

NORTEC AIRFOG - COMPRESSED AIR NOZZLE ENGINEERING MANUAL



NORTEC AIRFOG systems use the nozzle humidification technology of injecting droplets of cold water directly into the air. This method of humidification has the following advantages over steam humidification:

- A) Lower frequency of maintenance.
- B) Systems are mainly mechanical (water pipes and air pressure) with only a 24 VAC power requirement in the control panel.
- C) A “no cost” air cooling benefit due to latent heat of vaporization extracting heat from the air.
- D) Maintenance is primarily focused on keeping the air compressor operational.
- E) Change of components is fast and requires minimal system disassembly.

This manual is intended to be a working guide when designing an AIRFOG nozzle project. For details on a specific project be sure to consult your local NORTEC factory trained representative.

■ NORTEC AIRFOG FAMILY OF PRODUCTS

NORTEC manufactures AIRFOG products in two groups. The first group is modular systems, that require engineering design and component assembly while the second group is packaged. Both groups require connection to electrical power, water, and compressed air.

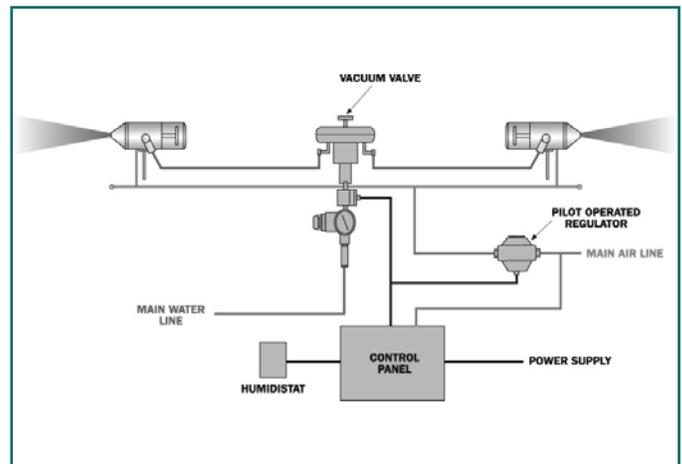
The modular systems group:

- AFE (AIRFOG Economical) Systems use subsonic air flow and is commonly used in space.

The packaged group consists of two families of humidifiers:

- AFE **Mini** Systems are wall mounted with 1 or 2 nozzles, and accept potable, RO, and DI water types.
- AFE **OCTO** Systems are either ceiling mounted with spray from two sides (dual configuration) of a rectangular case using 4, 6 or 8 AFE nozzles, or as wall

Figure 1
Typical Layout of AFE Nozzle System



mounted with spray from one side (single configuration) using 3 or 4 AFE nozzles. AFE OCTO systems are available with or without a AFE control panel built into the case. AFE OCTO systems are available for use with normal tap water, reverse osmosis, or deionized (DI) water.

AIRFOG products all require water and air feed lines to be piped to each system. With the modular system this piping requires more care when sizing the system. This manual will help in the selection of the correct system and the necessary components for that system.

■ AFE SYSTEM

PRINCIPLE OF OPERATION

The AFE nozzle uses air flow (based on Bernoulli principle) to siphon water out of zero psig water distribution pipes. Increases in air velocity (by increasing air pressure) will increase the vacuum pressure and hence increase the amount of water that is siphoned into the nozzle. As the water exits the nozzle it is broken down into a fine mist by a shearing action. Increases in air supply pressure also means that the exiting mixed flow is at a higher velocity.

Since AFE nozzle systems use a zero psig water pressure feed network, the water feed system and nozzles must be horizontal

and at the same height as the water pressure regulator (vacuum valve). Valleys or dips in vacuum valve altitude will adversely affect performance and in extreme cases will prevent the nozzles from producing any output. If obstructions prevent straight level piping, the water and air network delivery pipes must be routed under the obstruction. It is vital that the water pipes, downstream of the vacuum valve, never be elevated higher than the nozzles. The vacuum valve must always be at the same height as the nozzles.

ABSORPTION DISTANCE

Injection of water droplets from a nozzle into still air will require a certain amount of time to evaporate. The time for this vaporization can be converted to a distance depending on the velocity of injection into still air. The absorption distance will increase with the speed of the supply air. If absorption is not completed and the droplets hit solid objects like machines, lights, piping and duct work, they will moisten that surface. To avoid water damage, it is important to allow adequate distance for water to be absorbed.

ADIABATIC COOLING

There are no heating elements in any of NORTEC's AIRFOG humidifiers. Water is injected directly into the air at the temperature it is supplied. As the droplets evaporate, they extract the required latent heat of vaporization from the surrounding air which causes the temperature of the air to decrease. This can be a significant energy saving technique in situations where mechanical cooling would otherwise be required. Since humidification is most often required when the exterior atmospheric temperature is below room temperature, there is a necessity to warm the air either prior to addition of the water droplets or after absorption of the droplets into the air. It is recommended to add the moisture after the air is heated as this dramatically reduces the time and distance taken for the water droplets to evaporate.

Addition of water to the air will cool the air as the droplets will extract the energy (Latent Heat of Vaporization) necessary to convert them from liquid form to vapor. Heat will be extracted at the rate of approximately 1075 BTU's/pound of water. For example, the heat loss of 850 lbs/hr is:

$$850 \times 1075 = 913,750 \text{ BTU's per hour}$$

which would have to be added by the heating system. Of course, additional heat will also be required to heat the incoming fresh air. Without additional heat being supplied by heaters, rotating machines, people, large electronics

dissipating heat, etc., the bulk air temperature will drop causing the RH to increase until either the control system turns the system off or the dew point is reached and the water will not be absorbed.

COMPRESSED AIR

NORTEC AIRFOG systems use compressed air as the control fluid. Compressed air is provided by a compressor (supplied by others) or series of compressors. The modular approach to the NORTEC AIRFOG systems permit the designer to consider the cost implications of using multiple smaller horsepower compressors rather than one very large compressor and moving the compressed air over great distances. By using a multiple compressor design solution, system reliability is increased, maintenance is possible without shutting down all zones, and capital cost is often reduced.

It is recommended that air free of oil and moisture (control quality air) be used with AIRFOG systems. All air compressors will produce moisture which must be removed using a refrigerated air dryer. Excessive amounts of water in the air lines will reduce nozzle performance, and in extreme cases will prevent the nozzle from operating. Oil must also be removed from the compressed air through the use of oil removal filters.

Air pressure loss can be managed by reduction in the air pipe length, elimination of unnecessary elbows, valves and flow restrictions, increase in the diameter of the primary delivery pipe to the zones and elimination of leaks.

AIR CONSUMPTION

In order to properly size the air compressor, a worst case air consumption analysis is required.

The amount of compressed air required in Standard Cubic Feet per Minute (scfm) is calculated by multiplying the number of nozzles loading this compressor by the rated air consumption for that nozzle design. The AFE nozzle rated air consumption is 1.8 scfm (0.85 L/s) at 70 psig (483 kPa). For example, the required air volume for 64 nozzles is:

$$1.8 \times 64 = 115.2 \text{ scfm (54.4 L/s)}$$

The required compressor horsepower (hp) can be estimated by dividing the air volume (scfm) by 4.

$$115.2/4 = 28.8 \text{ hp.}$$

If the air delivery load on the compressor requires a 100% duty cycle to meet the system requirements, then many

compressors will soon overheat and fail as they are designed for a very low duty cycle. It is recommended that at least a 50% factor of safety be applied to this horsepower calculation. In this example at least a 45 hp compressor should be used to reduce operating time and maintenance. Follow the compressor manufacturers sizing and duty recommendations.

The compressor air quantity delivery capacity should be in excess of the required 115.2 scfm (54.4 L/s) by a factor of about 50% as well. Thus, the 45 hp air compressor should be able to deliver about 180 scfm (8.5 L/s) at 90 psig (621 kPa) or higher. Compressors that produce air above 150 psig (1035 kPa) must have their pressure reduced to no more than 150 psig (1035 kPa).

The three most popular types of compressors available are reciprocating, rotary screw and centrifugal designs. Of these three types, rotary screw designs are recommended as they come in a packaged system with an air dryer and air cooler, are designed for continuous operation as well as being very energy efficient, quiet and generating low vibrations. Industrial quality (as opposed to consumer quality sold at popular retail automotive and hardware stores) are recommended for prolonged life and low maintenance.

AFE NOZZLE

AFE nozzles are commonly used in space. Nozzles can all be pointing in one direction if wall mounted or they can be arranged to point in any direction if the system is suspended from the ceiling. Horizontal spacing between nozzles is the designer's choice, however it is recommended that nozzles be arranged such that the spray patterns do not intersect, refer to Figure 3. The spray pattern into still air is an expanding three dimensional cone with its apex at the nozzle orifice and growing linearly to a 4 foot (1.2 m) diameter when 15 feet (4.5 m) away.

A fail-safe feature of the AFE nozzles is that they will automatically close the output orifice against water egress if the air pressure supplied to them is less than 15 psig (103.5 kPa).

The AFE nozzle will deliver a maximum of 15 lbs (6.8 kg) of water per hour. Figure 2 AFE Nozzle Performance, illustrates the performance of a AFE nozzle through its design range. Pressures in excess of 70 psig (483 kPa) will not improve water throughout and are not recommended. See page 12 for component specifications.

AFE NOZZLE ELEVATION AND CAPACITY

The spray pattern from the AFE nozzle will fall slightly due to the cooling effect created as the water is evaporated. The nozzle can be operated at higher outputs when mounted at an elevation high above the floor, machinery and stored goods.

The capacity of the nozzles can be easily adjusted by regulating the air pressure at the control panel, and by adjusting the thumb wheel on the vacuum valve.

Figure 2
AFE Nozzle Performance

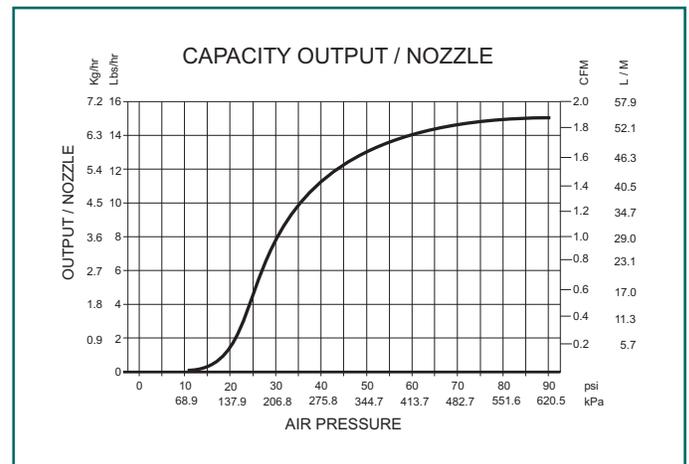
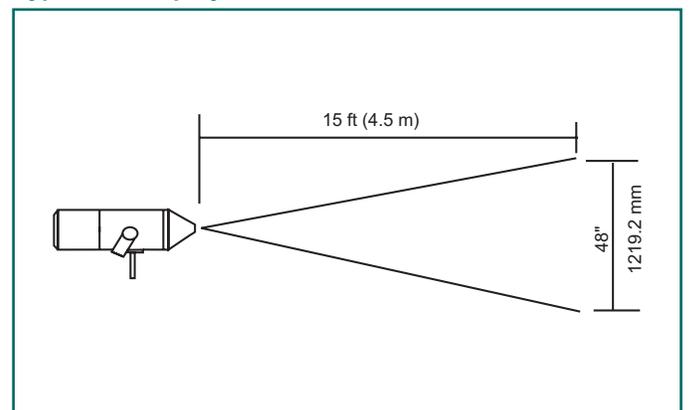


Figure 3
Typical AFE Spray Pattern



CONTROL PANEL

NORTEC's AIRFOG systems use varying air pressure to operate flow regulation valves in both the water and air supplies to the nozzles. The panel requires an unregulated supply off the main air supply at 90 psig (621 kPa). Figure 4 AFE Control Panel, illustrates the panel and the interfaces to it.

Interfaces to the Control Panel are:

- *Low voltage inlet*
24 Vac power input (transformer converting 110 Vac to 24 Vac is supplied by NORTEC). See page 12 for component specification.
- *Control wiring input*
On/Off Humidistat input (uses terminals 1 and 2 on the terminal board inside the Control Panel).
- *Pilot inlet*
Main air pressure input at 90 psig (621 kPa) branched off the air supply line upstream of the Air Regulator.
- *Pilot output*
Controlling air pressure to the Air Regulator and Vacuum Valve.
- The Control Panel is not limited by the number of nozzles or zones under its command.

Note: If more than four zones are operated using one Control Panel, or if the Control Panel is more than 200 feet away (61 m) from the vacuum valve, the designer is asked to refer to page 12 for component specification.

Figure 5 Typical Nozzle Layout, provides a sketch of a typical configuration and inter-connectivity of these components. This sketch is only intended to illustrate the various components used with the AIRFOG AFE system and is not intended as how all system must be installed. The layout and configuration of the components will vary based on limitation and restrictions from each application. The designer should become familiar with each component of the system and how it is used and connected within the overall system. Understanding the various components will aid in the system design.

AIRFOG control panels are available in both On/Off and modulating versions. Modulating panels are used in situations when tight humidity control is required. The On/Off controls are more suited to situations when humidity is required, but maintaining tight tolerances are not a priority.

Figure 4
AIRFOG AFE Control Panel

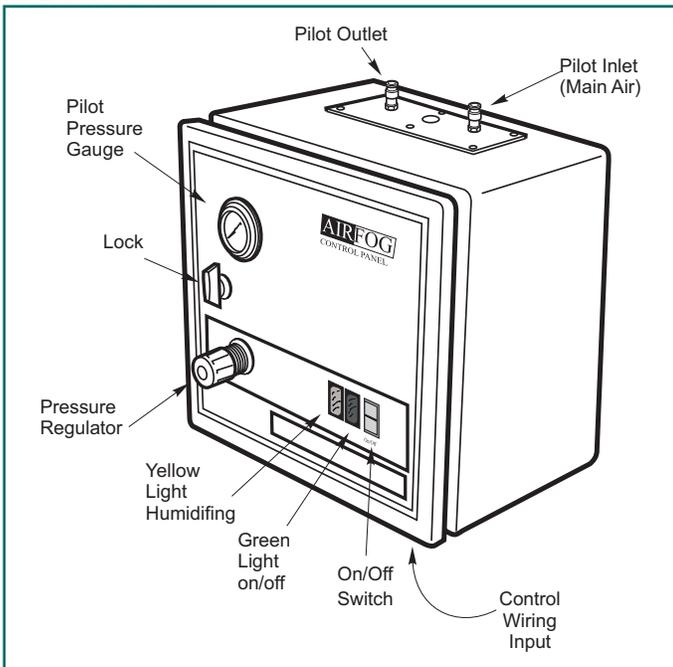
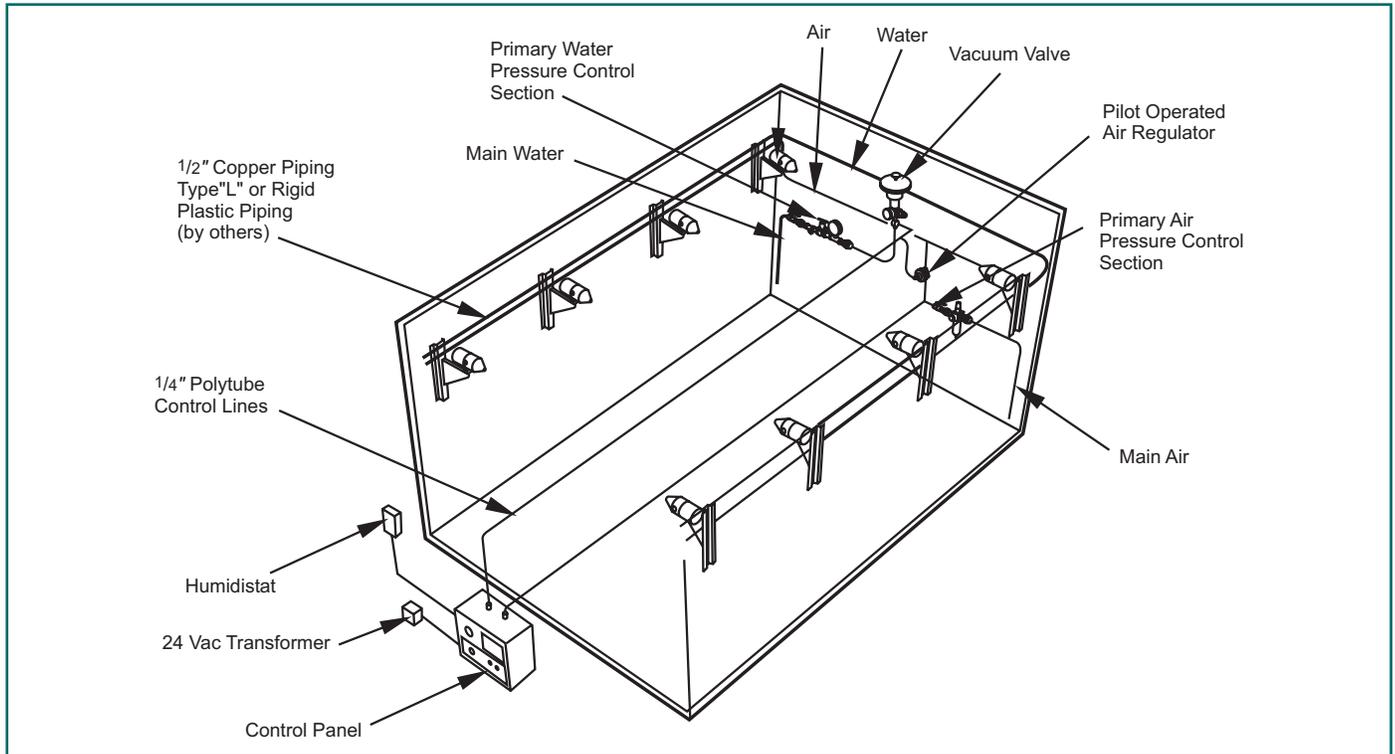


Figure 5
Typical Nozzle Layout



■ AFE DESIGN CONSIDERATIONS

COMPONENTS

The basic required components of a NORTEC single zone AFE humidification system are:

- Control Panel (On/Off or Modulating)
- Vacuum Valve (main water feed)
- Pilot Operated Air Regulator (main air feed)
- AFE Nozzles
- 24 volt (AC) transformer
- 1/2 inch copper pipe for the water and air distribution networks to the nozzles (supplied by others)
- 1/4 inch plastic tube for the command pressure lines
- 1/2 inch copper pipe for the air distribution network to the nozzles (supplied by others)

- Air Compressor - 90 psig (621 kPa) minimum (supplied by others)
- Mounting hardware (nuts, bolts, nails, etc.) (not supplied by NORTEC)

Optional equipment available from NORTEC include:

- Humidistat
- Primary Air Control Section
- Primary Water Control Section
- Nozzle Support Bracket
- Saddle Clamp and Adapter
- Modulation Control Adapter
- Modulation Control Package
- High Limit Humidistat

VACUUM VALVE (WATER PRESSURE REDUCTION)

Air pressure from the Control Panel opens the water safety valve permitting water to enter the Vacuum Valve which controls the water feed to the nozzles. Figure 6 Operation of Vacuum Valve, explains the operation of this water regulator.

The water flow rate through this valve is limited to 28.8 gph (110.8 l/hr) which limits the number of AFE nozzles it supplies to 16. If the analysis of section 3.0 indicates a necessity to have more than 16 nozzles, then the system must be broken into zones using multiples of 16 (or less) nozzles with each zone controlled by its own Vacuum Valve. One Control Panel can control multiple zones by branching off of the single Control Panel air pilot output.

The Vacuum Valve assembly has three sub-components. As illustrated in Figure 7 Vacuum Valve and Interfaces. First, the safety valve interfaces directly with the primary water supply; opening and closing on command from the Control Panel. Lost pilot air pressure (below 10 psi / 69 kPa) will automatically close this valve to prevent water from proceeding beyond this point. In series with, and downstream of the safety valve, is the water regulator used as the first stage of water pressure reduction. The water regulator reduces the raw water pressure to a range between 5 and 10 psig (34.5-69.0 kPa). This is set manually at time of installation, however system performance is not sensitive to the exact setting as long as the pressure is within this range.

The second stage of water pressure reduction is the vacuum diaphragm which drops the pressure to that of the room. Output is through one exit port on each of its two sides. This permits the nozzle to draw water from the supply as it is required rather than having pressure force it into the nozzle. This siphoning action of the nozzle is controlled by the Pilot Operated Air Regulator.

On top of the Vacuum Valve is a thumb wheel adjustment for adjustment of the AIRFOG droplet size. The adjustment changes the availability of water to the nozzles. Thus a reduction in available water for the same air consumption results in smaller droplets and a finer spray. This adjustment can be used to reduce the water throughput if there is a problem with water droplets reaching the floor. See page 12 for component specification.

Figure 6
Operation of Vacuum Valve

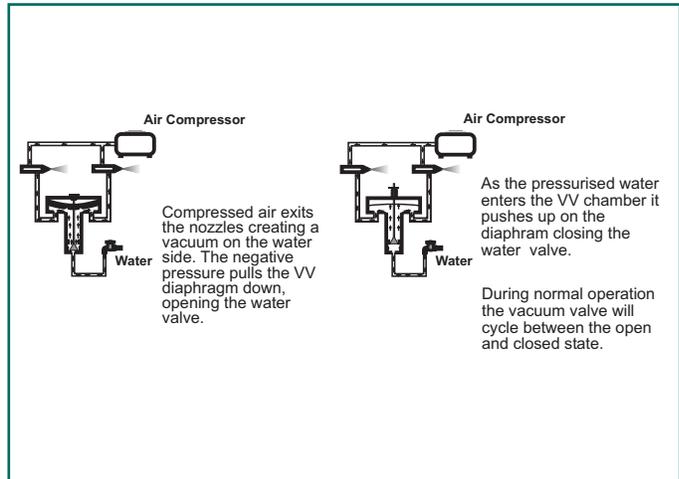


Figure 7
Vacuum Valve and Interfaces

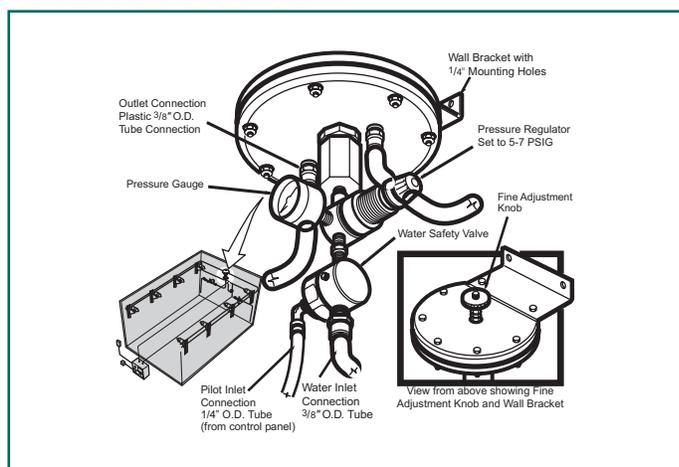
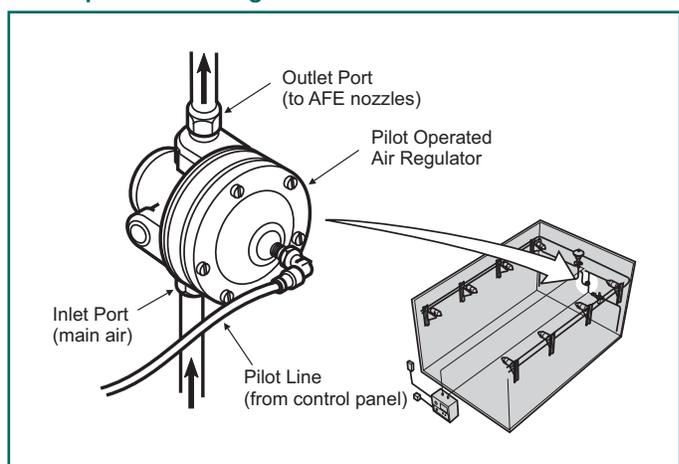


Figure 8
Pilot Operated Air Regulator



PILOT OPERATED AIR REGULATOR

The Pilot Operated Air Regulator controls the air feed to the nozzles and is illustrated in Figure 8 Pilot Operated Air Regulator. This regulator is an analog flow controller; the greater the commanded air pressure, the greater the air pressure fed to the nozzle supply network. This means that the Control Panel is able to command a proportional opening of the Air Regulator simply by varying the command pressure. There is a linear 1:1 relationship between the command pressure and the pressure drop. A pilot air pressure of 25 psig (172.5 kPa) will drive the Air Regulator to have an output of 25 psig (172.5 kPa).

The three ports on the Pilot Operated Air Regulator are the pilot air pressure input from the control panel, the primary air supply input feed and the output air feed to the nozzles. There are no manual adjustments needed or possible. See page 12 for component specifications.

■ AIR SUPPLY

Air must be free of oil and other contaminants through the use of oil removal and other filters. Compressor selection (90 psig (621 kPa) at the calculated air flow rate as a minimum) is a critical consideration. The delivered air must also be free of

moisture in order to maintain the performance of the nozzles. During compression, moisture is always produced and must be removed by refrigerated air drying. Moisture in the air pipes has the potential to not only reduce nozzle performance but the impact of excessive quantities could be sufficient to prevent the nozzle from delivering any water.

AIR SUPPLY NETWORK

The flow of compressed air in pipes causes friction and results in pressure losses. The ideal AIRFOG air delivery system would be designed to have less than 2 psig (13.8 kPa) pressure loss. To reduce the line pressure losses the following guidelines are useful:

- Reduce the distance the air must travel.
- Reduce the friction through the pipes by increasing the pipe size and eliminating unnecessary elbows, valves and other flow restrictions.
- Reduce the flow rate of air through the system.
- Minimize the drop in pressure across system components.

Table 1
Air Flow Rates For Various Pipe Diameters Under Pressure

Applied Pressure [PSIG]	Nominal Standard Pipe Size										
	1/8"	1/4"	3/8"	1/2"	3/4"	1"	1-1/4"	1-1/2"	2"	2-1/2"	3"
5	0.5 (0.2)	1.2 (0.6)	2.7 (1.3)	4.9 (2.3)	6.0 (3.1)	13 (6.1)	27 (12.7)	40 (18.9)	80 (37.8)	135 (63.7)	240 (113.3)
10	0.8 (0.4)	1.7 (0.8)	3.9 (1.8)	7.7 (3.6)	11.0 (5.2)	21 (9.9)	44 (20.8)	64 (30.2)	125 (59.0)	200 (94.4)	370 (174.6)
20	1.3 (0.6)	3.0 (1.4)	6.6 (3.1)	13.0 (6.1)	18.5 (8.7)	35 (16.5)	75 (35.4)	110 (51.9)	215 (101.5)	350 (165.2)	600 (283.2)
40	2.5 (1.2)	5.5 (2.6)	12.0 (5.7)	23.0 (10.9)	34.0 (16.0)	62 (29.3)	135 (63.7)	200 (94.4)	385 (181.7)	640 (302.1)	1100 (519.2)
60	3.5 (1.7)	8.0 (3.8)	18.0 (8.5)	34.0 (16.0)	50.0 (23.6)	93 (43.9)	195 (92.0)	290 (136.9)	560 (264.3)	900 (424.8)	1600 (755.2)
80	4.7 (2.2)	10.5 (5.0)	23.0 (10.9)	44.0 (20.8)	65.0 (30.7)	120 (56.6)	255 (120.4)	380 (179.4)	720 (339.8)	1200 (566.4)	2100 (991.2)
100	5.8 (2.7)	13.0 (6.1)	29.0 (13.7)	54.0 (25.5)	80.0 (37.8)	150 (70.8)	315 (148.7)	470 (221.8)	900 (424.8)	1450 (684.4)	2600 (1227.2)

Note: Flow rates - standard cubic feet/min (Liters/sec). Metric conversion = CFM x 0.472 = Liters/second.

- Eliminate leaks.

The air supply network is normally comprised of ½ inch type L hard copper pipe available from plumbing suppliers. Standard plumbing joining techniques are used in fabrication. Use Table 1 Air Flow Rates, to determine the appropriate pipe size for a given nozzle air requirement and pressure. As an example, a 60 nozzle system in six zones of 10 nozzles requires 18 scfm (8.5 L/s) air per zone for a total of (18 x 6) 108 scfm (8.5 L/s) at 90 psig (621 kPa). The recommended pipe size is 1" diameter for 80 psig (552 kPa) and 120 scfm (56.6 L/s). Pipe lengths longer than 100 ft should consider larger diameters.

Reduction to ½" diameter pipe can be made at the pilot operated air regulator as pressure losses will not be excessive over these shorter lengths.

PILOT AIR PIPING

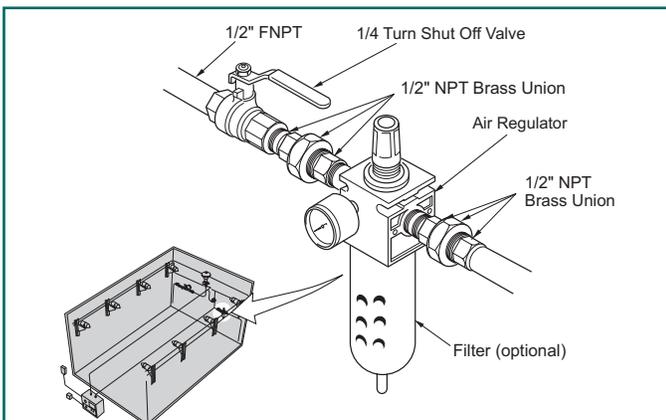
The pilot air pressure line from the Control Panel to the Pilot Air Regulator and the Vacuum Valve uses ¼" plastic tube. The supply air pressure line to the Control Panel comes from the unregulated air supply via ¼" plastic tube as illustrated in Figure 5 Typical Nozzle Layout.

PRIMARY AIR CONTROL SECTION (OPTIONAL)

This hardware, used to control and regulate the air flow from the compressor to the air regulator, is illustrated in Figure 9 Primary Air Control Section.

It can be used to regulate air output pressure to 70 psig (483 kPa) and to attenuate pressure spikes that may result from the compressor. This hardware is limited to supplying 16 AFE nozzles.

Figure 9
Primary Air Control Section



It includes a shut off valve, primary air regulator (0 to 100 psig) (0-690 kPa) and a pressure gauge, and a filter (optional). It is threaded to connect with ½" NPT female thread. See page 12 for component specifications.

■ WATER SUPPLY

The AIRFOG nozzles work with potable, RO, and De-ionized water. Please note that mineral content in potable water will vary according to geographic location. This mineral content will precipitate out as a fine dust. In many buildings, this is not a major concern. It is recommended not to use water from a sodium softener, as it will cause excessive dusting.

In the printing and electronics manufacturing sectors, dusting is considered to be a major concern. Water for these applications may be processed through a Reverse Osmosis (RO) membrane to remove the minerals and obtain very high water purity. The piping may have to be upgraded to a compatible plastic or stainless steel. The storage tank and associated water plumbing is provided by the building owner.

For ultra clean rooms (spacecraft assembly, electronics assembly, printing plate fabrication, etc.) de-ionized (DI) water will be required. This process will require selection of a compatible plastic or stainless steel pipe. Water storage and pumping will also be required. See page 12 for component specifications.

WATER SUPPLY NETWORK

The water supply network feeding the nozzles is normally comprised of ½ inch type L hard copper, stainless steel or heavy wall rigid plastic pipe available from plumbing suppliers. Standard plumbing joining techniques are used in fabrication.

Selection of the pipe material is the designer's choice but this is often determined by cost and the aggressiveness of the water.

PRIMARY WATER PRESSURE CONTROL SECTION (OPTIONAL)

This hardware is used to control water pressure and regulate the water flow from the supply system to zone Vacuum Valve(s). As shown in Figure 10 Primary Water Pressure Control Section, it consists of break away unions, a shut off ball valve, a water strainer and a water pressure regulator. It will permit isolation shut off to a zone for maintenance activities while other zones remain operational. The maximum flow rate capacity is 3 gallons per minute (0.19

L/s). This capacity can provide water to many nozzles but it is recommended that not more than 4 zones be controlled by a single Primary Water Control Section. Not suitable for DI water.

It is threaded for NPT female pipe thread.

WALL SUPPORT BRACKETS (OPTIONAL)

These brackets as shown in Figure 11 NORTEC Wall Support Bracket, have been specifically designed to permit easy mounting of a AFE nozzle to a wall, column or pillar. The bracket provides for +/- 5 inches (127 mm) from centerline vertical adjustment to provide the installers with an easy method to adjust all nozzles in a zone to be equidistant from the floor. Since the nozzles use a siphoning action in the water distribution network at 0 psig, it is vital that there be no vertical gradients in this network. The bracket also provides a convenient place to rest water and air distribution piping.

Ceiling mounting brackets are also available as shown in Figure 12 Ceiling Mounting Hardware.

MOUNTING HARDWARE PACKAGES

Each package consists of two saddle clamps and two feet of tubing to connect the air distribution pipe and the water distribution pipe to a nozzle. Not suitable for DI water.

Figure 10
Primary Water Pressure Control Section

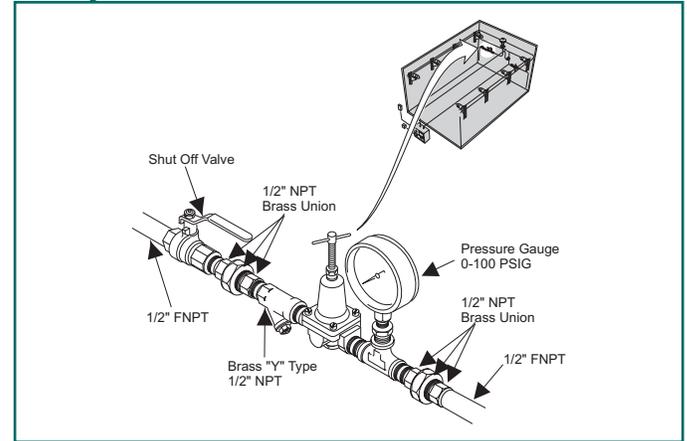


Figure 11
Nortec Wall Support Bracket

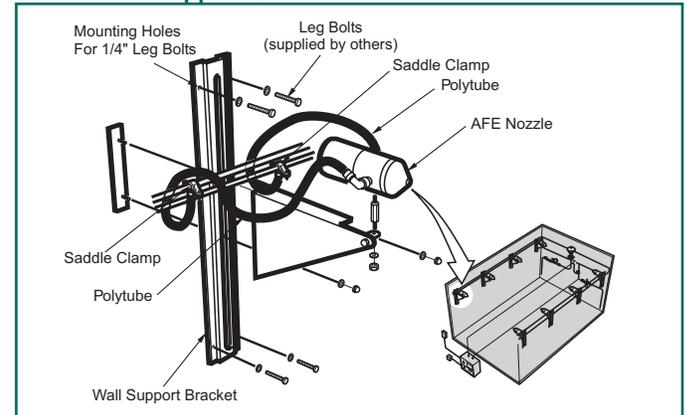
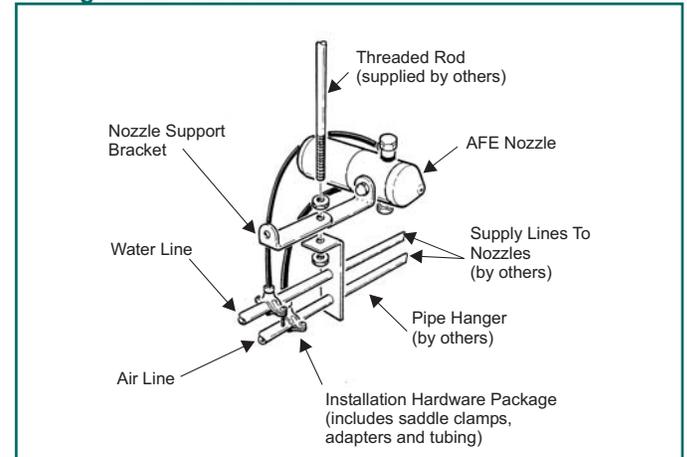


Figure 12
Ceiling Mounted Hardware



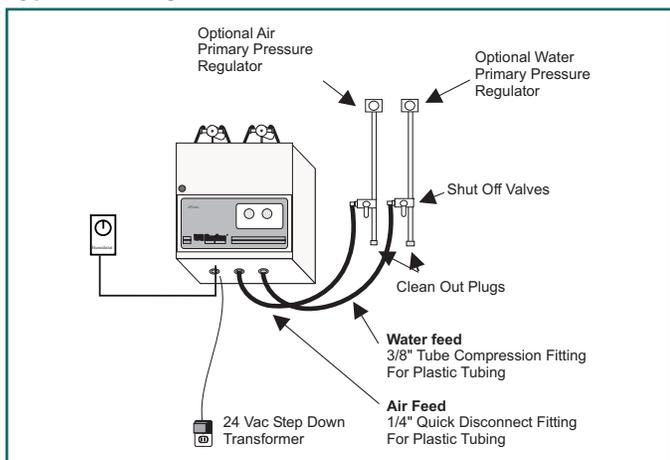
■ **AFE MINI**

DESIGN CONSIDERATIONS

For smaller applications requiring 1 or 2 nozzles, and AFE Mini system is the best choice.

These are self contained wall mounted units (one or two nozzles only) which require a nozzle clearance of 6 feet (1.8 m) off the floor and 3 feet (0.91 m) from the ceiling. Compressed air, water and 110 VAC need to be conveniently located and a centrally located humidistat will be required.

Figure 13
Typical MINI System



AFE MINI systems are can be ordered with 1 or 2 nozzles, and are available in versions that are compatible with de-ionized (DI) water. All AFE MINI systems are configured for On/Off control.

■ **AFE OCTO**

DESIGN CONSIDERATIONS

AFE OCTO systems are self contained ceiling mounted units with up to 8 AFE nozzles per system.

If you require 3 or more nozzles than an AFE OCTO or several AFE OCTO systems could be suitable.

AFE Octo systems are available in a variety of configurations, including versions available for de-ionized (DI) water. 4,6 or 8 nozzles can be ordered on an OCTO, spraying out of 2 sides of the enclosure. Configurations with only 4 nozzles can be ordered with 4 nozzles on one side and none on the other for

easy wall mounting (as opposed to 2 nozzles per side for ceiling mounting).

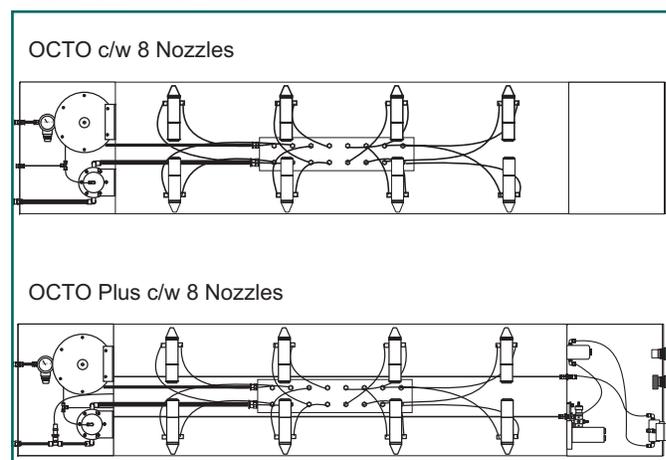
Control options also vary; the Octo can be ordered with an external control panel (AFE OCTO) for convenient remote control of the system. The base OCTO supports on/off or modulating control depending on the AFE control panel ordered. Up to 4 AFE OCTO's can be controlled from a single AFE control panel. See Figure 16 Four OCTO Systems Operated From One Control Panel. The OCTO can also be ordered with an internal control panel (OCTO Plus). The OCTO Plus is available in an on/off control configuration (OCTO Plus) or a modulating control configuration (OCTO Plus Modulation).

Complete work space humidification can be supplied by a single or a number of OCTO systems. One control panel can control up to 4 OCTO systems. For systems requiring only one unit of 8 or less nozzles, there is the OCTO PLUS which comes complete with a self contained control panel. See Figure 14 OCTO and OCTO Plus. Multiple OCTO systems must be broken down into sections of 4 OCTO's systems (maximum of 4 x 8 = 32 nozzles) with each section of 4 OCTO's controlled by one Control Panel. As illustrated in Figure 16 Four OCTO Systems Operated From One Control Panel.

Each of the OCTO systems will require its own compressed air and water supplies. Piping selection is identical to the AFE nozzle systems described earlier.

OCTO systems should be installed with a minimum clearance to the floor of 20 feet (6.1 m).

Figure 14
OCTO and OCTO Plus



The spray pattern for an 8 nozzle OCTO system can extend to 16 feet (4.9 m) in each direction (4 nozzles spray in each of 2 opposite directions). Figure 15 AFE OCTO Spray Pattern, demonstrates the spray pattern dimensions that have to be free of collision with obstacles and spray plumes from other nozzles. Nozzle point angles are adjustable in both horizontal and vertical directions. Adiabatic cooling under the spray may be significant for operating equipment and people in the vicinity and must be considered in locating OCTO systems.

Figure 15
AFE OCTO Spray Pattern

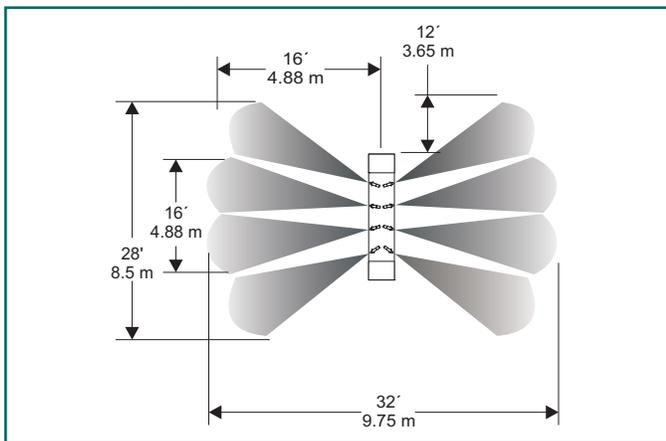
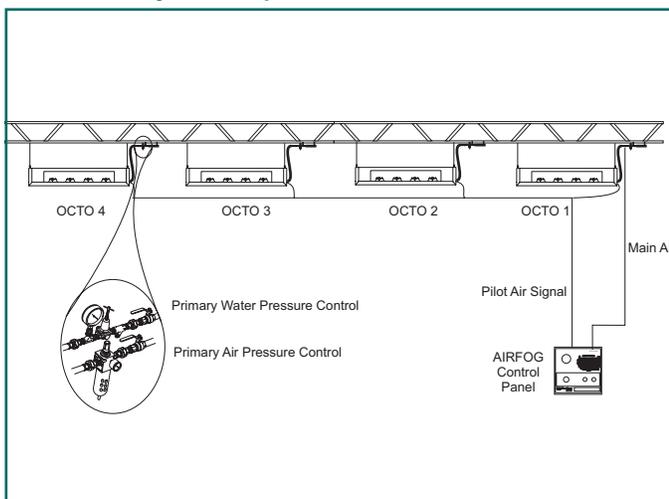


Figure 16 Four OCTO Systems Operated From One Control Panel, is a typical installation layout for 4 OCTO units and a control panel. The pilot air pressure input to the control panel is connected directly to the air pressure line (90 psig) (621 kPa) by 1/4 inch plastic tubing. The “Pilot - Out” from the Control Panel is the command pressure which can be

Figure 16
Four OCTO Systems Operated From One Control Panel



“T” connected to all four OCTO systems. In this way, one Control Panel can control up to 4 OCTO systems.

Modular AFE nozzle systems are often more economical than multiple OCTO systems. However, advantages of using multiple OCTO units compared to a full modular design include:

- Ease of installation
- Ease of OCTO air and water isolation for maintenance
- Ease of access
- Prepackaged units that are ready to run.
- Saving in design time
- Fewer startup problems

■ AIRFOG SYSTEM COMPONENT SPECIFICATIONS

AFE CONTROL PANEL

- 24 VAC
- Standard configuration On/Off
- Bulkhead fittings at top of panel for 1/4" plastic tube. Pilot lines only
- 4 zones of 16 nozzles each
- If more than 200 ft (61 m) use pilot air regulator acting as a volume booster
- More zones can be controlled with one control panel with the use of a pilot air regulator acting as a volume booster
- Weight 15.2 lbs (6.9 kg)

TRANSFORMER

- 110 VAC primary
- 24 VAC secondary
- 40 VA maximum
- 51 W
- Plug in style
- Screw terminals for secondary line connection
- Weight 1.6 lbs (0.72 kg)

HUMIDISTAT

- One per control panel
- Ability to switch 24 VAC at 1 amp
- On/Off style (On/Off control panels only)
- 0-10 V or 4-20 mA Demand Signal (modulating control panels only)

VACUUM VALVE (WATER FEED)

- One per zone feeding a maximum of 16 nozzles
- Maximum flow rate of 28.8 gph (110 L/hr)
- Inlet connection use 3/8" plastic tubing
- Outlet connections use 3/8" plastic tubing
- Mounting holes 1/4"
- Weight 3.2 lbs (1.45 kg)

PILOT OPERATED AIR REGULATOR

- One per zone feeding a maximum of 16 nozzles
- Air flow rate 45 scfm (21.2 L/s)
- Inlet and outlet connection 3/8" (female) NPT
- Pilot connection 1/4" (female) NPT
- Can be used as a volume booster where there are large pressure losses

AFE NOZZLES

- Water throughput of 0 to 15 lbs/hr (6.8 kg/hr)
- Air consumption maximum of 1.8 scfm (0.85 L/s)
- Pressure range 0 to 70 psig (0-483 kPa)
- Nozzle connections 1/4" plastic tube
- Mounting port thread 3/8" NC
- Weight 1.46 lbs (0.66 kg)

PRIMARY AIR CONTROL SECTION

- Maximum supply pressure 150 psig (1035 kPa)
- Adjustable pressure 0-120 psig (0-828 kPa)
- One per zone of 16 nozzles (45 scfm) (21.2 L/s)
- 1/2" (female) NPT port

- Weight 3.1 lbs (1.4 kg)

PRIMARY WATER CONTROL SECTION

- Primary pressure range 150 psig (1035 kPa)
- ½" (female) NPT ports
- The capacity is 100 gallons/hr (378 L/hr) but recommend a limit of one for 4 zones
- Weight 4.3 lbs (1.95 kg)

■ MINI SYSTEM COMPONENT CAPACITIES

MINI CONTROL PANEL

- Capacity 0 - 28 lbs/hr (0-12.7 kg/hr)
- 24 VAC
- On/Off configuration only
- Air connection 1/4" plastic tube
- Water connection 3/8" plastic tube
- Weight 20 lbs (9.0 kg)

AFF NOZZLES

- See page 12.

TRANSFORMER

- See page 12.

■ OCTO SYSTEM COMPONENT CAPACITIES

OCTO AND OCTO PLUS UNIT

- System capacity up to 120 lbs/hr (54.5 kg/hr)
- Air connection ½" plastic or soft copper tube
- Water connection 3/8" plastic or soft copper tube
- Pilot connection ¼" plastic tube
- Weight up to 64 lbs (29 kg)

AIRFOG CONTROL PANEL / OCTO PLUS

- 24 VAC
- On/Off configuration (OCTO and OCTO Plus)
- Modulating Configuration (OCTO and OCTO Plus Modulation)
- Bulkhead fittings at top of panel for ¼" plastic tube. Pilot lines only.
- Up to 4 zones of 16 nozzles each. More zones can be controlled with one control panel with the use of a pilot air regulator acting as a volume booster
- Weight 15.2 lbs (6.9 kg)

AFF NOZZLES

- See page 12.

TRANSFORMER

- See page 12.

■ **SPECIFICATIONS**

PART 1 - GENERAL

1.1 WORK INCLUDED

- a) NORTEC AIRFOG atomizing nozzle humidifier[s] as indicated on drawing[s] and as indicated on schedule[s].
- b) Complete and operable humidification system [which meets applicable building codes].
- c) Equipment startup and project inspection by qualified factory trained representative.

1.2 RELATED SECTIONS:

- a) 15010 Mechanical General Requirements
- b) 15[] Piping Installation
- c) 15[] Control System

1.3 REFERENCES:

- a) ISO 9001-2000

1.4 SUBMITTALS:

- a) Submit shop drawings and product data for humidifier[s] and control panel[s] in accordance with Section [] Shop Drawings, Product Data
- b) Exceptions to this specification and accompanying schedules to be noted on separate sheet [with notation].
- c) Submit operation and maintenance data for incorporation into manual specified in Section [] Operation and Maintenance Manual.

1.5 SCHEDULES:

- a) Refer to information contained in schedule[s] attached to this specification.
- b) Humidifiers to be of type, capacity, and arrangement as listed in schedule[s].

- c) Include accessories listed in schedule[s] and those accessories required for type of unit.

NOZZLE HUMIDIFICATION SYSTEM

AIRFOG ATOMIZING MODEL AFE

SpecNote: Product specified below is manufactured by Walter Meier in ISO 9001-2000 certified facilities.

PART 2 - PRODUCTS

2.1 AIRFOG AFE ATOMIZING NOZZLE SYSTEM USING COMPRESSED AIR TO ATOMIZE WATER, DRAWN THROUGH A VACUUM VALVE AT ATMOSPHERIC PRESSURE, WITHIN THE AIR STREAM.

2.2 BUILT-UP SYSTEM, FOR DIRECT SPACE APPLICATION, REQUIRING AFE CONTROL PANEL[S], VACUUM VALVE[S], PILOT OPERATED AIR REGULATOR[S] AND AFE NOZZLE[S].

2.3 SYSTEM TO BE COMPLETE WITH:

- a) Operating and safety controls to ensure an automatic and fail safe system.
- b) Nozzles to shut down automatically on loss of air pressure without dripping even when water pressure is maintained to system.
- c) Linear output adjustment as air pressure is reduced to nozzle and continues to produce droplets no larger than 10 microns in size as air pressure reduces.
- d) Vacuum valve to provide water supply to nozzles at atmospheric pressure.
- e) Pilot operated air regulator to allow variable supply air pressure to nozzles.
- f) Control panel with built-in air pressure regulator, repeat cycle timer, on/off switch, pilot light and air pressure gauge.

2.4 ATOMIZING NOZZLE TO BE:

- a) Constructed of stainless steel.

- b) Complete with air operated piston to activate plunger and pin to clean water orifice each time system cycles off.
- c) Serviceable without removal from system.
- d) Without obstructions after orifice, which may collect dust, water or foreign matter.

2.5 CONTROL PANEL TO INCLUDE:

- a) NEMA 12 construction.
- b) Cabinet to allow user full front access with keyed lock.
- c) Compressed air regulator with gauge.
- d) Adjustable repeat cycle timer, for cleaning action of nozzle.
- e) Compressed air pilot line operation only. No direct water line connections to control panel permitted.
- f) On/off switch complete with pilot light.
- g) Solenoid valve to shut down system on loss of electrical power.
- h) Controls to provide safety shutdown of system for:
 - Loss of air pressure.
 - Loss of electric power.
- i) Internal factory wiring and piping.
- j) Connection for pilot tubing to pilot operated water regulator at vacuum valve, and pilot operated air regulator.
- k) External 120/24 Vac plug-in transformer for internal power.

2.6 VACUUM VALVE TO INCLUDE:

- a) Adjustable water pressure regulator.

- b) Pilot operated water regulator as safety to interrupt supply water pressure when supply air pressure is lost.

2.7 PERFORMANCE:

- a) Water pressure: 10 psig [69 kPa] minimum.
- b) Working water pressure: atmospheric.
- c) Air pressure: 90 psig [621 kPa] minimum, 150 psig maximum [1035 kPa].
- d) Working air pressure: 0-70 psig [0-483 kPa].
- e) Nozzle compressed air consumption: 1.8 cfm @ 70 psig [51 L/m @ 483 kPa].
- f) Nozzle mist output: 14 lbs/hr @ 70 psig [6.4 kg/hr @ 483 kPa].

2.8 OPTIONAL ACCESSORIES:

- a) Refer to options schedule.



■ LIMITED WARRANTY

Walter Meier Inc. and/or Walter Meier Ltd. (hereinafter collectively referred to as THE COMPANY), warrant for a period of two years from date of shipment, that THE COMPANY's manufactured and assembled products, not otherwise expressly warranted, are free from defects in material and workmanship. No warranty is made against corrosion, deterioration, or suitability of substituted materials used as a result of compliance with government regulations.

THE COMPANY's obligations and liabilities under this warranty are limited to furnishing replacement parts to the customer, F.O.B. THE COMPANY's factory, providing the defective part(s) is returned freight prepaid by the customer. Parts used for repairs are warranted for the balance of the term of the warranty on the original humidifier or 90 days, whichever is longer.

The warranties set forth herein are in lieu of all other warranties expressed or implied by law. No liability whatsoever shall be attached to THE COMPANY until said products have been paid for in full and then said liability shall be limited to the original purchase price for the product. Any further warranty must be in writing, signed by an officer of THE COMPANY.

THE COMPANY's limited warranty on accessories, not of Walter Meier's manufacture, such as controls, humidistats, pumps, etc. is limited to the warranty of the original equipment manufacturer from date of original shipment of humidifier.

THE COMPANY makes no warranty and assumes no liability unless the equipment is installed in strict accordance with a copy of the catalog and installation manual in effect at the date of purchase and by a contractor approved by THE COMPANY to install such equipment.

THE COMPANY makes no warranty and assumes no liability whatsoever for consequential damage or damage resulting directly from misapplication, incorrect sizing or lack of proper maintenance of the equipment.

THE COMPANY retains the right to change the design, specification and performance criteria of its products without notice or obligation.