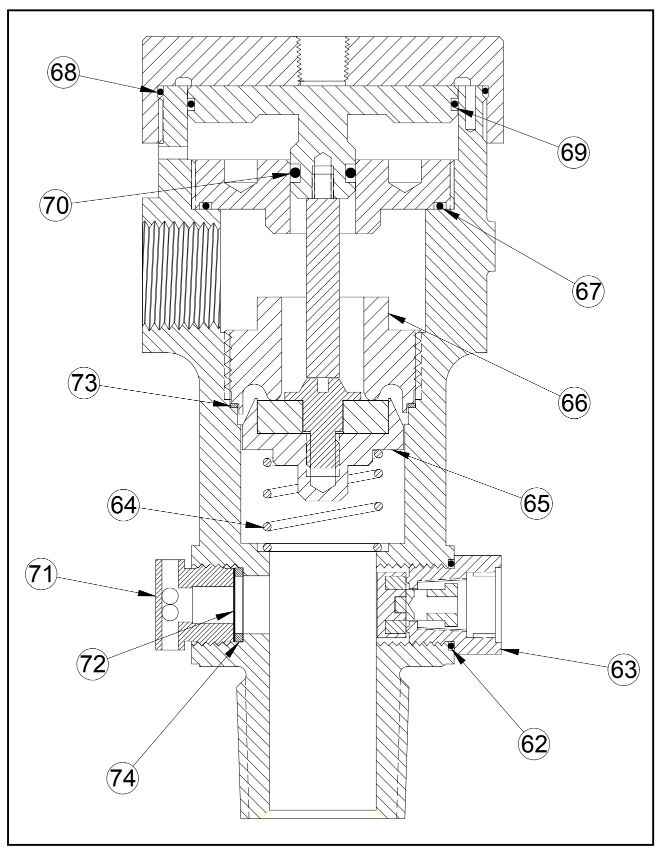
Detail View of Connections of 70 Gallon (265 liter) Micromist® System



Detail View of Connections of 107 Gallon (405 liter) Micromist® System



**Detail View
Of
Nitrogen Tank
Connections
Of
107 Gallon
(405 liter)
Micromist® System**



**Detail View
Of
Nitrogen Valve
for
Micromist® Systems**