

MEEFOG™ HIGH PRESSURE FOGGING SYSTEMS

Commercial Humidification



Mee Industries Inc.



Facebook, Smithsonian, Army Research Lab, TDS Telecom,
NYC Cancer Research and Treatment Center,
National Center for Atmospheric Research, Iowa State University,
Calvin College - Covenant Fine Arts Center, Commonwealth of Virginia,
Alliant Energy Corporation, Ann Arbor News, Connor-Winfield,
NSF International, Upper Peninsula Medical Center,
Pall Life Sciences, Milwaukee Journal Sentinel,
Grand Valley University, Valparaiso University

MeeFog™ systems can save as much
as 99% in energy use compared to
other humidification technologies,
and have been used by more than
10,000 customers around the
world.

**Unmatched energy savings, greater flexibility & control, for a wider
range of applications.**

In a world increasingly looking for energy saving solutions, MeeFog™ systems offer an efficient, economical way to humidify an impressive range of operations.

MeeFog™ commercial humidification systems are in use around the world in a wide variety of facilities, including office buildings, laboratories, manufacturing facilities and other temperature and humidity-sensitive environments. MeeFog™ humidification is a highly effective alternative to traditional, more costly methods of humidification. Most importantly, return on investment when installing a MeeFog™ system can often be achieved in less than one year.

In the following pages, you'll see how MeeFog™ systems outperform other humidification systems.

Lower Costs, Greater Reliability, Low Maintenance

Fog is Better. MeeFog is Best.

The MeeFog™ system uses high-pressure pumps to pressurize treated supply water to 1000 psi. The proprietary MeeFog™ nozzles then atomize the water into billions of ultra-fine fog droplets. By taking advantage of the adiabatic process, existing heat in the air evaporates the water droplets. This is what yields the incredible energy savings as compared to other technologies, such as steam, compressed air, or ultrasonic systems. A typical MeeFog™ system uses just one horsepower of energy for every 600 lbs of water evaporated.

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ENERGY COST COMPARISON CHART (ANNUAL)		
MeeFog™ System	\$706	1%
Ultrasonic	\$8,467	6%
Compressed Air	\$13,054	9%
Steam to Steam	\$113,263	74%
Gas to Steam	\$74,966	49%
Electric Steam	\$153,931	100%
Assumptions: \$0.10 per kWh, \$1.20 per therm, 3500 hours operation, 1000 lbs. per hour moisture output.		

Operating a MeeFog™ system costs \$706 per year compared with \$13,054 for compressed air atomizers and \$153,931 for electric steam humidifiers.

“The numbers came back very attractive and we purchased it, we also received a \$16,000 energy savings rebate from Con Edison so the payback worked out to just under two years.”



— General Manager – Plant Operations, Energy and Engineering
Major NYC Cancer Research and Treatment Center

The Mee Difference

One of the key technological advantages of using MeeFog™ system is the uniquely designed and meticulously crafted stainless steel impaction-pin fog nozzle. MeeFog™ nozzles are installed in TIG welded stainless steel adapters with an o-ring seal for easy removal and re-installation. Each nozzle has replaceable, last-chance filter.

With more than 46 years of industry-leading experience behind our technology, it is no wonder that Mee Industries is the leading manufacturer of high pressure fogging systems today.

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Mee impaction pin nozzle precisely atomizes water into billions of ultra-fine droplets.

“The MeeFog™ system is much lower on maintenance than our legacy steam humidifiers. We don’t have any calcification issues, no elements to burn out, no floats to get fouled or bubble indicators. We just have to change the oil, check the belts, change the filters and we are done.”

— Eric Patterson, Facilities Manager
Madison Data Center

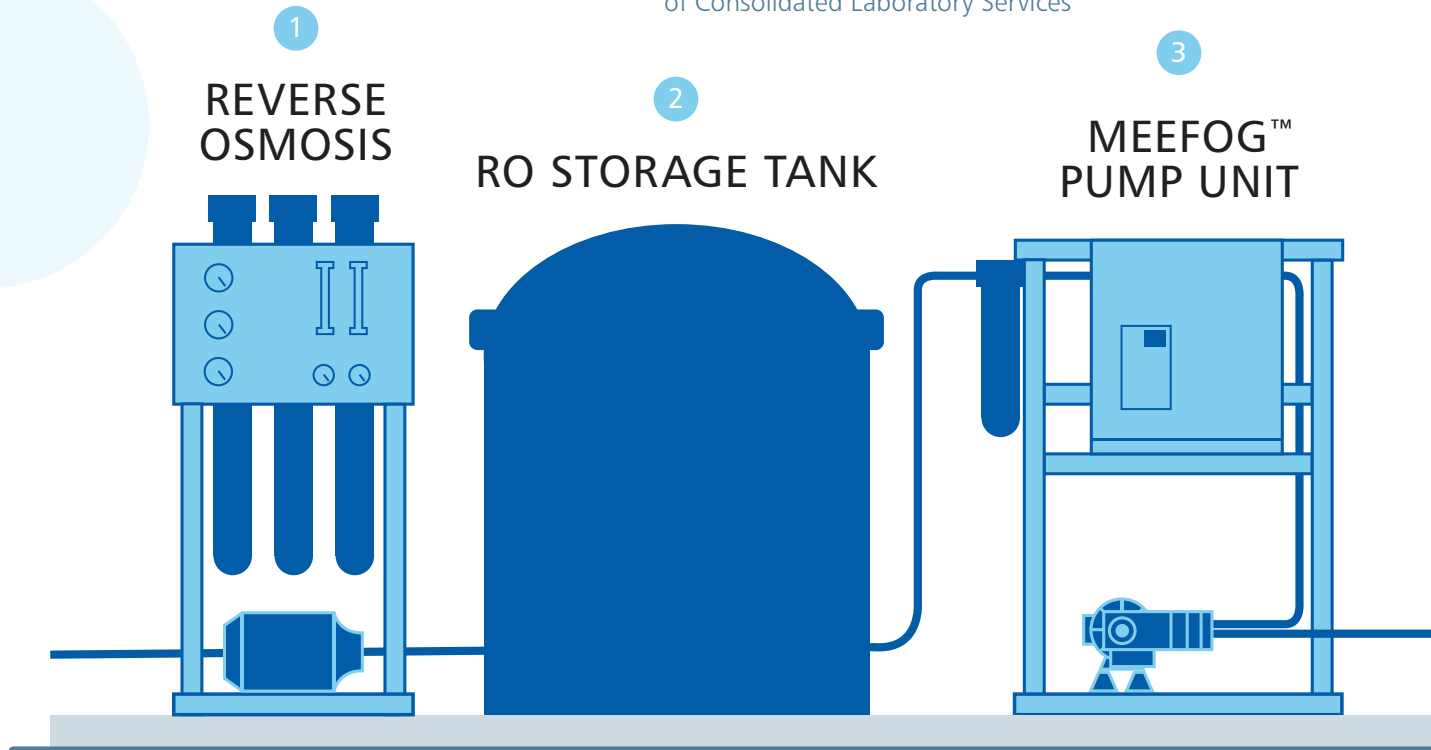
Simplicity Is Designed Into Every Mee Installation

MeeFog™ nozzle manifolds are typically installed in the air handling units (AHU), or in modified duct sections.

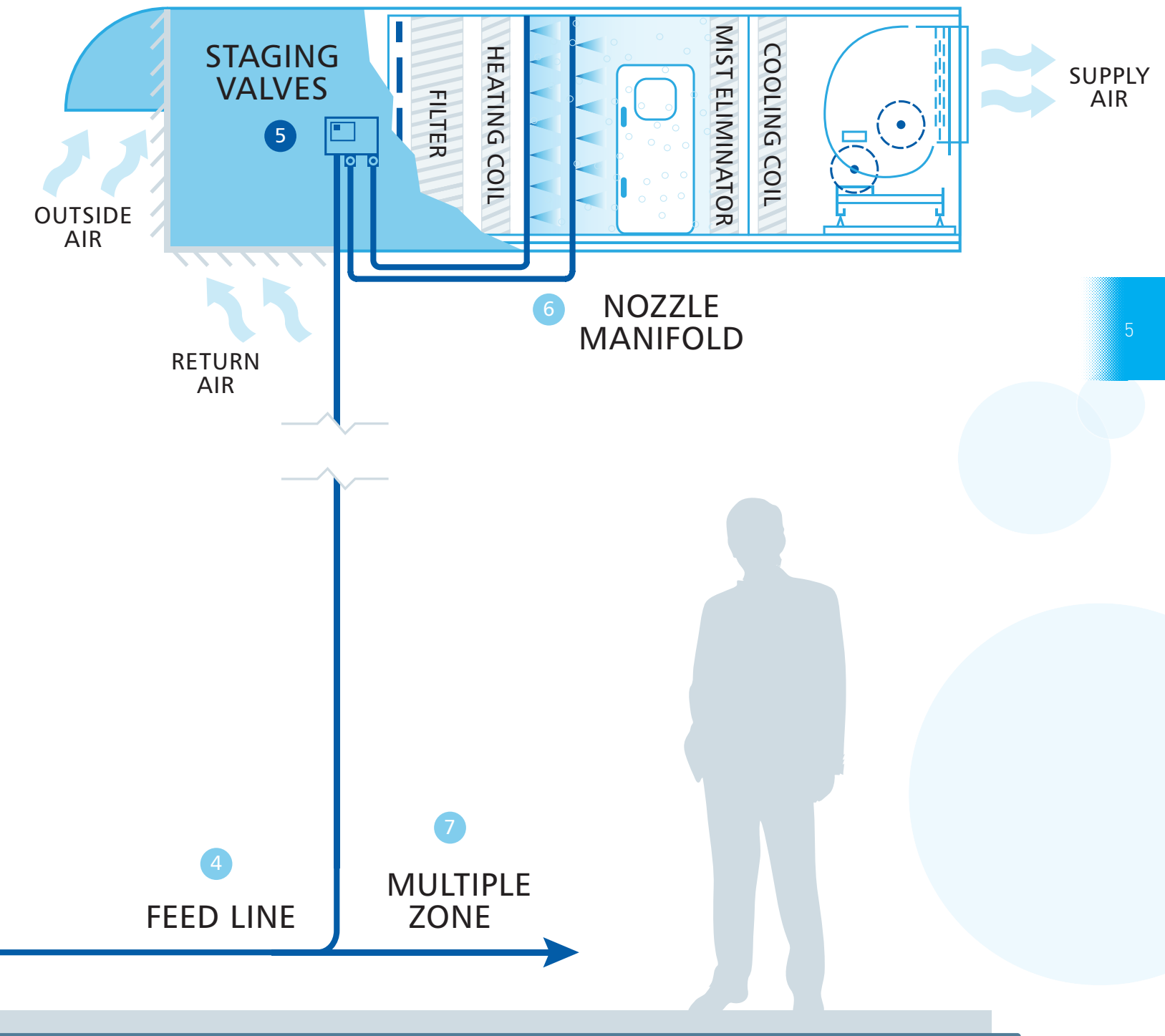
MeeFog™ humidification systems do not require compressed air or steam, which greatly simplifies the installation. The use of direct pressure requires very few moving parts (with none in the air handler itself). One MeeFog™ pump unit can often run multiple air handlers and can also be configured with system redundancy if needed.

We liked the simple design of the system and we have been very satisfied with the way it has performed. It's not a big, complicated system, they were even able to install the spray racks in the air handlers while the handlers were running, so there was no interruption in the operations.

— Steve Crouch, Building Manager at Virginia Division of Consolidated Laboratory Services



1. MeeFog™ reverse osmosis systems are state-of-the-art water purification systems. Ask your MeeFog™ rep for details.
2. RO storage tank is used to store water for future use. A recycle pump and UV sterilization system ensure no biological growth.
3. MeeFog™ pump unit with stainless steel frame, VFD, direct drive, ceramic plunger pumps, on-board computer with color interface screen.
4. 1/2 inch stainless steel feed lines connect the pump to the nozzle manifold.

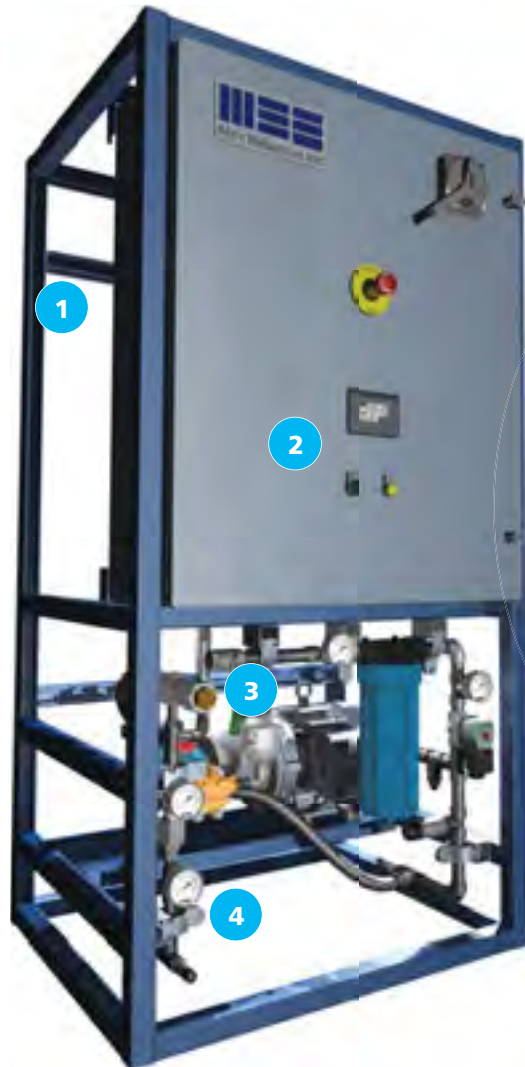


5. Staging valves allow for multiple stages of output. PLC with interface screen manages staging based on humidity demand signal.
6. Manifolds of high-pressure nozzles are supplied with 1000-psi water, and designed to disperse the fog evenly.
7. Expands to multiple zones for additional AHUs according to your project needs.

The MeeFog™ Pump Unit - a Standardized Component of a Customized System

The MeeFog™ pump unit has been designed to perform in the most demanding situations. All components are industrial duty, and the system is designed for 24/7 operation. MeeFog™ systems feature a Variable Frequency Drive (VFD) that enables a “soft start” of the pump motor and maintains the lowest pump speed possible for energy savings and long pump life. The pump unit can be run down to a minimum flow of one fog nozzle – or even a closed discharge – without the need to bypass water back to an RO tank or dump water to drain to prevent overheating.

Each pump unit is fully assembled & tested at our factory in the United States before being shipped to the job site. MeeFog manufactures pump units to meet exacting UL, CUL, or CE requirements. All of this adds up to strong, durable equipment that will perform flawlessly upon installation.



MeeFog™ Pump Unit

1. Heat exchanger for part load pump cooling along with VFD speed control.
2. Control panel includes PLC with user interface, alarms and shut-offs for high/low pressure.
3. Direct drive pump with high efficiency motor. All wetted parts are stainless steel.
4. Pressure gauges indicate inlet and discharge pressure and differential across filters.
5. All components are mounted on a stainless steel frame.

“We need to manage the humidity year round. The cooling systems provide the dehumidification in the summertime. In winter we add humidity by spraying water inside the air handlers and vaporize it to add humidity.”

— Steven Schultz, Engineer at GMB Architects + Engineers

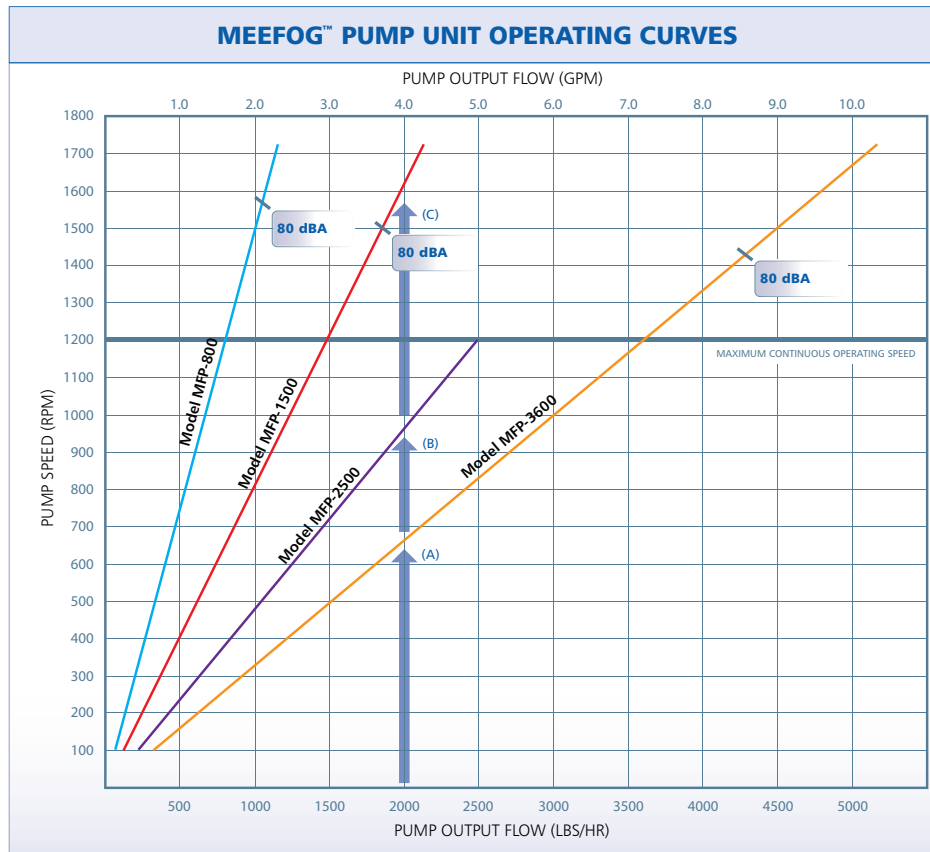
The Right Size Pump Unit For Any Application

MEEFOG™ PUMP UNITS FOR HVAC APPLICATIONS				
	MFP-800	MFP-1500	MFP-2500	MFP-3600
Pump Unit Capacity Continuous Use*	LBS/HR 800	1,500	2,500	3,600
	GPM 1.6	3.0	5.0	7.2
Motor	2 HP	3 HP	7.5 HP	7.5 HP
Power	230/460V 3PH	230/460V 3PH	460V 3PH	460V 3PH
Max Motor Amps	5.4/2.7 A	7.8/3.9 A	6.0 A	9.0 A
Fuse Size	15 amp @ 460 V	20 amp @ 460 V	35 amp @ 460 V	35 amp @ 460 V
Pump Unit Dimensions W x D x H		33.5" x 28.3" x 65.4"		
Pump Unit Weight	450 LBS	490 LBS	565 LBS	580 LBS
Alternate Allowable Maximum Flow for Intermittent Use** (80 dBA max noise level)	LBS/HR 1,000	1,850	N/A	4,250
	GPM 2.0	3.7	N/A	8.5
Max Pump RPM	1725	1725	1200	1725

*at 1200 RPM maximum

**Mee recommends discussing the use of the maximum flow spec with a Mee Industries application engineer. Alternate allowable maximum flow for intermittent use is not usually suitable for a high-occupancy building where high humidification demand could occur during the hours of occupation.

Pump Unit Operating Curves



Selecting A Pump Unit

Example: If a maximum flow of 2000 lbs/hr (4.0 gpm) is required, there are three pump choices.

Select an MFP-3600 (A) for a very low rpm, long lasting, and quiet pump unit. This pump is a good option if, for example, the pump unit must be located near occupied spaces where noise could be an issue or if the pump is expected to operate at full flow most of the time.

Select an MFP-2500 (B) for a low rpm, long lasting, quiet pump unit. This pump is a good and cost effective option for any application.

Select MFP-1500 (C) only if the pump will operate at less than 1500 lbs/hr (3.0 gpm) most of the time but could operate for a few hours per year at higher flows. This pump is a low-cost option that should be selected only if the pump is expected to operate at low flows most of the time and only if occasional operation at over 80 dBA is acceptable.

Get the Precise Humidity Control You Need

We know that precise humidity control is an essential feature of any humidity system. The MeeFog™ system modulates output by the use of solenoid staging valves that can achieve exactly that. Based on the humidity demand signal, staging valves open and close to alter the fog output and match the humidity requirement.

Solenoid staging valves are connected to stainless steel fog nozzle manifolds. Each manifold consists of a precise number of fog nozzles. As can be seen in the example to the right, using only 4 solenoid valves, we can achieve 14 stages of control, with an approximate 7% control increment. By varying the amount of staging valves provided, and the amount of nozzles per stage, the MeeFog™ system can provide the precise control that your application requires based on a nozzle flow rate of 16 lbs/hr.

Solenoid panels are strategically located near the humidifier section of the AHU and can provide humidity control to multiple AHU's from just a single MeeFog™ pump unit. This can reduce the amount of equipment required, and make an already cost effective system even more so.

“The MeeFog™ system held humidity levels much tighter than we had before with the old system, it was the first winter where I had no complaints about the vivarium humidification levels.”

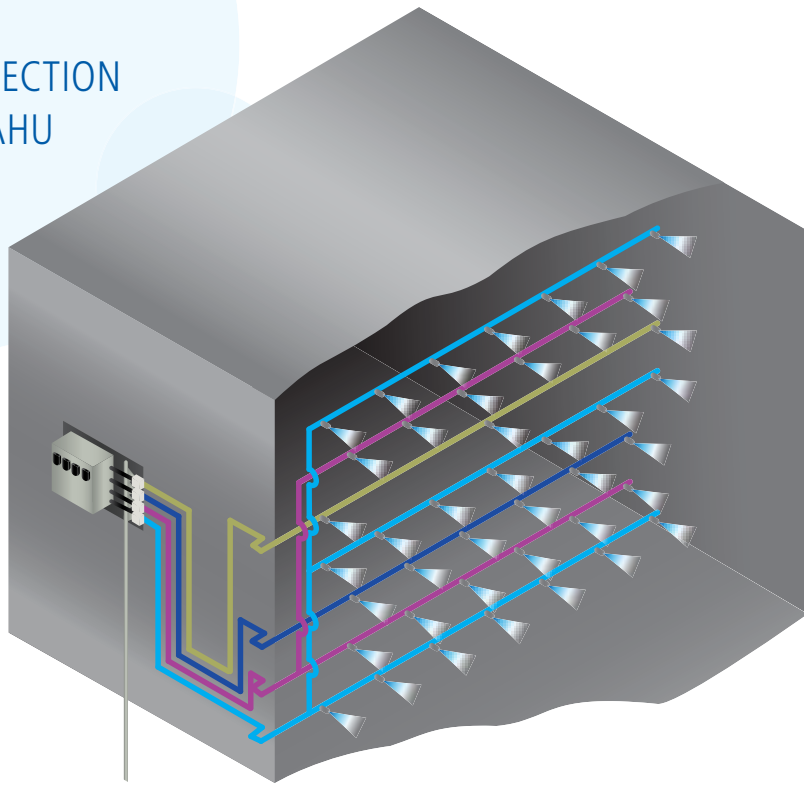
— General Manager – Plant Operations, Energy and Engineering
Major NYC Cancer Research and Treatment Center



Staging Valves

High pressure valves are often used to modulate the output of MeeFog™ systems. This staged-control method can give very precise control of the humidity level in the air duct. Tight control can be accomplished by using a number of valves, each supplying water to a different number of nozzles, and controlling those valves in the proper sequence to get many stages of fog output.

CROSS SECTION OF AN AHU



1000 PSI
WATER FROM
PUMP UNIT

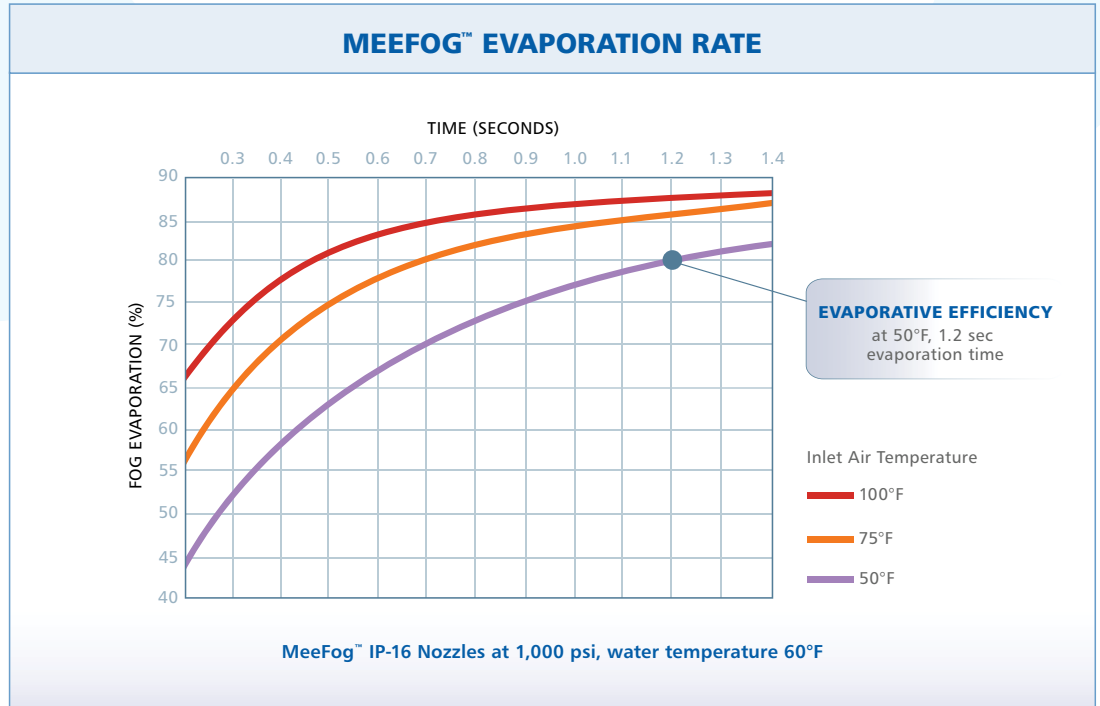


STAGING SCHEDULE EXAMPLE

STAGE	SOLEINOID				NOZZLES	OUTPUT (LBS/HR)	NET OUTPUT (at 75% EVAP. EFFICIENCY)	CAPACITY (% of load)
	VALVE 1	VALVE 2	VALVE 3	VALVE 4				
1	ON				3	48	36	7.1
2		ON			6	96	72	14.3
3	ON	ON			9	144	108	21.4
4			ON		12	192	144	28.6
5	ON		ON		15	240	180	35.7
6		ON	ON		18	288	216	42.9
7				ON	21	336	252	50.0
8	ON			ON	24	384	288	57.1
9		ON		ON	27	432	324	64.3
10	ON	ON		ON	30	480	360	71.4
11			ON	ON	33	528	396	78.6
12	ON		ON	ON	36	576	432	85.7
13		ON	ON	ON	39	624	468	92.9
14	ON	ON	ON	ON	42	672	504	100.0

Evaporative Efficiency

Air velocity and spray distance establish evaporation time for the fog droplets. With a greater evaporation time, more fog will evaporate. The ratio of evaporated fog to drain water establishes the evaporative efficiency of the system.



Average evaporation time considering three different initial air temperatures.

$$\frac{\text{Evaporation Distance}}{\text{Air Velocity}} = \text{Evaporation Time}$$

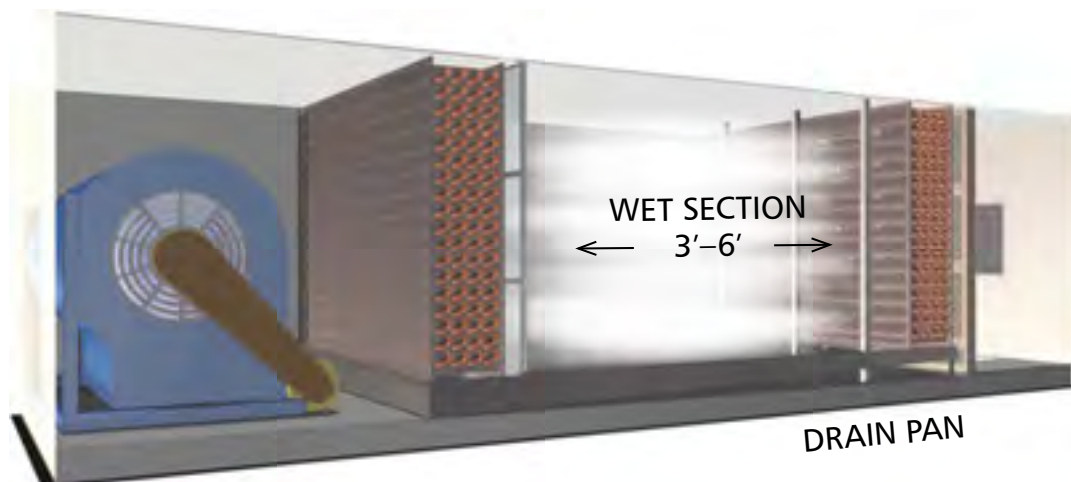
The spray distance and airflow velocity determine the average evaporation time. This calculation can be used along with the chart above to properly determine the size of the system, according to your load requirement.

The MeeFog™ system is more energy efficient, especially for a building that is getting humidification throughout the greater percentage of the year. We originally were moving in the direction of a steam boiler system and steam injection, but the Smithsonian brought up that they were going to be spending a lot of money on utilities, so we looked at the MeeFog™ system as an option to keep the operational cost down.

— Don Posson, Principal Engineer at Vanderweil Engineers

MeeFog™ Humidification Section

Many factors affect evaporation efficiency, including evaporation time of the fog droplets in the air, the size of the droplets in the air stream, the relative humidity and temperature of the air and water. The MeeFog™ system design addresses such factors.



To achieve optimal results please consider the following guidelines in designing the humidification section:

- Typical section has 3-6 feet of evaporative distance
- 250 - 650 feet per minute air stream velocity

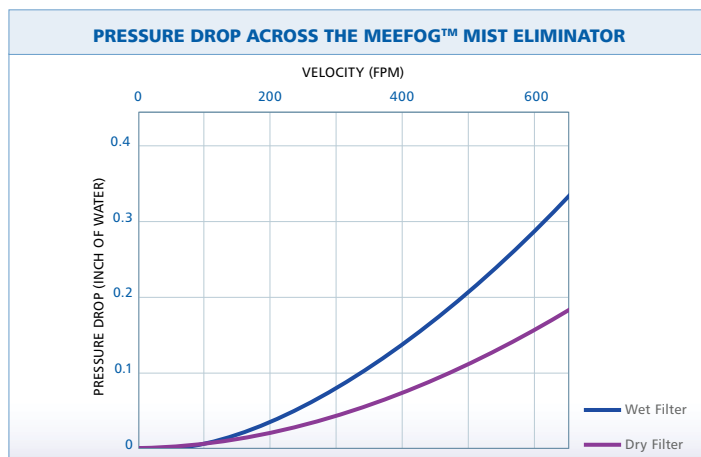
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The humidifier section for new construction should be made of stainless steel with a sloped drain pan that covers the entire section, a typical section will be located just upstream of the cooling coil. The area where the humidifier pan and cooling coil pan intersect should be properly sealed, the nozzle manifolds should be installed within the entering side of the pan, and the mist eliminators at the end and as close to the cooling coil as possible. If a cooling coil is not available in the humidifier section, the drain pan must extend after the mist eliminators to capture any falling droplets.

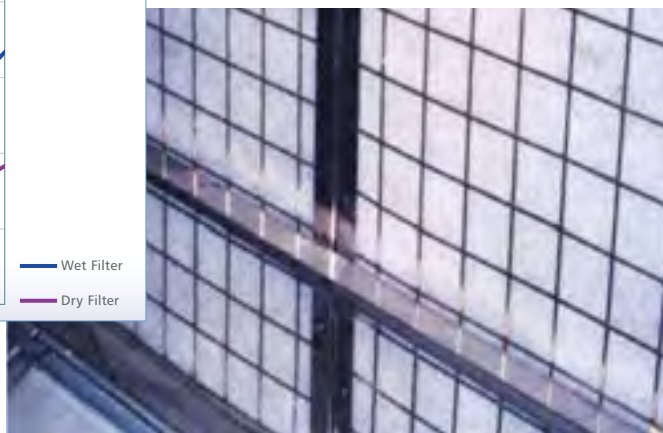
Modifying an existing AHU's is a simple retrofit. A sloped stainless steel drain pan is added to the entire section and the walls and ceiling are lined with stainless steel or epoxy coated. It may be possible to construct a raised pan and have it slope into the cooling coil's condensate pan to utilize the existing drain connection.

All of the mounting hardware for the nozzle manifolds and mist eliminators is provided with your MeeFog™ system.

The mist eliminator removes water droplets larger than 5 microns, and are supplied in stainless steel frames. The filter pads come off and can be washed or replaced easily.



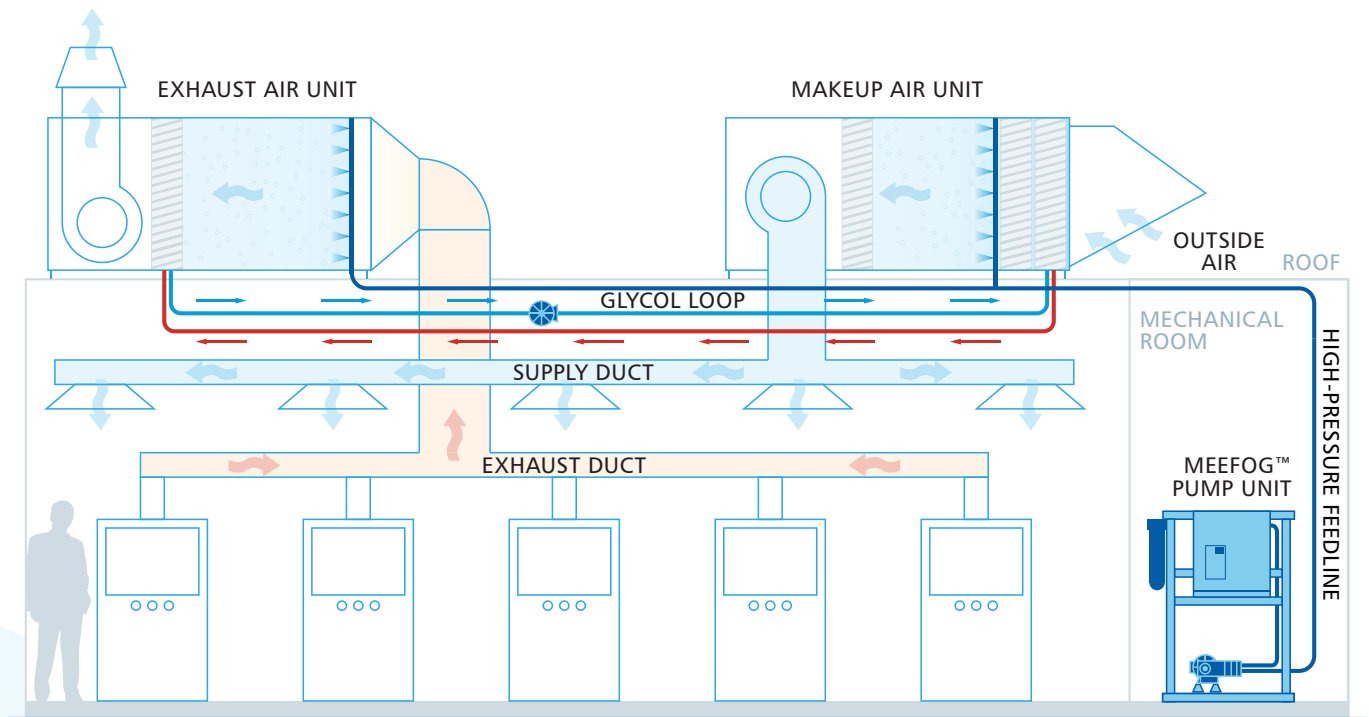
The air pressure drop across the mist eliminator is a function of the air velocity and degree of saturation.



Make the most out of your MeeFog™ System with Energy Recovery

The benefits of using Energy Recovery in HVAC systems are well documented and have been in practice for decades. However, there is much more energy savings to be found by using your MeeFog™ system as a pre-cooler to the exhaust side recovery coil. The same MeeFog™ system that provides humidity control in the supply air during the winter and transitional seasons can be used during the summer months to evaporatively cool the exhaust air. For every 1 lb of water evaporated, approximately 1,000 BTUs of cooling is provided, and the high pressure water pump uses very little energy to achieve this.

A MeeFog™ system that is being used for humidification in the supply air sits dormant during the summer months when low humidity is not an issue. By simply placing an additional set of nozzle manifolds just upstream of the exhaust side recovery coil, you can provide as much as 10°F of additional precooling on a typical application by using the same pumping system. This can be used for hundreds, and sometimes thousands of hours depending on location, to provide low cost precooling to the supply air.



Evaporative Cooling Applications

MeeFog™ uses the proven technology of high-pressure fog to deliver the most cost-effective, stable and energy efficient way to cool large volumes of air. Applications range from data centers to air cooled condensers and almost any other environment where stable, precisely controlled temperatures and humidity are required. MeeFog provides significant air cooling with low energy input. A typical MeeFog™ system uses only one horsepower of energy for every 600 lbs. of water dispersed, which is only 3% of the energy usage of compressed air-type systems and about 1% of the energy required by steam systems.

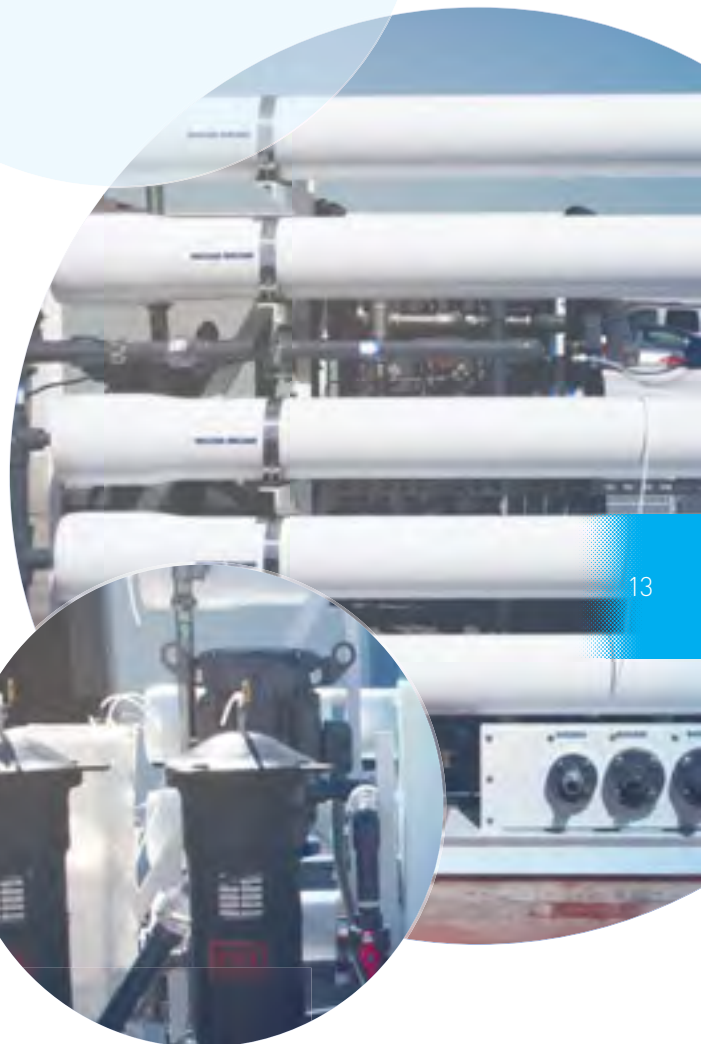


Fully Engineered, Turn-key Water Treatment from Mee

Mee provides the option of engineering a turnkey water treatment option into its custom-tailored MeeFog™ humidification systems. Configurations can include pre-filtration and dual pass reverse osmosis technology to make sure that every drop of water used in the MeeFog™ system is pure. Holding tanks are connected to a forwarding pump for re-pressurization. Automation includes regeneration of water softener, as well as back-flush of charcoal filter. Tanks may be equipped with water level indicators and alarmed safety shut-off devices.

Benefits of Using Mee-Engineered Water Treatment

- Optimized interface and design ensures ideal sizing of tanks and treated water supply
- All controls integrated for set-and-forget ease of use
- Single supplier and point-of-contact allows for outstanding project execution and after-sale customer service
- Fully-tested in actual configuration on-site to ensure full functionality and optimum performance



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The use of water filtered through a Reverse Osmosis systems (RO) is recommended for all MeeFog™ systems. The removal of minerals and dissolved solids from supply water will reduce routine maintenance. Our technicians can size the proper water treatment system according to your project.

Turn to Mee for Turn-key Solutions

Whatever your HVAC challenge, Mee Industries is exceptionally experienced and uniquely able to understand the specifics of your situation and to provide an ideally tailored solution to deliver maximum performance and efficiency with significant savings of energy and costs.

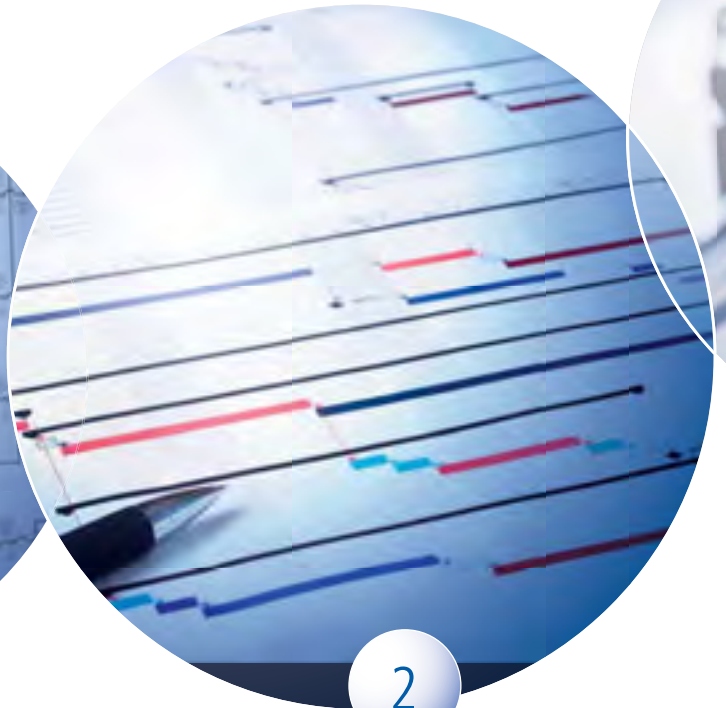
Mee provides precision-engineered, turnkey solutions for even the most demanding application or project. Our position as the global leader in high-pressure fog technology means we work closely with HVAC engineers and operators around the world to meet special project requirements, including accelerated delivery schedules, and to provide our valued customers with highly responsive after-sale support. We take great pride in meeting deadlines, our company-wide success metric is, "successful projects completed on time."



1

PROJECT DRAWINGS AND DOCUMENTATION

Once an order is placed, Mee begins the process of developing project drawings and documentation consisting of schematics, wiring diagrams, P&IDs, general arrangement drawings and installation instructions.



2

PROJECT MANAGEMENT

Each MeeFog project is assigned a project manager to communicate with the customer, track the progress of the project and to ensure that any project bugs are fixed quickly and correctly.





Micro in size. Macro in benefits.

The MeeFog™ nozzle atomizes water into billions of ultra-fine droplets, resulting in rapid evaporation and maximum evaporative efficiency. Each MeeFog™ impaction-pin nozzle is manufactured and thoroughly tested at our facility in California.

Our nozzle is made using high grade stainless steel, features a 0.006 inch (150 micrometer) diameter orifice, and is the most efficient nozzle in the industry. At an operating pressure of 1000 psi with an output of 16 lbs/hr. The resulting average droplet size is far below 10 microns, or one-tenth the diameter of a single strand of human hair. The resulting fog cools and evaporates more rapidly - as well as efficiently and economically - than any other fogging system.

1. IMPACTION-PIN

Micro-machined tip, TIG welded to nozzle base.

2. NOZZLE FILTER

40 micron particle size, replaceable, last chance filter.

3. O-RING SEAL

Flat stainless steel base for O-ring seal.

4. ANTI-DRIP CHECK VALVE

Eliminates dripping when the zone is turned off.

5. STAINLESS STEEL SPRING

6. STAINLESS STEEL BALL

Seals shut at low pressure.

7. TUBE ADAPTER

316 L stainless steel TIG welded to tube

8. NOZZLE LINE

Meets ASME 31.1 Power Piping Code

Research & Development

Mee Industries is committed to an extensive research & development program designed to continuously optimize and enhance its MeeFog™ systems. The 3,000 sq.ft. research facility is equipped with a fully instrumented, variable-air-velocity duct section and state-of-the-art laser particle measuring instruments.

Wind tunnel used to study droplet kinetics and thermodynamics. Research and development facilities such as these set Mee Industries apart from the competition.



MeeFog™ nozzle droplet sizing with laser particle analyzer instrument.



Mee the world leader in high-pressure fog technology

For over 40 years Mee Industries has led the world with innovative water fog technology. MeeFog™ systems are used to humidify and cool many industrial, commercial and agricultural processes and to create interesting and dynamic special effects. Today there are over ten thousand MeeFog™ systems in use around the world. The MeeFog team looks forward to helping you with your fogging project.

The Mee Advantage: Experience, Innovation, Performance

In 1969, Thomas Mee Jr. a former Cornell University research scientist, founded Mee Industries. The company originally manufactured high-tech electro-optical, meteorological instrumentation, but by the early 1980's, high-pressure water fogging had become the main focus of the company. Today, Mee Industries provides innovative, highly effective, economical fog solutions for many industrial applications including gas turbine inlet-air fogging, commercial and industrial building humidification and cooling, data center humidification, outdoor air conditioning, greenhouse climate control, wine barrel storage humidification, as well as dynamic special effects for the entertainment industry and theme parks.

Industry Leaders—Focused on Fog Technology

Mee specializes in providing custom-engineered, turn-key high-pressure fog solutions. We are committed to researching, developing, marketing and supporting the most innovative and reliable fog systems available anywhere in the world.



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Mee Industries is a privately held company with corporate headquarters in Irwindale, California.



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