



Important: Read and save these instructions. This guide to be left with equipment.



AIRFOG Series

Installation and Operation Manual

Includes installation, operation
maintenance and troubleshooting
information for your AirFog Series
Atomizing humidifier

Thank you for choosing NORTEC.

INSTALLATION DATE (MM/DD/YYYY)

MODEL #

SERIAL #

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Introduction

Note: Prior to installing any AirFog product carefully READ through this entire guide, it contains valuable information, which will assist in all aspects of the installation.



Applicability

This document is applicable to all Nortec AirFog system components purchased after February 2004. If the designer has existing system components purchased prior to February 2004, the Nortec Technical Service Department should be consulted to determine compatibility with the newer equipment, parts and external interfaces.

AirFog Humidifiers

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:

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

AirFog Family of Products

The AirFog family is Nortec most advanced adiabatic humidifiers. There are groups of products that fall in this family: applied products and packaged products.

The applied products group describes systems that are tailored specifically for each application:

- AFE Nozzle systems use compressed subsonic air flows and water to create a fine mist that is sprayed directly into a space.

The packaged products group describes systems that are ready to operate out of the box, and need only be connected to power, air, and water. These products include:

- AFE Mini: Systems are wall mounted and have 1 or 2 AFE nozzles.
- AFE Octo: Systems are ceiling mounted and available in many configurations including modulating versions, and have between 3 and 8 AFE nozzles.

This manual describes the installation, operation, and maintenance of all AFE, Mini and Octo systems.

AFE Principle of Operation

The AFE nozzle uses air flow and the 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 increase the rate that water is siphoned into the nozzle. As the water exits the nozzle it is broken down into a fine mist by a shearing action created by the compressed air. 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 at the same height as the water pressure reduction regulator (vacuum valve). Valleys or peaks in altitude will adversely affect performance and in some 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.

General AirFog Technical Considerations

Adiabatic Cooling Phenomena

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 sensible from the surrounding air at a rate of approximately 1,000 BTU per pound of water evaporated. This causes the temperature of the air to decrease, meaning that both humidity and cooling are provided simultaneously. This could be a significant energy saving technique if mechanical cooling is 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.

Humidification Zones (In Space Applications)

The movement of humidity through a space is very rapid. In applications where accurate humidity control is essential, it is important that the structure be reasonably air-tight, well insulated, and have good vapor barriers, to prevent humidity from escaping to the outside. If a large amount of infiltration or exfiltration is encountered it may be necessary to oversize the system to compensate for this.

AFE systems are frequently used in large factory applications for dust and static suppression. Often these structures have large doors open for loading and unloading of goods. Keeping doors closed, except when needed for movement of goods, can improve the performance of the humidification system by containing humidity levels within the space.

Absorption Distance

Water mist sprayed by the AFE nozzle requires a certain distance to be absorbed by the air. Absorption distance is affected by many factors including temperature, existing humidity levels and air pressure. However, in general increasing the air pressure (and hence the water flow) to the nozzle will increase the absorption distance since more water is being sprayed. It is important to follow the clearances in this guide to prevent the accidental wetting of structures or machinery.

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 permits the designer to consider the cost implications of using multiple smaller horsepower compressors rather than one very large compressor. 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 producing any mist. 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, increasing the diameter of the primary delivery pipe to the zones and elimination of leaks.

Water Quality

AirFog AFE nozzles are controlled from 316 stainless steel and can be used with potable, reverse osmosis, and deionized water types. Potable water contains dissolved minerals that will precipitate out of the water in the form of dust as the water evaporates. These minerals are usually not harmful to the occupants of a space or to presses such as woodworking, printing, paper, storage facilities, etc., however, clean area applications such as computer rooms, electronics manufacturing, laboratories, paint, or fired finish areas may be adversely affected by mineral dusting. In these cases Nortec recommends the use of reverse osmosis or deionization systems to reduce the mineral content of the water before it enters the humidifier.

If you have questions regarding the suitability of the water for your application, please contact the design engineer or your local Nortec representative.

Installation Tools and Equipment

The designer should have already provided drawings of the proposed AirFog humidification system physical layout. These drawings and parts list should clearly identify the system components by name and part number, physical spacing, zone identification and comments on nozzle location and pointing directions.

During installation there will be a requirement to:

- Attach mounting brackets to walls, ceilings or other structures, which may be higher than six feet off the floor.
- Cut and join copper, stainless steel or plastic pipe using standard plumbing joining techniques.
- Connect low voltage wiring to the control panel.
- Connect plastic tubing.
- The installer should have all the tools and be certified to perform these plumbing, mounting and electrical tasks.

Parts

A parts list should be included with the drawings developed by the designer. Not all the necessary parts are provided by Nortec. The following parts are supplied by others:

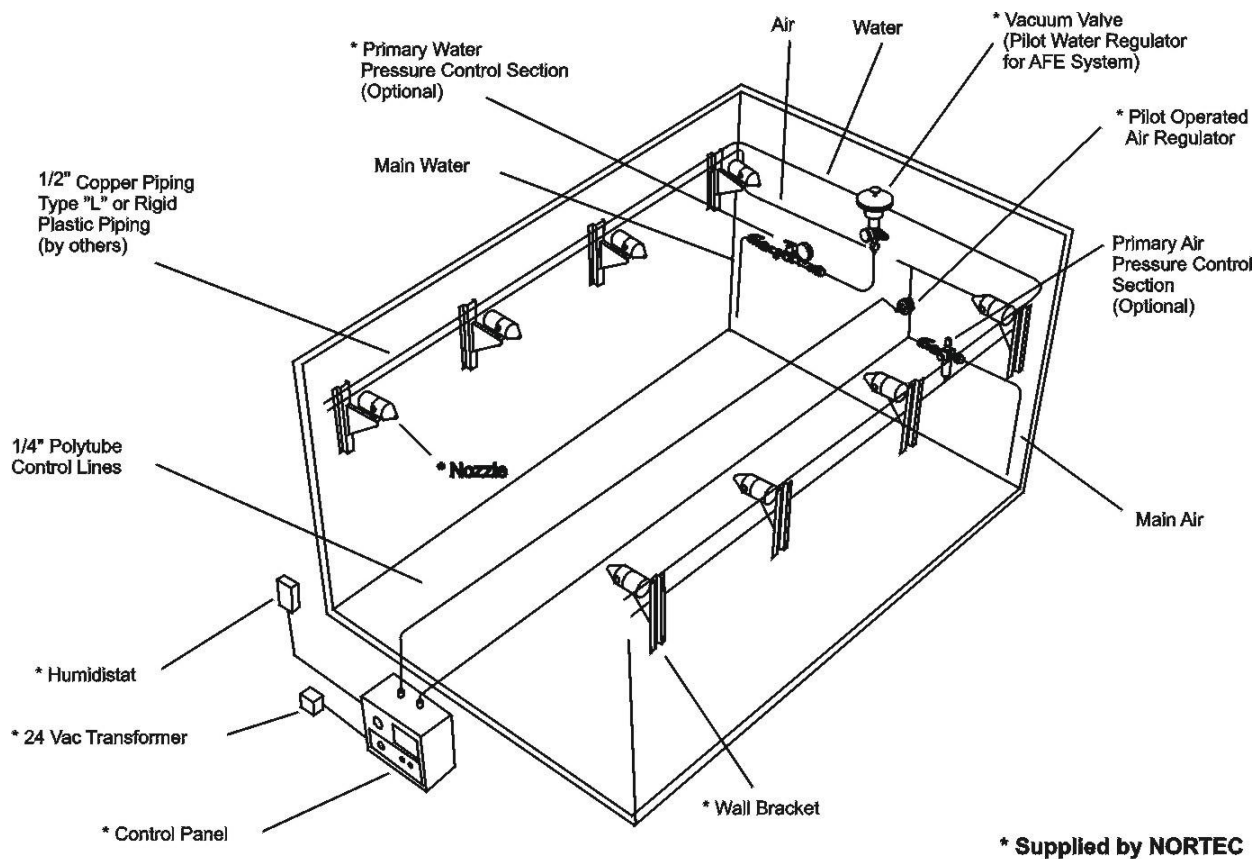
- Pipe, elbows, pipe hanger and mounting hardware for inside HVAC units, T-joints, pipe size adapters, Teflon sealing tape and other plumbing supplies from a local plumbing supplier. Pipe material is either copper, stainless steel or plastic and should be specified on the designer produced drawings.
- Wire for the electrical connections is 18 gauge standard insulation, which can carry 24 Volts AC at 1 amp. This wire can be purchased from most electrical suppliers.
- Nails, screws, bolts, threaded rods, anchors, rivets etc. to attach mounting brackets to the structure. The fasteners used will depend on the material used in the mounting surface.
- Insulation for the cold water pipe feeding the system is required to prevent water vapor from condensing and dripping on other structures, machines, personnel or materials.
- The Nortec supplied parts should be checked against the designer's drawings and parts list to ensure the correct quantity of the correct part numbers are available.

Installation

Nozzle System Layout

If a drawing for the proposed system was not supplied, then it is recommended that one be created prior to installing the system. With reference to the AirFog Engineering Manual, review the site where the nozzle system is to be installed. The location of equipment, lights, pillars and other structures should be drawn on the floor plans. The proper selection and location of the nozzles is very dependent upon these obstructions. Figure 1: Typical Nozzle Layout, can be used as a guide for identifying the various components used with a system.

The supply and feed lines for the system should be kept in straight unobstructed lines where possible. Air and water distribution network pipes are to be installed level along walls, pillars or hung from the ceiling. Avoid placing the lines over top of equipment and other areas, which will make it difficult to gain access at a later date. If the lines have to be routed around an obstacle such as a beam, always go under the obstacle, never over it.



Typical nozzle layout for wall mounted system

Figure 1: Typical Nozzle Layout for Wall Mounted System

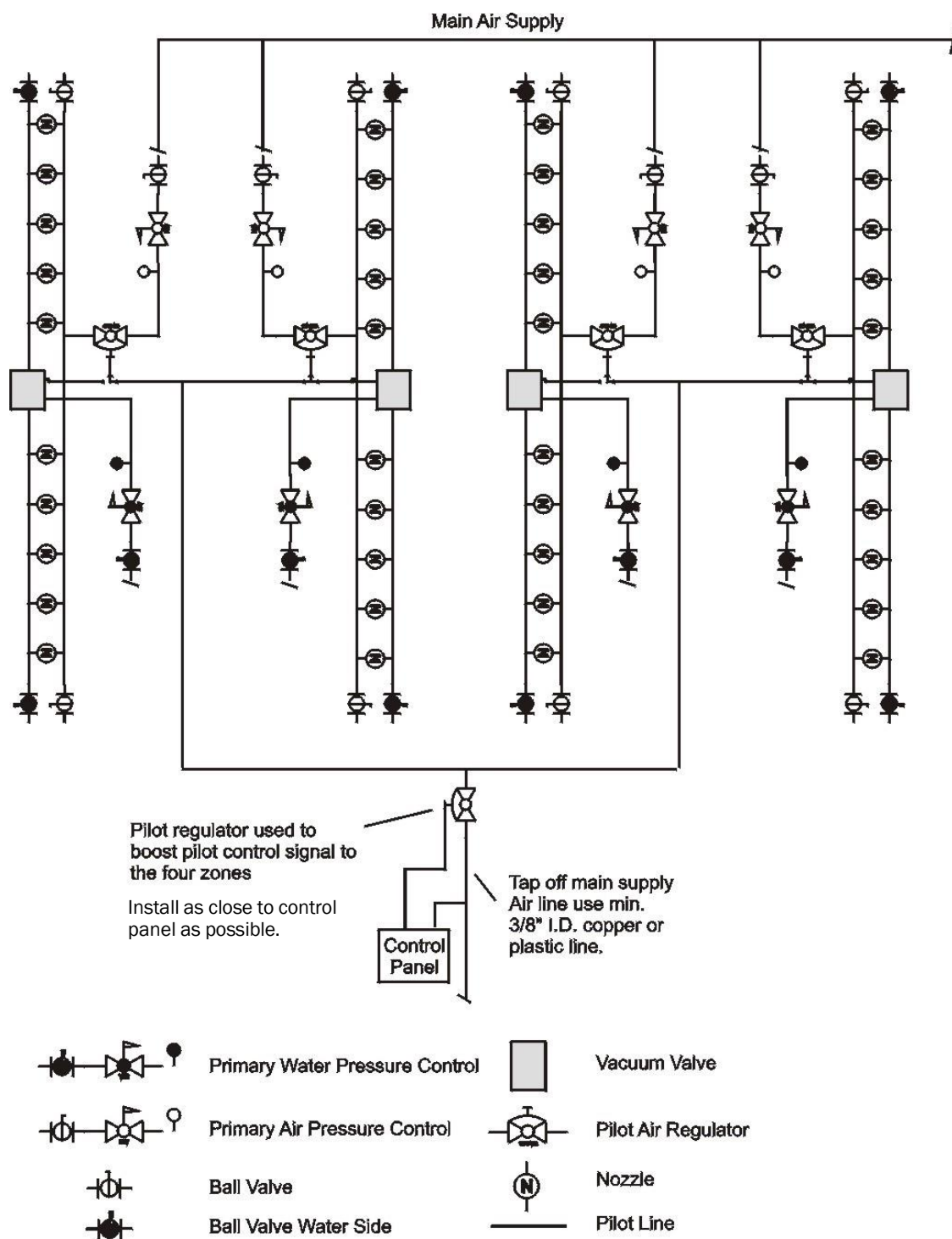


Figure 2: Multi Zone Layout

Zones

Introduction

It may be necessary to break down the space to be humidified into zones. Limitation of the control devices and maximum run of feed piping may indicate the need for multiple zones. Refer to the Engineering manual for detailed limitation of components. Up to four zones can be controlled from one control panel, additional zones can be added with the use of a pilot air regulator acting as a volume booster for the pilot signal. See Figure 2: Multiple Zone Layout.

Supply Feed Lines

Main supply lines connecting to the system must be sized to handle system flow volumes and pressures. Connections to each zone should have an isolation valve installed by using a NORTEC supplied primary pressure control section as illustrated in Figure 3: Water and Air Line Pressure Control. Primary air pressure feed to each zone should not exceed 90 psig. Water feed pressure is not to exceed 25 psig for AFE, Mini and Octo hardware. Supply water pressure is not to exceed 65 psig for AFD systems.

Both water and air lines must be installed as per the mechanical drawings using standard plumbing joining techniques. The spans must not be greater than 5 feet without a supporting bracket. For long runs of piping, expansion joints may be needed and these joints must meet local building codes. When using Nortec supplied saddle clamps, the maximum line size for supplying to nozzles is 11/16" O.D. If saddle clamps by others are used, please size fittings to match the pipe.

Cleaning

Manual valves must be installed at the ends of all lines to facilitate cleaning and drainage of lines. Cleaning is done by temporarily connecting the pipes to a compressed air source at one end of the pipe. The other end of the pipe must not be connected to any equipment but be free to allow the egress of foreign matter. Care must be taken to protect personnel, animals, machines or other sensitive material from the potentially hazardous and contaminating matter, which will exit at high speed from the opening.

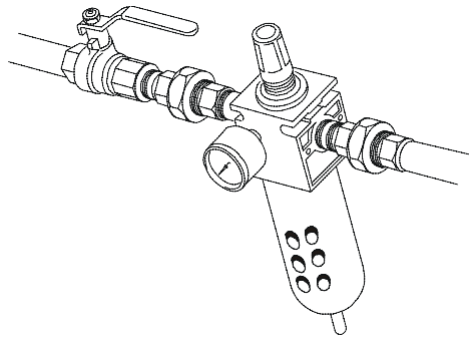
Note: Cleaning of the lines of all foreign material prior to connecting any system component is critical, failure to maintain clean lines may void the warranty.



Mounting of Nozzles

Each supplied Nortec nozzle has a 3/8" NC 16 threaded port on the under side of the nozzle which is used to fasten the nozzle to a mounting bracket, as illustrated in Figure 4: Nozzle To Bracket Interface or Figure 5: AFE Nozzle Ceiling Mounting. If other than NORTEC supplied mounting hardware is to be used, ensure correct bolt and thread size is used. Nozzles can be mounted in any elevation angle as water throughput capacity is not affected by this orientation. However, AFE nozzle capacity is sensitive to vertical height differences to the vacuum valve. The maximum nozzle installation height allowable above the water supply line is 12" (30 cm).

Primary Air Pressure Control Section



Primary Water Pressure Control Section

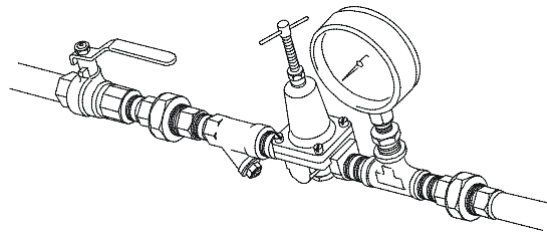


Figure 3: Water and Air Line Pressure Control

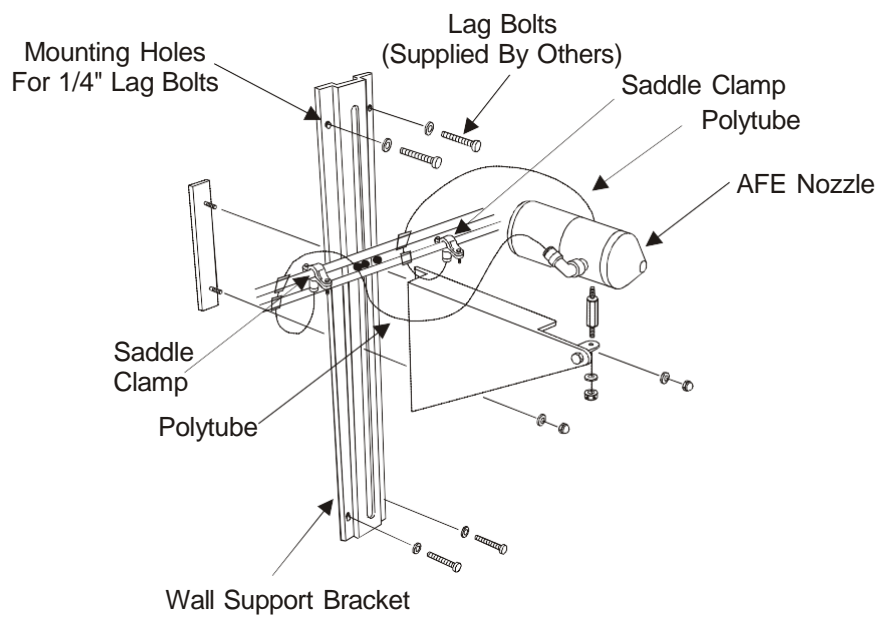


Figure 4: Nozzle to Bracket Interface

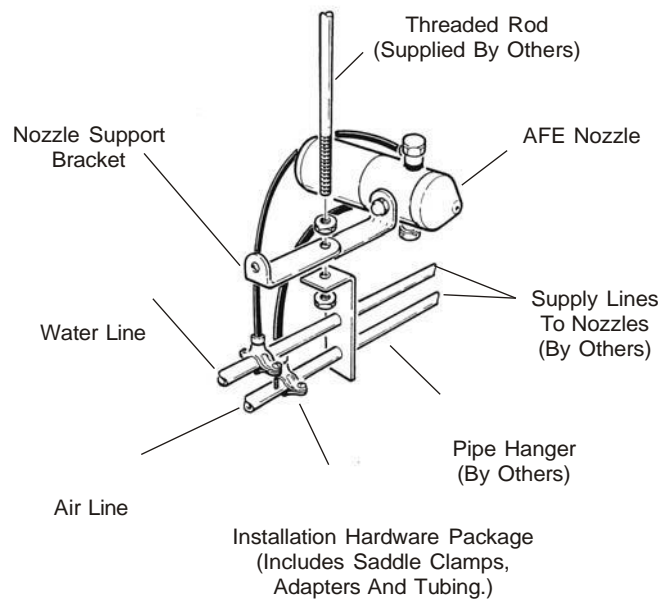


Figure 5: AFE Nozzle Ceiling Mounting

Connecting Nozzles

All the supplied nozzles have two inlet ports with push in, quick release style fittings as shown in Figure 6: Quick Release Fittings. These fittings are only designed for use with 1/4" O.D. plastic tubing. If other than Nortec supplied tubing is to be used, it must be a high grade uniform tubing from a reputable supplier.

The Nortec supplied fitting uses an o-ring to seal the O.D. of the tubing and finger clamps to hold it in place. Failure to use proper size tubing may result in poor sealing and cause system failure. The tubing **MUST** be cut square using a knife or plastic tube cutter rather than pliers. To connect the tube to the nozzle simply push the tubing into the nozzle fitting until it reaches the bottom. Gentle pulling of the tube without movement is a good indication that a proper seal has been made.

Allow enough free tubing to permit the nozzle to swivel horizontally or vertically for future pointing alignment.

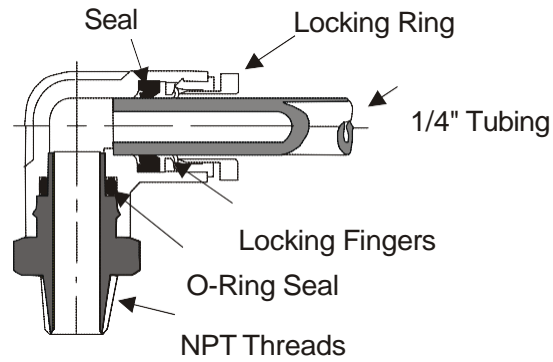
Saddle Clamp Installation

The type of clamp used by Nortec, as shown in Figure 7: Saddle Clamp, requires that the pipe be drilled first. Drill a 1/4" hole squarely into the air and water pipes close to each nozzle within 24" (60 cm). Place the sealing gasket on the male part of clamp, insert it into the drilled hole, then clamp it into place using the provided screws. The saddle clamp has a 1/8" FNPT port; install either the supplied compression fitting or another style fitting suitable for plastic tubing. Two saddle clamps, one for air and one for water, are required for each nozzle.

Note: Not to be used with DI water. For DI water use stainless steel tee.



Cut-away View of Quick Disconnect Fitting



1/4" Tubing



Tubing **MUST** be cut **PERPENDICULAR** to ensure proper seal. Use sharp knife, not wire cutters or pliers.

Figure 6: Quick Release Fitting

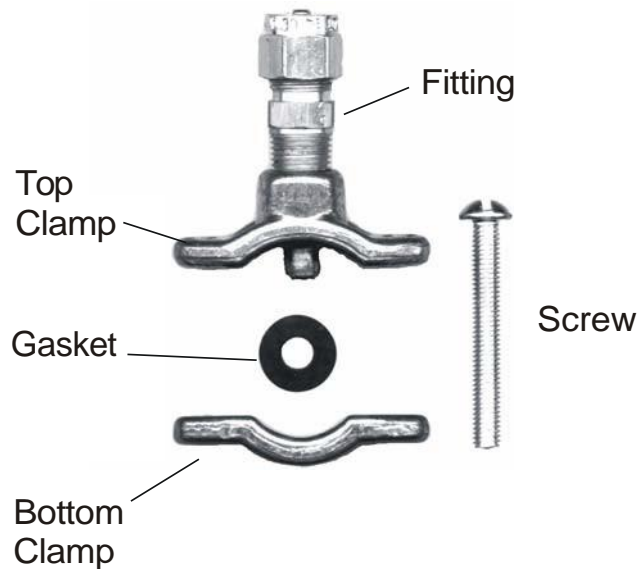


Figure 7: Saddle Clamp

Vacuum Valve

The vacuum valve must be centrally located so there are approximately an equal number of nozzles being fed from each of its two output ports (one on the left side and the other on the right side). There is a mounting bracket supplied with each vacuum valve. Figure 9: Vacuum Valve Interfaces illustrates the plumbing interface details. Elevation of the valve is very critical, as is the positioning of the nozzles. The maximum height above the nozzle supply line the valve should be installed is 12" (30 cm). Never install the vacuum valve lower than the nozzle water feed lines.

The water flow rate through this valve is limited to 24 GPH, which limits the number of AFE nozzles it can supply to 16. If more than 16 nozzles are to be installed, 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 "T"ing off the single control panel air pilot output.

Air pressure from the control panel is used to open the water safety valve permitting water to enter the vacuum valve, which controls the water feed to the nozzles. Figure 8: Vacuum Valve Operation explains the operation of this water regulator. The vacuum valve assembly has three sub-components. As illustrated in Figure 9: Vacuum Valve Interfaces. First, the safety valve interfaces directly with the primary water supply to open or close on command from the control panel. Loss of pilot air pressure (below 10 psig) will automatically close this valve to prevent water proceeding beyond this point. In series with, and downstream of the safety valve, is the water regulator. The water regulator is used as the first stage of water pressure reduction. The water regulator reduces the supply water pressure to a range between 5 and 10 psig. This is set manually at time of installation. Please note that 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 ambient (0 psig). Output is through two exit ports on the underside of the vacuum valve. This permits the nozzle to draw water from the supply as required rather than having pressure force it into the nozzle. The 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 volume of water to the nozzles. A reduction in available water for a constant air flow 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.

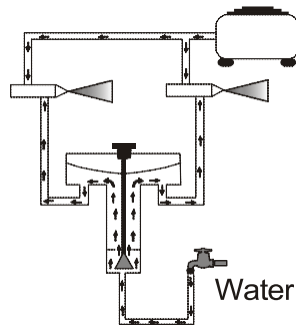
Pilot Operated Air Regulator

The pilot operated air regulator controls the air supply to the nozzles and is illustrated in Figure 10: Pilot Air Regulator. The pilot regulator is modulating flow controller rather than a simple On/Off valve. The greater the pilot air pressure, the greater the air pressure fed to the nozzle supply network. This means that the Control Panel is able to request a proportional opening of the Air Regulator simply by varying the pilot pressure. There is a linear 1:1 relationship between the pilot pressure and the output 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). A pilot pressure of 50 psig will drive the air regulator to have an output of 50 psig. The pilot air pressure range is from 0 to 70 psig.

The four ports on the pilot operated air regulator are the pilot air pressure input from the control panel, the primary air supply input feed, the output air feed to the nozzles and to gauge port used to feed pilot signal to the water regulator. There are no manual adjustments required.

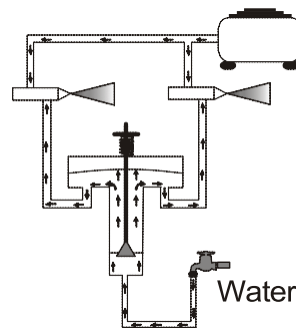
Install the pilot air regulator on the feed line before the nozzles by splicing into the air feed line to the nozzles. See Figure 11: Pilot Air Regulator Installation. Ensure the proper flow direction when installing this device.

Air Compressor



Compressed air exits the nozzles creating a vacuum on the water side. The negative pressure pulls the VV diaphragm down, opening the water valve.

Air Compressor



As the pressurised water enters the VV chamber it pushes up on the diaphragm closing the water valve.

During normal operation the vacuum valve will cycle between the open and closed state.

Figure 8: Vacuum Valve Operation

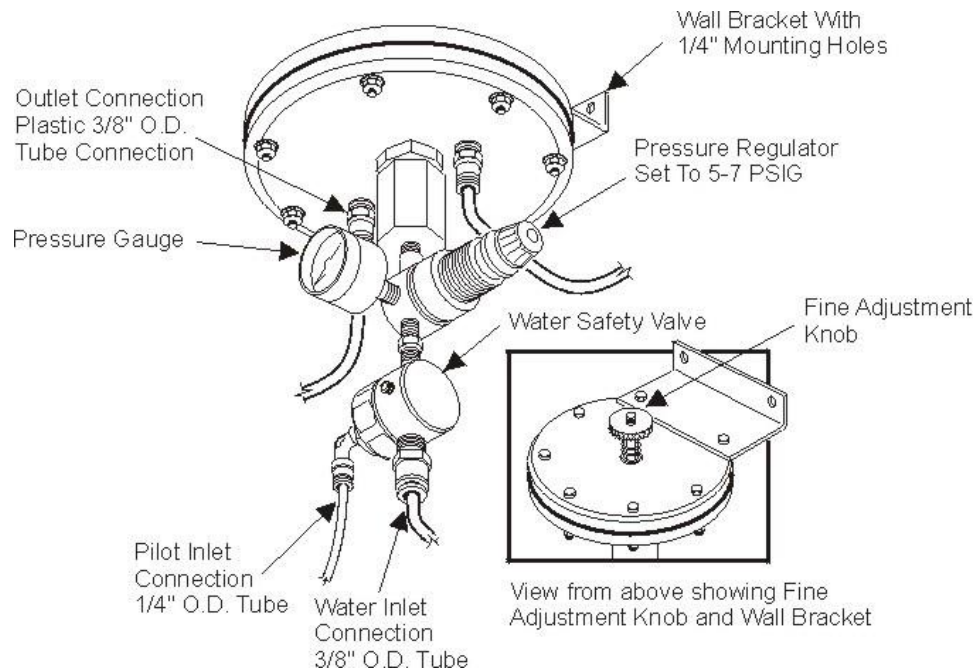


Figure 9: Vacuum Valve Interfaces

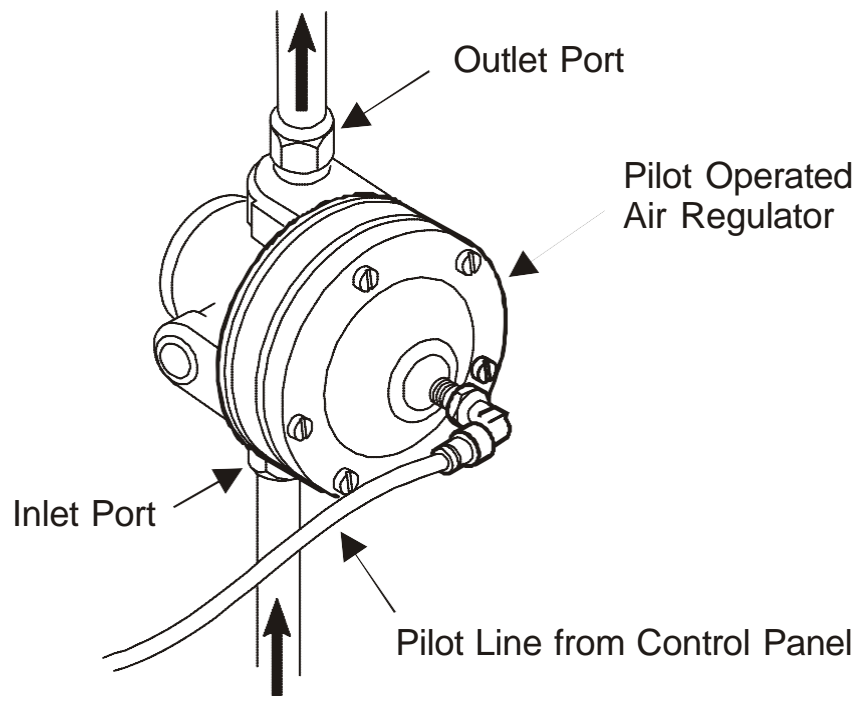


Figure 10: Pilot Air Regulator

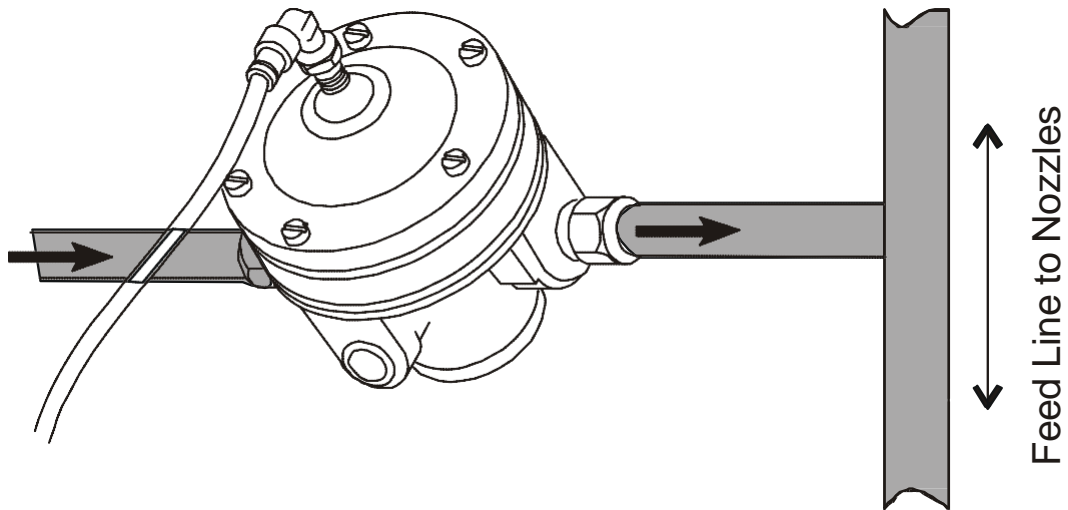


Figure 11: Pilot Air Regulator Installation

Primary Air Pressure Control

The primary air pressure control section (with the shutoff valve) is connected to the air compressor or the compressed air source as specified in the Designer produced drawings. See Figure 12: Primary Air Pressure Control Section.

Primary Water Pressure Control

The primary water pressure control section connects the main water supply. The shutoff valve end of section is the inlet. The gauge end of the section is joined to the water inlet of the vacuum valve for AFE systems. See Figure 13: Primary Water Pressure Control Section.

Control Panel

Bolt the panel directly to the surface through the mounting holes. Place the panel level against the surface and mark locations for holes to be drilled. Remove the panel and drill 2 holes (hole size to match field supplied lag bolts and anchors). Place panel over the holes and secure it using bolts.

Electrical Wiring

Electrical connections of the control panel use 18 ga wire for all external wiring. The control panel requires 24 VAC, which is provided by the Nortec supplied step down transformer (120 VAC to 24 VAC). The transformer plugs into any standard 120 VAC outlet that must be located within 6' (six feet) of the control panel. Power is connected to the low voltage terminal trip located inside the panel as illustrated in Figure 16: Control Panel Terminal Strip Interfaces. Control panels are supplied by Nortec in two configurations. The first is for use with systems that are designed to operate with only an On/Off humidistat and the second is designed to operate with a modulation controller. Within the control panel there is a 7 point terminal block, terminals 6 & 7 are for power voltage 24 VAC. A wiring diagram is provided with each control panel. Both control panels reserve terminals 1 & 2 are for on/ off control wiring which may be a simple humidistat, a relay for remote operation or other interlock devices (dry make break contacts).

Modulation controlled systems use terminal 3, 4 & 5 on the 7 terminal block strip as follows: terminal 3 is to be connected to the "+" terminal on the controller, terminal 4 is to be connected to the "-" terminal on the controller and terminal 5 is for 24 VAC supply to the controller. This is illustrated in Figure 15: Control Panel Terminal Strip Interfaces.

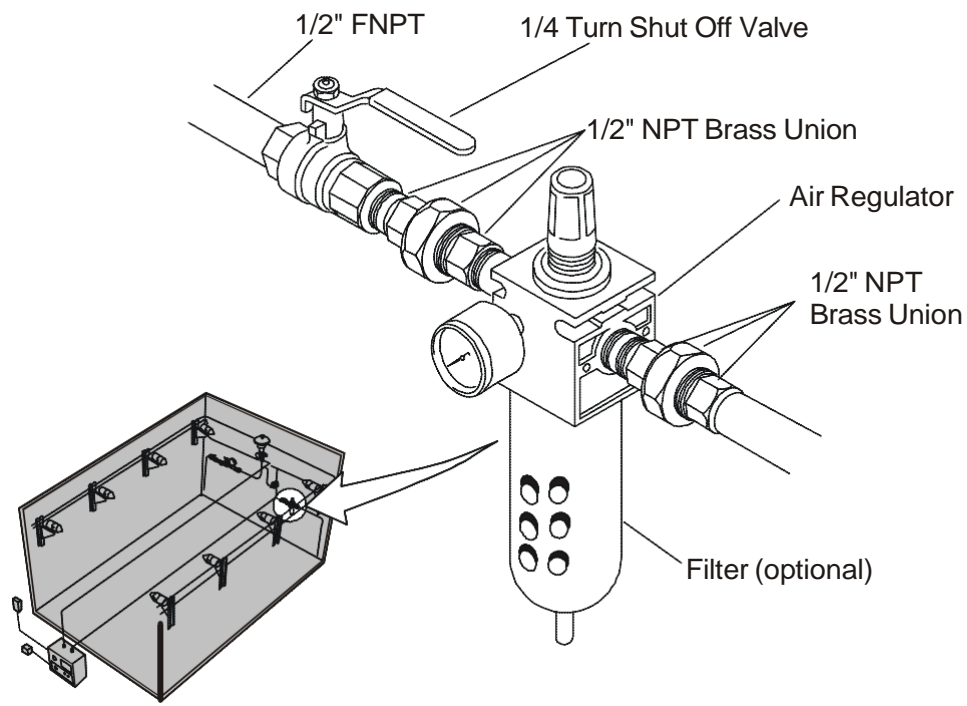


Figure 12: Primary Air Pressure Control Section

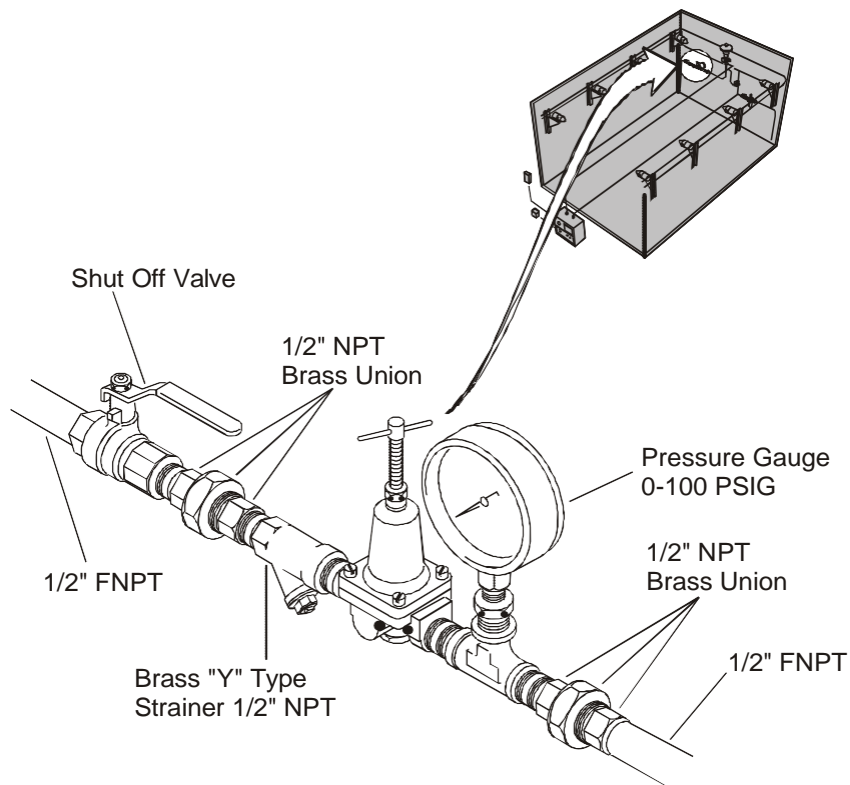


Figure 13: Primary Water Pressure Control Section

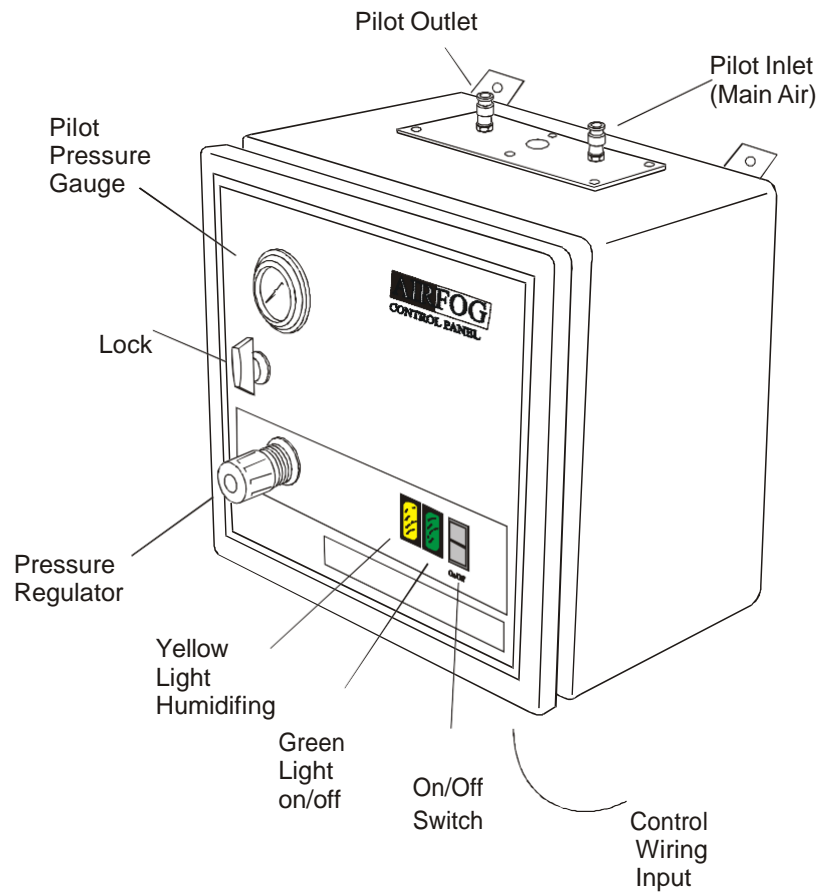


Figure 14: Control Panel

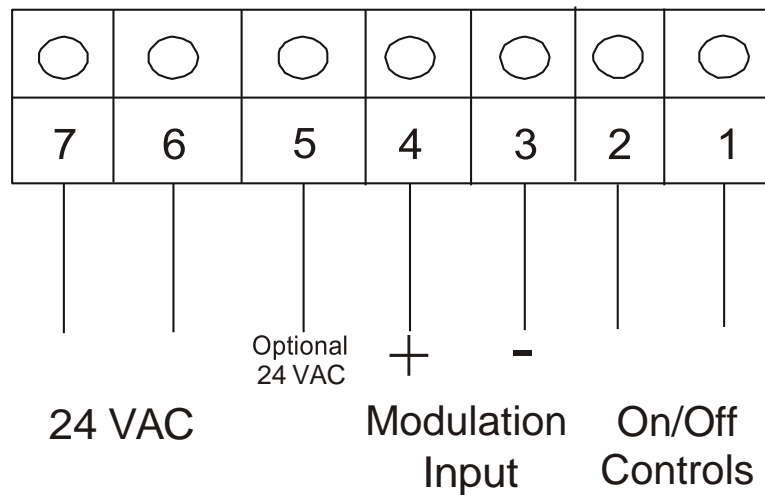


Figure 15: Control Panel Terminal Strip Interfaces

Pilot Lines

All air pressure lines connecting to the control panel must be 1/4" O.D. plastic tubing rated for 150 psig. Figure 16: Schematic Plumbing Layout illustrates the proper connections of the air supply to and from the control panel to the vacuum valve and the pilot air regulator. The control panel requires an input pneumatic (air) control supply, which is usually tapped off the main air supply line upstream of the pilot air regulator. The control panel has two pneumatic fittings located on its top plate; one marked "pilot in" and the other marked "pilot out". The "pilot in" is connected to the control supply with the 1/4" plastic tubing. A second 1/4" line connects the "pilot out" to both the pilot air regulator and the vacuum valve using a "T" connector.

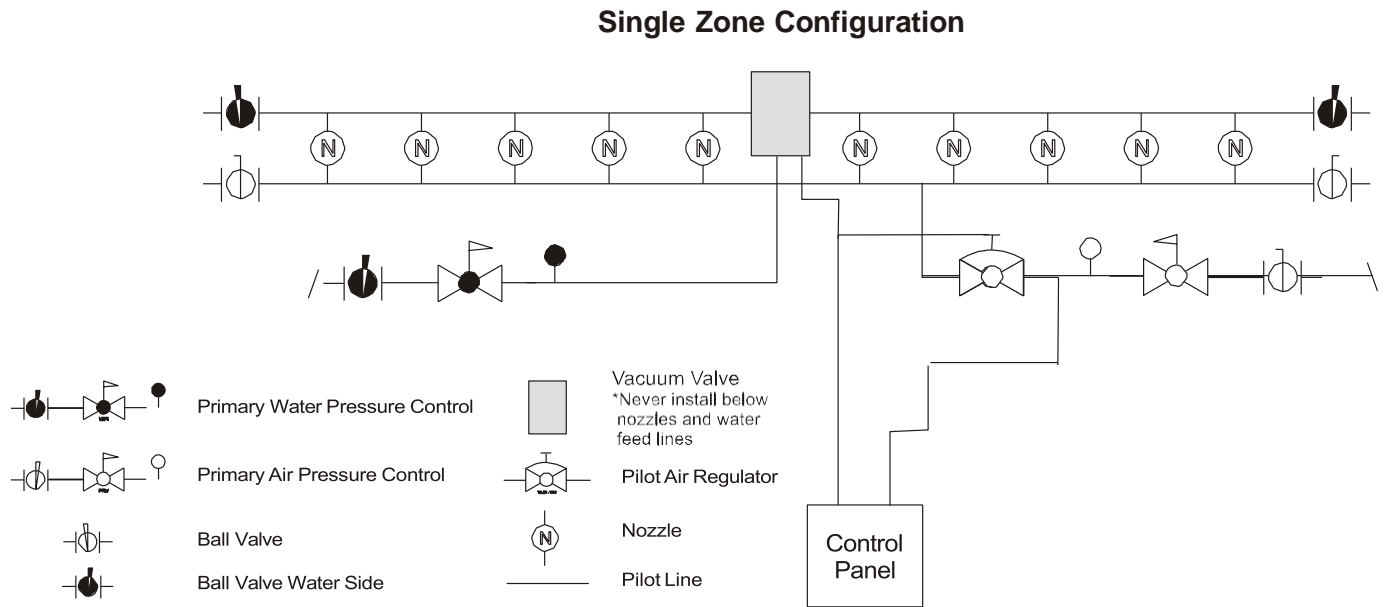


Figure 16: Schematic Plumbing Layout

AFE Self Contained AirFog systems

AFE Mini Systems

AFE MINI systems are self-contained packaged systems that include all necessary components.

They require the following connections:

- 3/8" O.D. plastic or soft copper water supply line rated at a minimum of 25 psig.
- 1/4" O.D. plastic or soft copper air supply line rated at a minimum of 90 psig
- Isolation valves for both air and water lines
- Mounting hardware
- Support anchors
- 1/4" lag bolts
- 120 VAC standard electrical receptacle
- Humidity control device (Humidistat)

The best location for a MINI is on a wall or column with the mist discharging down an aisle where it will not condense on solid surfaces. A clear run of at least 15 feet forward of the nozzles is normally a sufficient distance for complete absorption. Adiabatic cooling may be uncomfortable to people occupying workstations directly beneath the Mini systems.

The Mini nozzles must be a minimum of 6 feet above the floor and 36" below the ceiling in order to prevent condensation on these surfaces.

Four accessible internal mounting holes are located in each corner of the rear panel. The mounting procedure is:

- Either attach the supplied mounting bracket hardware or bolt panel directly onto the wall surface via the mounting holes.
- Place the panel level against the surface and mark the drill holes.
- Remove the panel and drill the holes (hole size to match field supplied lag bolts and anchors).
- Replace the panel and secure using bolts.

Install water and air supply lines. Both water and air lines should have an isolation valve installed near the unit. Water connection at the unit is designed for 3/8" plastic tubing but if soft copper pipe is to be used, replace the plastic sleeve in the fitting with the supplied brass sleeve. The air connection is designed for 1/4" plastic tubing.

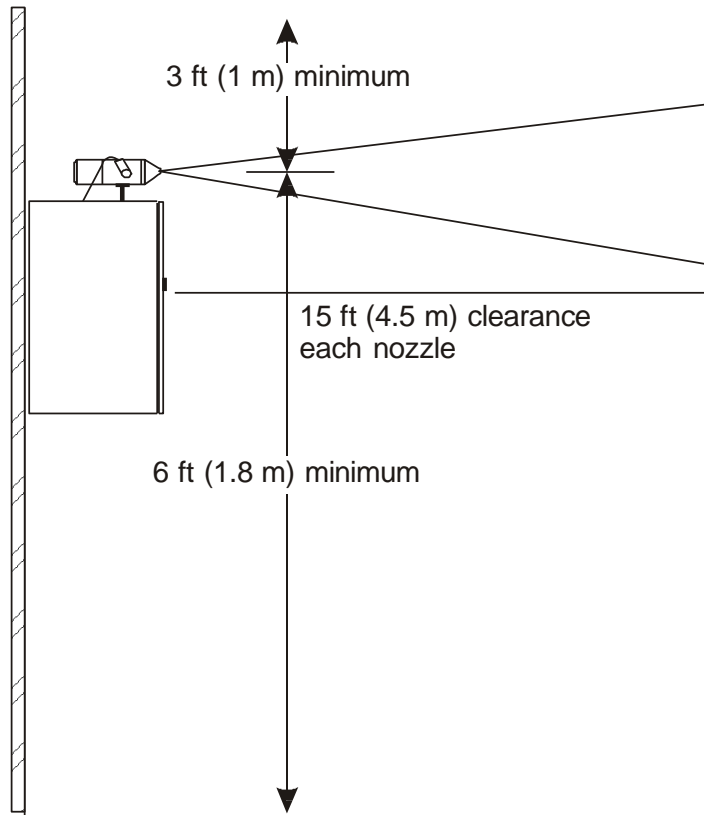


Figure 17: Control Panel

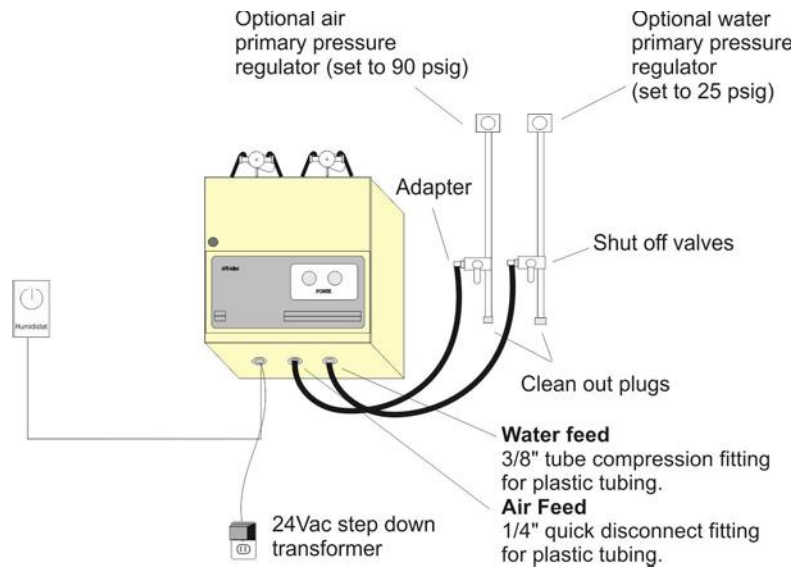


Figure 18: AirFog Mini Connections

AFE Octo Systems

Octo systems are partially self contained and are between the simple Mini self-contained installation and the modular AFE systems. The Designer's drawings and parts list will define the configuration. The only installation difference between the full modular system and the Octo is that the vacuum valve and pilot air regulator are located inside the Octo case as illustrated in Figure 19: Octo Layout and Interfaces.

The Octo interfaces are:

- 3/8" O.D. plastic or soft copper water supply line rated at a minimum pressure of 25 psig
- 1/2" O.D. plastic or soft copper air supply line rated at a minimum pressure of 90 psig
- 1/4" O.D. plastic tubing for command air pressure (pilot air)
- Isolation valves for both air and water lines
- Hanging hardware
- Chains
- Threaded rod
- Support anchors
- AFE Control panel
- 120 VAC standard electrical receptacle
- Humidity control device (Humidistat)

Installation Procedure

Octo units are designed to be suspended from the ceiling by either a threaded rod or chains. Octos with nozzles on only one side may also be mounted on a wall or pillar (single sided configurations). Prior to mounting, ensure there are no obstacles such as duct work, lighting, large equipment, etc., Please refer to Figure 20: Octo Spray Pattern for further information. The Octo unit should be installed as high as possible above the floor, any equipment or work space. Adiabatic cooling maybe uncomfortable to people occupying workstations directly beneath the Octo systems. The recommended height above the floor is 20 ft (6.1 m) and 18" below ceiling joists.

When using chains to suspend the Octo, ensure the chains are rated for the units weight (64 lbs) and that all local building codes are followed.

In general:

- Each Octo weighs up to 64 lbs (29 kg).
- Install the four 3/8" NC eye bolts into the four mounting holes on the unit using the supplied lock washers & nuts.
- Install field supplied supporting chains or rods from the ceiling then raise the unit up into location and secure in place.

Note: Always hang units, never use a cradle assembly, which can interfere with spray pattern or restrict access for service.



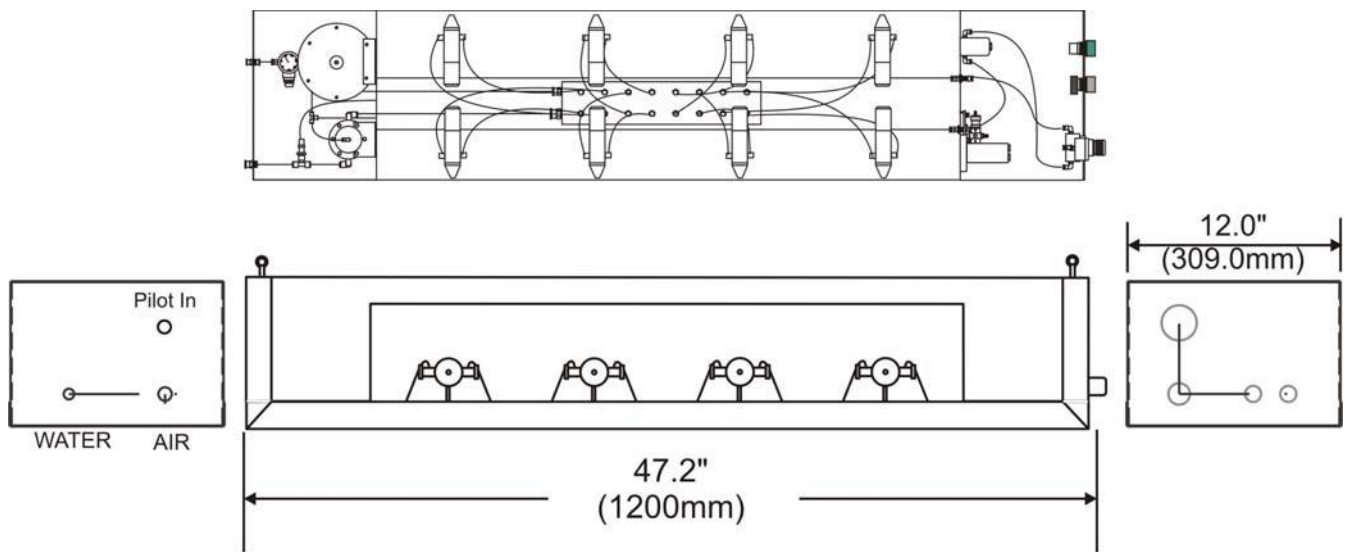


Figure 19: Octo Layout with Interfaces

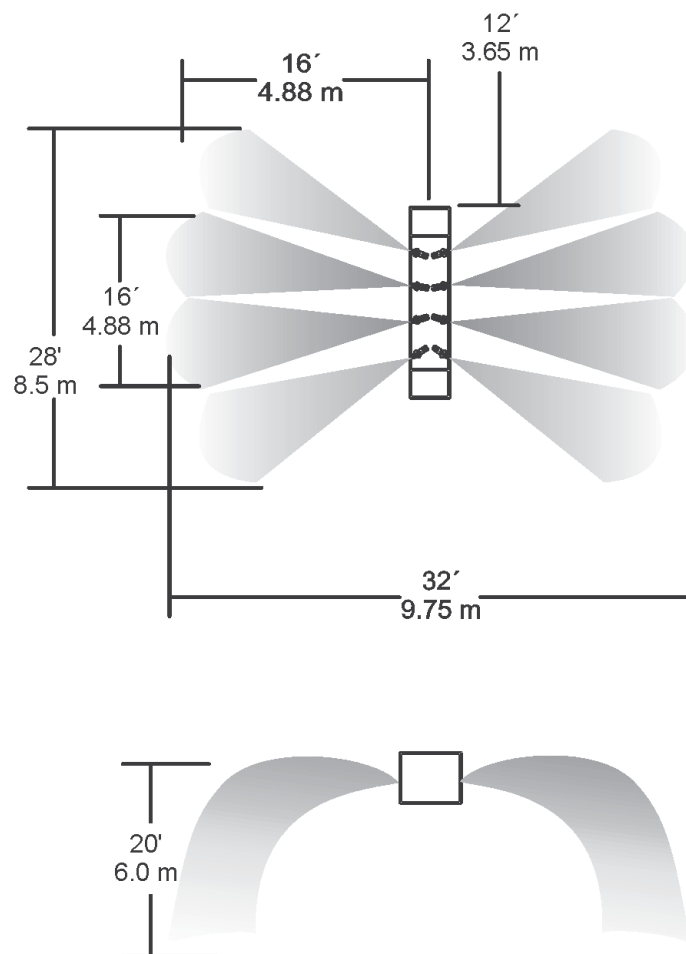


Figure 20: Octo Spray Pattern

Mounting using threaded rods requires installing field supplied 3/8" NC supporting rods from the ceiling, raising the unit up into location and securing it to the support rods using the supplied washers and nuts.

Both water and air lines should have an isolation valve installed near the unit as illustrated in Figure 23: Octo Air And Water Interfaces. Water connection at the unit is designed for 3/8" plastic tubing; however, if soft copper pipe is to be used, replace the plastic sleeve in the fitting with the supplied brass sleeve. Air connection is designed for 1/2" plastic tubing. If soft copper pipe is to be used, replace the plastic sleeve in the fitting with the supplied brass sleeve.

For a standard Octo unit, a separate control panel and 1/4" O.D. plastic tubing for pilot line is required. To install this line the fitting on the unit is a push in style located above the main air connection. Simply cut the tubing square and push one end into the fitting. Route the line back to control panel location.

If multiple Octo units are to be controlled from a single control panel then "T" off the pilot air pressure line to connect the other OCTO units as illustrated in Figure 23: Four Octo Units With A Single Control Panel. If more than four Octo's are to be controlled from one control panel, use a pilot air regulator or a volume booster for the pilot line.

Octo Plus units do not require a separate control panel as there is one mounted within the unit. All that is necessary is to connect it electrically as explained in this manual under Electrical Wiring.

Control Panel installation for standard Octo hardware is explained in the under Control Panel section.

The nozzles on the Octo units are pointed straight forward when shipped but these can be oriented in any direction that will not have the plume strike a solid object or another plume for at least 16 feet. Figure 24: AFE Octo Nozzle Spray Pattern helps in visualization of these AIRFOG plumes.

Typical Installation Layout

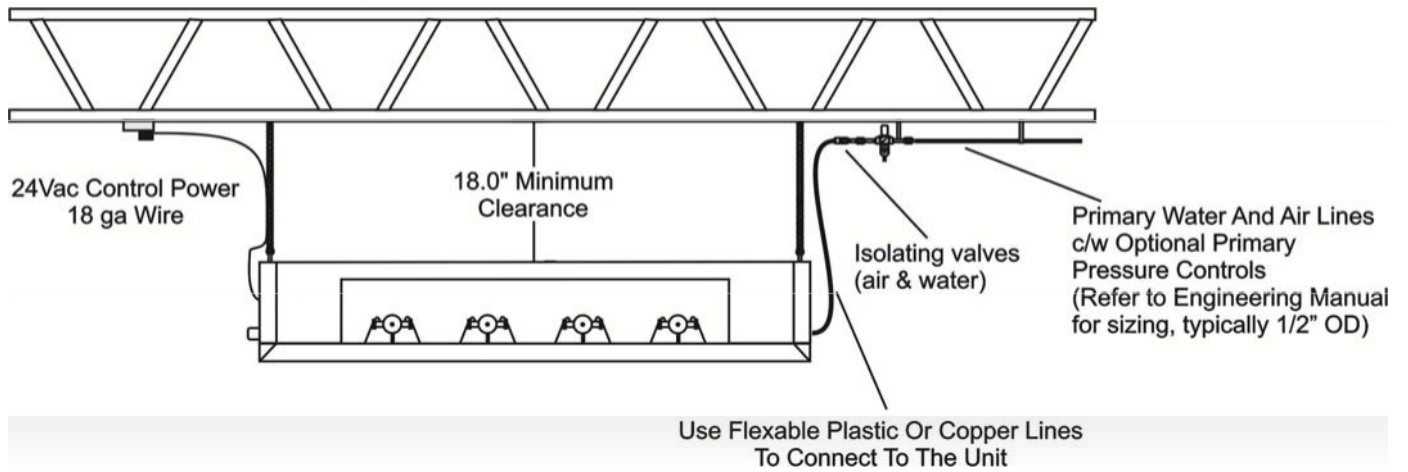


Figure 21: Ceiling Mounting of Octo

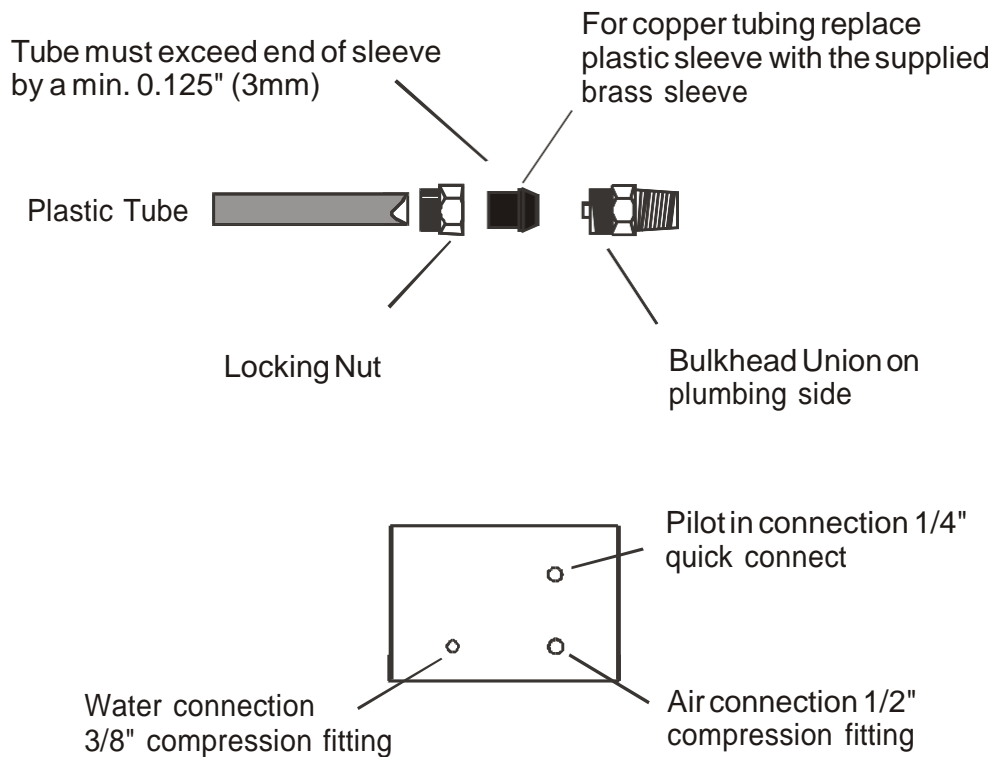


Figure 22: Octo Air and Water Interfaces

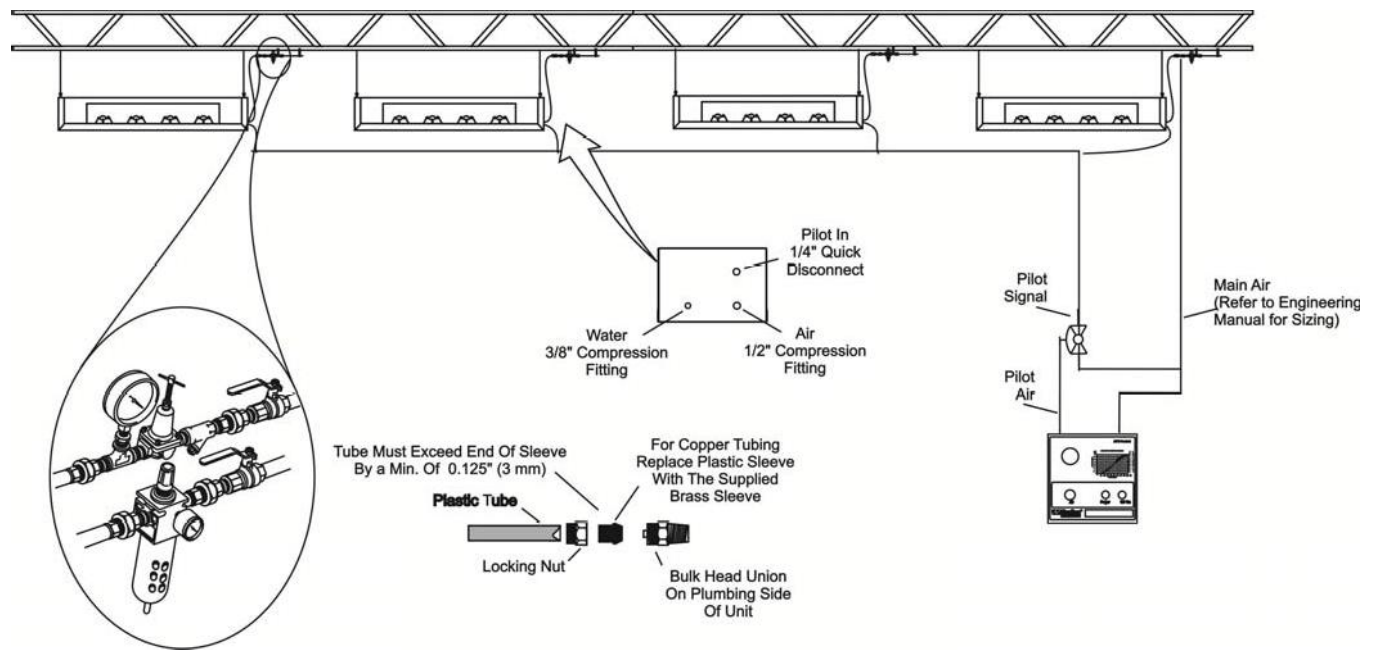


Figure 23: Four Octo Units with a Single Control Panel

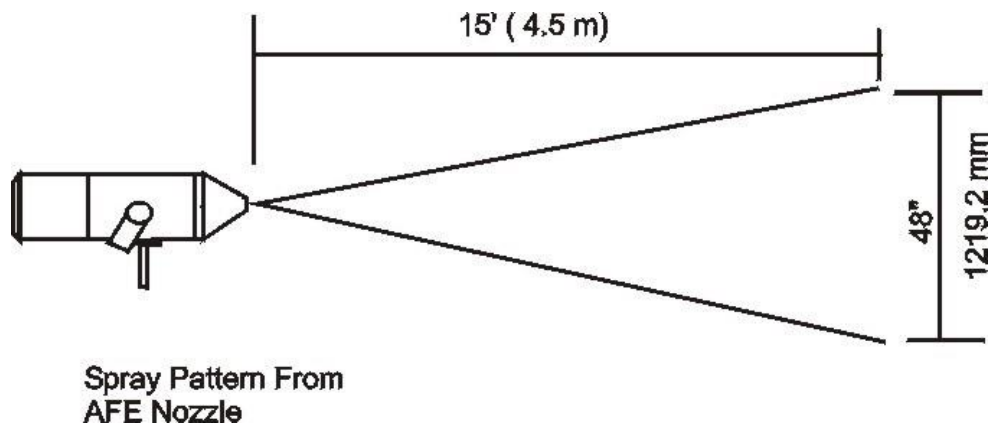


Figure 24: AFE Octo Nozzle Spray Pattern

AFE, Mini, and Octo Start-up Procedures

Introduction

The operator must make reference to Figure 1: Typical Nozzle Layout when following these instructions. Prior to startup, ensure the following:

- All components have been visually checked for proper connections.
- All supply and feed lines have been cleaned.
- The on/off valve of the primary water pressure control section is OFF.
- Water at 25 psig pressure from the main supply is ON.
- The on/off valve of the primary air pressure control section is OFF.
- The air compressor is running and providing a minimum of 90 psig.
- The control panel switch is OFF.
- The 24 VAC transformer is plugged into a 110 VAC source and the green control panel power indicator light is illuminated.
- The humidistat is set at 100% relative humidity. (For startup & testing purposes only).
Adjust to desired setpoint after unit operation has been confirmed.

Compressed Air Supply

The clean out valves on the ends of the supply pipes must be closed.

The on/off valve of the primary air pressure control section is opened to the ON position. The handle should be in line with the pipe (as opposed to 90 degrees to it).

The control panel switch is turned to the ON position.

Adjust the air pressure regulator in the control panel to about 70 psig to obtain maximum water throughput for each nozzle for this startup test.

There should be an audible hissing sound as the compressed air works its way through the piping to the nozzles. If this is not detected and air cannot be felt by hand directly in front of the nozzle orifice, then air is not being provided to the system. Check the compressed air line back to the compressor for other valves that may not be open.

The air pressure regulator knob in the primary air pressure control section is to be adjusted until its gauge indicates 90 psig.

Most significant air pressure leaks can be detected by sensing the air flow with the hand or by spraying on soapy water to observe the growth of bubbles around the leak. If an AFE nozzle is sucking some air rather than 100% water through the water pipes, the nozzles will sputter/spit and behave irregularly as opposed to a steady production of uniform mist. A thorough survey should be conducted to identify and fix leaking joints.

Water Supply

The clean out valves on the ends of the water supply pipes must be closed.

The on/off valve of the primary water pressure control section is turned ON. The handle should be in line with the pipe (as opposed to 90 degrees to it).

Adjust the water regulator valve in the primary water pressure control section until the gauge reads 25 psig. The pressure regulator on the vacuum valve should be adjusted to read between 5 and 7 psig.

Manually depressing the thumb screw on top of the vacuum valve will permit water to flow into the pipes and fill them.

AIRFOG water throughput can be controlled at the control panel by adjusting the air pressure. This air pressure must never be greater than 75 psig. If water spray should reach the floor, then the water throughput can be reduced by adjusting the air pressure, droplet size, or both as described in the following paragraph. Reducing the air pressure feed to the nozzles. Refer to Figure 25: Capacity Output vs. Vacuum Valve Adjustment and Figure 26: AFE Capacity Chart.

Water flow through the nozzles can be adjusted using the thumb-wheel on the vacuum valve. Turning the thumb-wheel clockwise will lower water flow through the valve, which will cause a finer mist from the nozzles and a lower capacity. Turning the thumb-wheel counterclockwise will raise the water flow through the valve, which will cause a coarser mist from the nozzles and increased capacity. The optimal setting for the valve is a balance between capacity and spray length. If the spray is reaching the floor or wetting equipment, try turning the thumb-wheel clockwise. If the room is not receiving enough humidity, try turning the thumb-wheel counterclockwise. Some experimentation may be necessary to obtain the best results. Please refer to Figure 1: Capacity Output vs. Vacuum Valve Adjustment for more information.

Self Cleaning Cycle Adjustment

The AFE, Mini, and Octo Systems all feature an automatic self-cleaning mechanism that prevents mineral build-up in the nozzle tip. Buildup of lint, dust, or other materials on the exterior of the nose cone can affect nozzle performance. Nozzles should be inspected and cleaned periodically to remove any buildup. This mechanism activates whenever air pressure falls below 10 psig. This will occur every time the humidistat cycles the nozzles off based on demand, or when the unit is manually switched off. Additionally, a timer is included that allows the user to set automatic cleaning cycles (off time), which occur after a period of operation.

The timer is a white box with several dials on the front of it. The timer can be removed (after the unit has been powered off) for ease of adjustment; simply pull on the timer to remove it. To adjust the timer:

- The upper white dial and blue dial control the length of the time the system will remain on for (T_{on}). The white dial is used to set the scale, and the blue dial is used to set the value. For example, to have the unit remain on for 4 hours before powering off, turn the white dial to point at 1-10h, and then turn the blue dial to point at 4.
- The lower white and blue dials control the length of time the system will remain off for one the timer cycles it off (T_{off}). The white dial sets scale, and blue dial sets the value. For example, to have the unit remain off for 2 minutes, set the white dial to 1-10min, and then turn the blue dial to point at 2.

If the timer were set as in the above examples, the system would run for 4 hours, shut off for 2 minutes, run for another 4 hours, shut off for 2 minutes, and so on and so forth.

Note: The humidistat takes precedence over the timer for shutting down the system. If the humidistat reaches its set point, it will shut the system off regardless of the timer to prevent over humidifying the space.



The factory default setting for the timer is 2 minutes of off time (cleaning time) after every 8 hours of operation. Using settings that result in an off time of less than 10 seconds are not recommended. As well, using settings that result in an on time of less than 15 minutes are not recommended.

Setting the System for Normal Operation

Once the start-up and adjustment, and configuration procedures have been completed the unit is ready to operate normally. The following steps complete the start-up procedures:

- Close and lock all covers including the control panel covers.
- Tighten the lock nuts on the primary air and water regulators.
- Set the humidistat to the desired level.

The AirFog humidification system is now ready to operate normally.



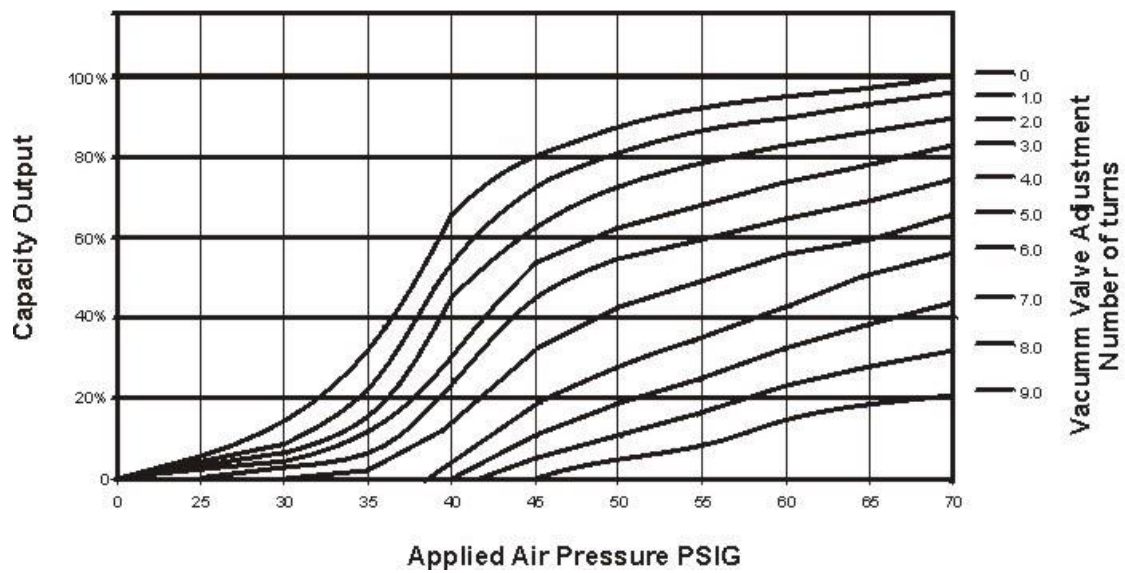


Figure 25: Capacity Output vs. Vacuum Valve Adjustment

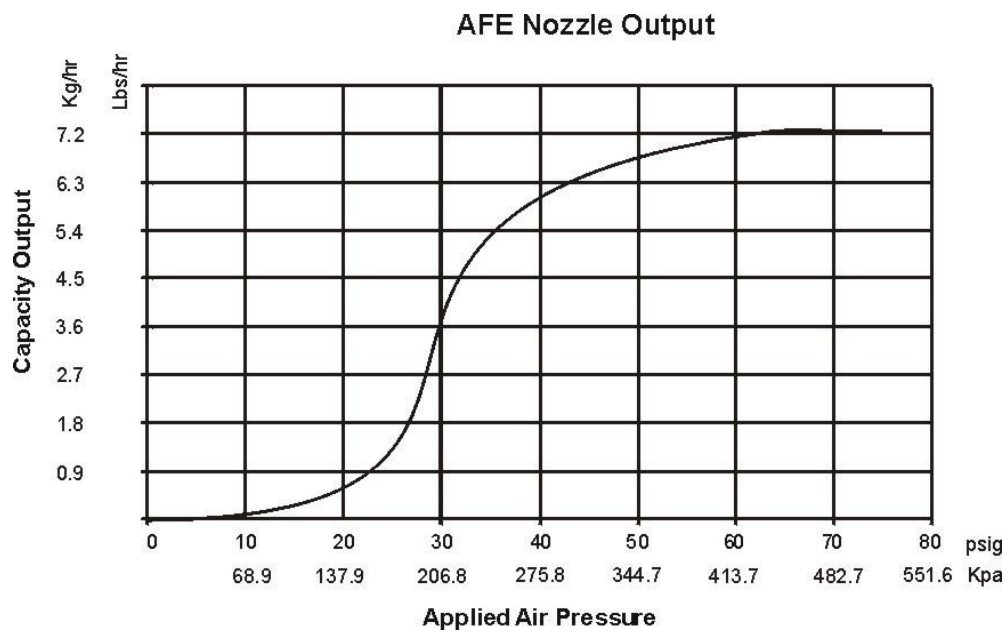


Figure 26: AFE Capacity Chart

AFE, Mini, and Octo Shut Down Procedures

Controlled system shutdowns are conducted for either maintenance (scheduled or repair) or long term seasonal reasons. If the shutdown is for short term maintenance then it may be possible to shorten this full procedure.

The following procedures are the recommended method to manually terminate AirFog operations for long periods of time. Typically this would be after the heating season (winter) is over.

- Turn off the water supply valve on the primary water pressure control section
- Allow the system to operate for 10 minutes to extract as much of the water as possible from the water pipes.
- Turn off the system and connect a hose to the clean out valves / hose bib. Direct the hose to a bucket, open the valve, and allow the system to drain completely.
- Disconnect the 24 VAC transformer from the 110 VAC supply.
- Turn off the air supply valve on the primary air pressure control system.
- Turn the system off at the control panel.
- Turn the air compressor off.

For long periods (weeks or longer) of system down time, it is recommended that pressurized air is used to blow all water out of the system.

It is important that components are not disconnected or removed from the system while they are under pressure (air or water). Turning the master switch off in the control panel will isolate all high pressure water system components downstream of the vacuum valve (AFE systems). This control panel switch will also isolate all high pressure air system components downstream of the pilot air regulator. This is often all that is required to isolate the nozzles. Be sure that the air and water mains supplying the system will still be under pressure.

If there is any doubt about whether a component, pipe or tube is under pressure, then turn off the main switch in the control panel, turn off the water pressure at the main water pressure control section and turn off the air pressure at the primary air pressure control section. Bleed off the remaining pressures prior to disconnection of any plumbing interface fittings.

Maintenance

The two most probable maintenance problems are:

- The accumulation of dirt and mineral deposits in/on the nozzle
- Air and water leaks that may be due to marginal workmanship during installation but not obvious until after many hours of operations.

Nozzle cleaning is recommended at least once a year. Remove the nose cone from the nozzle body by turning it by hand and mechanically remove deposits by gentle scraping or scrubbing with a brush or steel wool. Care must be taken not to damage the nozzle or its surfaces. Wipe clean using a clean dry rag.

Leaks in the air and water delivery system could develop over time as the mechanical seals age. Full nozzle replacement, taken from the spare parts purchased as part of initial acquisition, is the recommended maintenance procedure if a nozzle should cease to perform. The nozzle can be repaired back at the workshop using a Level III maintenance nozzle repair kit. Leaks in the piping can be repaired using standard plumbing methods.

Repair kits for the AFE nozzle, Vacuum Valve, Air Regulator and the Water Regulator are available. Instructions are provided with each kit.

Seasonal Maintenance

In most cases there is a humidification season but if this is not the case, it is recommended that the following actions be conducted once a year.

- A detailed visual leak inspection using soapy water and low pressure (less than 10 psig) of all air and water transport pipes and system components is to be recorded on a sketch to indicate leak locations and severity.
- Comparison with previous inspection records could indicate systematic problems as compared to random events.
- Repair leaks and verify the system is fully operational using the procedure described in the Start Up section of this guide.
- The AirFog system is to be shutdown in accordance with the procedure described in the Shut Down section of this guide.
- Each nozzle shall be cleaned of mineral water deposits and accumulated dirt using the procedure described in the Maintenance section of this guide.
- Each nozzle should be lubricated using a silicone based lubricant.
- The compressor manual should be consulted for its recommended seasonal maintenance.

Seasonal Startup

A detailed visual inspection of all air and water transport pipes and components is to be recorded on a humidification system sketch to indicate damage, non-conformances and abnormalities.

Comparison with previous inspection records could indicate systematic problems as compared

to random events.

Repair the identified problems and verify the system is fully operational using the procedure described in the Start Up section of this guide.

Unscheduled Maintenance

Normally an unscheduled maintenance activity is initiated by an observation of a leak or other failure.

- The AirFog system is to be shutdown in accordance with the procedure described in the Shut Down section of this guide.
- Execute repair action either by repairing the leak or replacement of the suspected component.
- Record the date, nature of the problem, the repair action taken, other pertinent details and sign the failure report.
- Comparison with previous inspection records and failure reports could indicate systematic problems as compared to random events.
- Verify the system is fully operational using the procedures described in the Start Up section of this guide.

Vacuum Valve Testing

Setup for test:

- Adjust air feed pressure from the control panel to 70 psig.
- Adjust water feed to vacuum valve to 25 psig.
- Adjust vacuum valve regulator to 7 psig. (This adjustment cannot be made until the system is turned on and a pilot signal of 15 psig or greater is applied.)
- Adjust vacuum valve thumb wheel to zero force (spring backed off).

While system in operating, visually watch the spray pattern from the nozzles.

If the system is completely sealed (no vacuum leaks in the water line) then once the system is turned on for the first time all nozzles should start spraying starting with the nozzles closest to the vacuum valve. The negative pressure created in the water line by the high velocity air exiting the nozzles will cause the water line to fill with water, the farther the nozzle is from the vacuum valve the longer it will take for the water to reach that nozzle. Once the system has gone through the priming stage, it should start spraying within seconds after the system has been turned on after a shut down. The priming stage should not take any longer than five minutes. If the system fails to fully prime after five minutes this may indicate a problem.

Checking For Vacuum Leaks

The best way to check for leaks is to, bypass the vacuum valve by connecting the nozzle supply water line and connecting it directly to the system water supply line. This will pressurize the line and any leaks should cause dripping allowing location and repair of the leaks.

To test the operation of the vacuum valve:

- Reduce the control panel pressure to 40 psig.
- Adjust thumb wheel tension by turning it in a clockwise direction. There should be a visible decrease in the output of the nozzles as more tension is applied to the spring. Be sure not to press down on the thumb wheel while turning it.
- Release the thumb wheel tension by turning clockwise, a visible decrease in nozzle output should be observed.

The spring tension of the vacuum valve restricts the flow of water to the nozzles by changing the required amount of vacuum needed to operate the vacuum valve. Since the nozzles can only generate a fixed amount of vacuum (negative pressure) the flow rate of water is reduced which causes a finer spray and less output. If there was a vacuum leak in the water line it may not be noticeable with the vacuum valve spring tension set to zero, but it should become noticeable with greater tension applied to the spring. A good indication of a small leak would be very little visual difference in nozzle output while performing this test. Other symptoms of vacuum leaks include visible, bubbles in the water lines leaving the vacuum valve or entering the nozzles pattering or intermittent nozzle output may also indicate this problem.

Troubleshooting

Part	Possible Failure	Symptoms	Solution
Vacuum Valve	Diaphragm Failure	Nozzle sputter. Low output. No output.	Replace defective component.
	Pilot Safety Regulator Diaphragm Ripped	Nozzles sputter. Air in water line. Low output. No Output. Water drips from bonnet.	Repair regulator using repair kit.
	Valve Seat O-Ring	Pressure water line resulting in heavy mist. Could damage main diaphragm. No control of output.	Replace o-ring, rebuilt vacuum valve.
	Other O-rings	Vacuum leak, low output, no output. Water leaks out.	Replace.
	Cracked Housing	Vacuum leak or water dripping from valve.	Replace damaged component.
	Blockage	Reduced output. No output.	Clean.
Pilot Air Regulator	Damaged Diaphragm	Loss in air pressure. No air pressure. Uncontrolled air pressure.	Repair.
	Stuck Closed Or Open	Unable to adjust pressure.	Disassemble and clean.
Pilot Water Regulator	Damaged Diaphragm	Loss in water pressure. No water pressure. Uncontrolled water pressure.	Repair.
	Stuck Closed Or Open	Unable to adjust pressure.	Disassemble and clean.
Solenoid Valve	Burnt Coil	Valve does not activate.	Replace.
	Blocked	No pressure leaving the valve.	Clean.
	Stuck Closed Or Open	Dirty plunger.	Clean and install external filters.
Timer	Wrong Timer Settings	System will not come on. System only stays on for a few seconds.	Reduce the off cycle. Increase the on cycle.
	Burnt Timer	The timer lights are not on. Burnt smell from inside the control panel.	Replace.
Panel Regulators	Damaged Diaphragm	Loss in air pressure. No air pressure. Uncontrolled air pressure.	Repair.
AFE Nozzle	Stuck Cleaning Needle	Nozzle does not clean itself.	Lubricate seal and shaft of needle.
	Nozzle Drips	Water on the floor.	Replace damaged o-ring on end of needle.

	Low Air Pressure	System not spraying properly	Check control signal. Check humidistat setting. Check compressor or air supply.
	Sputtering	Air bubbles in nozzle water line	

Spare Parts

Typically some spare parts are ordered with an AirFog system. These parts and kits are to be retained in some safe location in a workshop for immediate access. It is recommended that spare parts and repair kits be replaced as soon as they are consumed.

Some Nortec AirFog humidification system owners choose to not maintain in-house spares or repair kits as there is sufficient redundancy built into the original design to remain fully operational even if a few nozzles have to be shut down (disconnecting the air pressure tube or removal and capping off the water and air delivery nozzle tubes). The lead time to obtain replacement parts or repair kits is considered an acceptable risk. Other owners decide that this risk is too high and choose to maintain spare parts and repair kits in-house so that rapid repairs can be made.

Replacement Parts

Part	Description
1603002	Replacement Water Pressure Regulator, Norgren, 1/4", Brass
1603004	Replacement Pilot Water Regulator, Watts, 1/4", Brass
1603110	Replacement Pilot Water Regulator, Norgren, SS
1603114	Replacement Water Pressure Regulator, Watts, SS
1609503	Filter for Air Pressure Control Section

Repair Kits

Part	Description
1509351	Repair kit for 1603110 Norgren stainless steel pilot water regulator
1603116	Repair Kit for 1603004 Watts Brass Pilot Water Regulator
1603119	Repair Kit for 1603002 Norgren Water Pressure Regulator, Brass
1603120	Repair Kit for 1609209 AFE Nozzles (Also for Mini and OCTO)
1603122	Repair Kit for 1608000 and 1609000 vacuum valve diaphragm
2549782	Repair kit for 1603114 Watts Water Pressure Regulator, SS

Octo Exploded View & Spare Parts

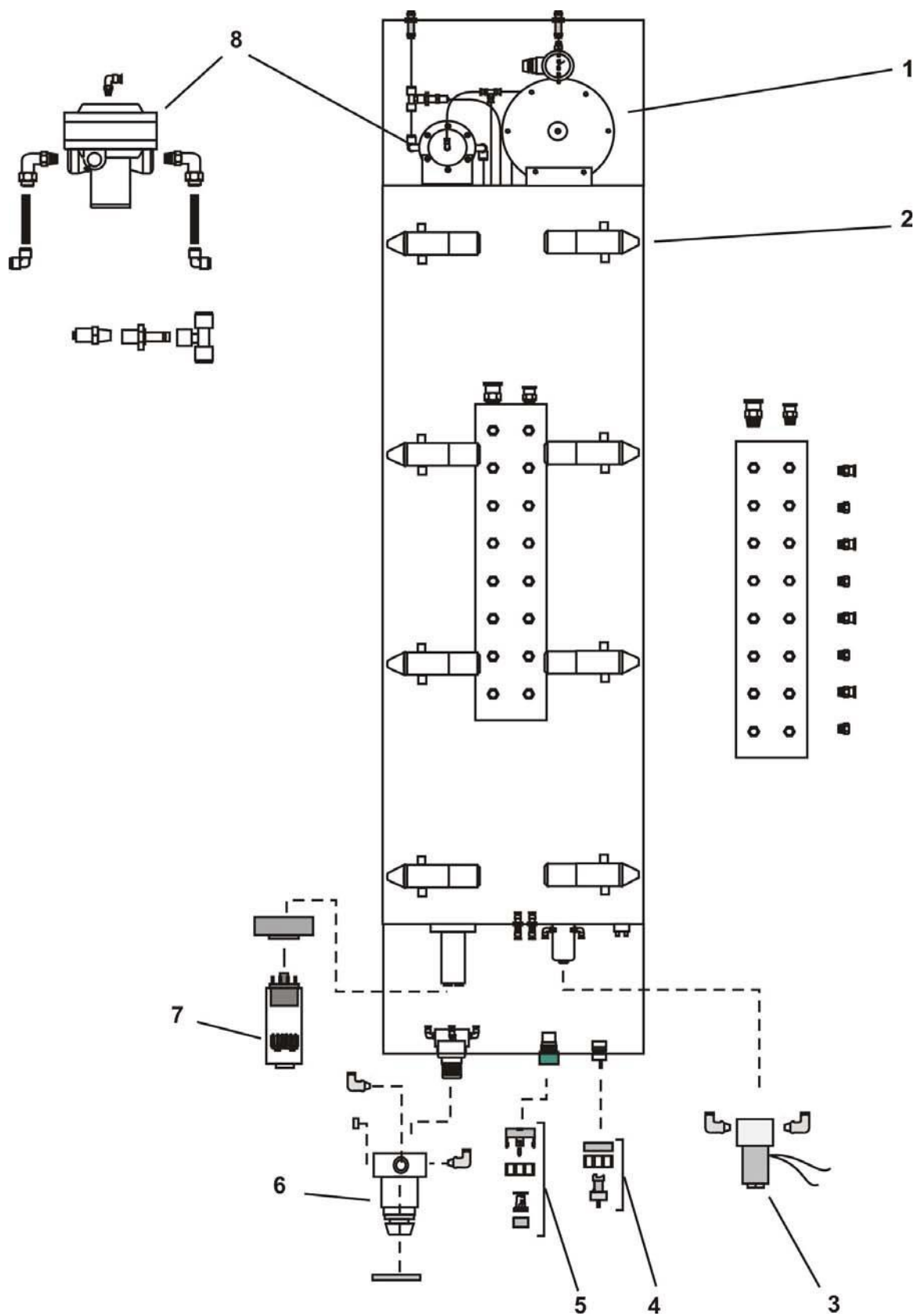


Figure 27: Octo Exploded View

Octo Spare Parts

Item	Part #	Description	OCTO			OCTO PLUS			OCTO PLUS Modulation		
			4	6	8	4	6	8	4	6	8
1	1608000*	Octo Vacuum Valve (See Figure 27)	1	1	1	1	1	1	1	1	1
2	1609209*	AFE Nozzle (See Figure 27)	4	6	8	4	6	8	4	6	8
3	1603064	3-Way Solenoid Valve 24 VAC Replacement Kit	0	0	0	1	1	1	1	1	1
4	1603020	On/Off Switch Assembly	0	0	0	1	1	1	1	1	1
5	1603021	Pilot Lamp Assembly	0	0	0	1	1	1	1	1	1
6	1603001	Air Regulator Panel Mount	0	0	0	1	1	1	1	1	1
7	1603050	Repeat Cycle Timer	0	0	0	1	1	1	1	1	1
8	1603112	Watts Pilot Air Regulator	0	0	0	1	1	1	1	1	1
Not Shown	1506260	E/P Converter	0	0	0	0	0	0	1	1	1
Not Shown	1603081	Pressure Sensor	0	0	0	0	0	0	1	1	1

* Denotes replacement for complete part, repair kits exist for these parts.

AFE Nozzle Exploded View & Spare Parts

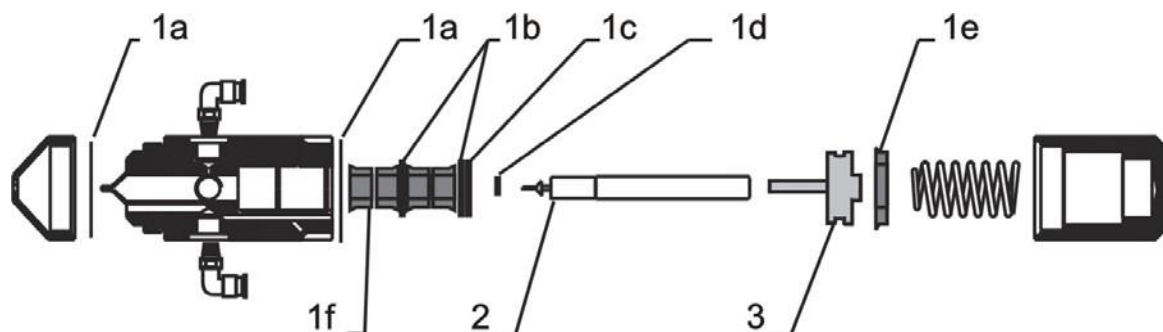


Figure 28: AFE Nozzle Exploded View

Item #	Part #	Description	Qty
1	1603120	AFE Nozzle Repair Kit	
1a		O-Ring Seal	2
1b		Flat Washer	2
1c		Retaining Clip SST	2
1d		O-Ring Valve Seat	1
1e		Piston Seal	1
1f		Rod Seal	4
2	1604040	Cleaning Needle	1
3	1604039	Piston	1

Vacuum Valve Exploded View & Spare Parts

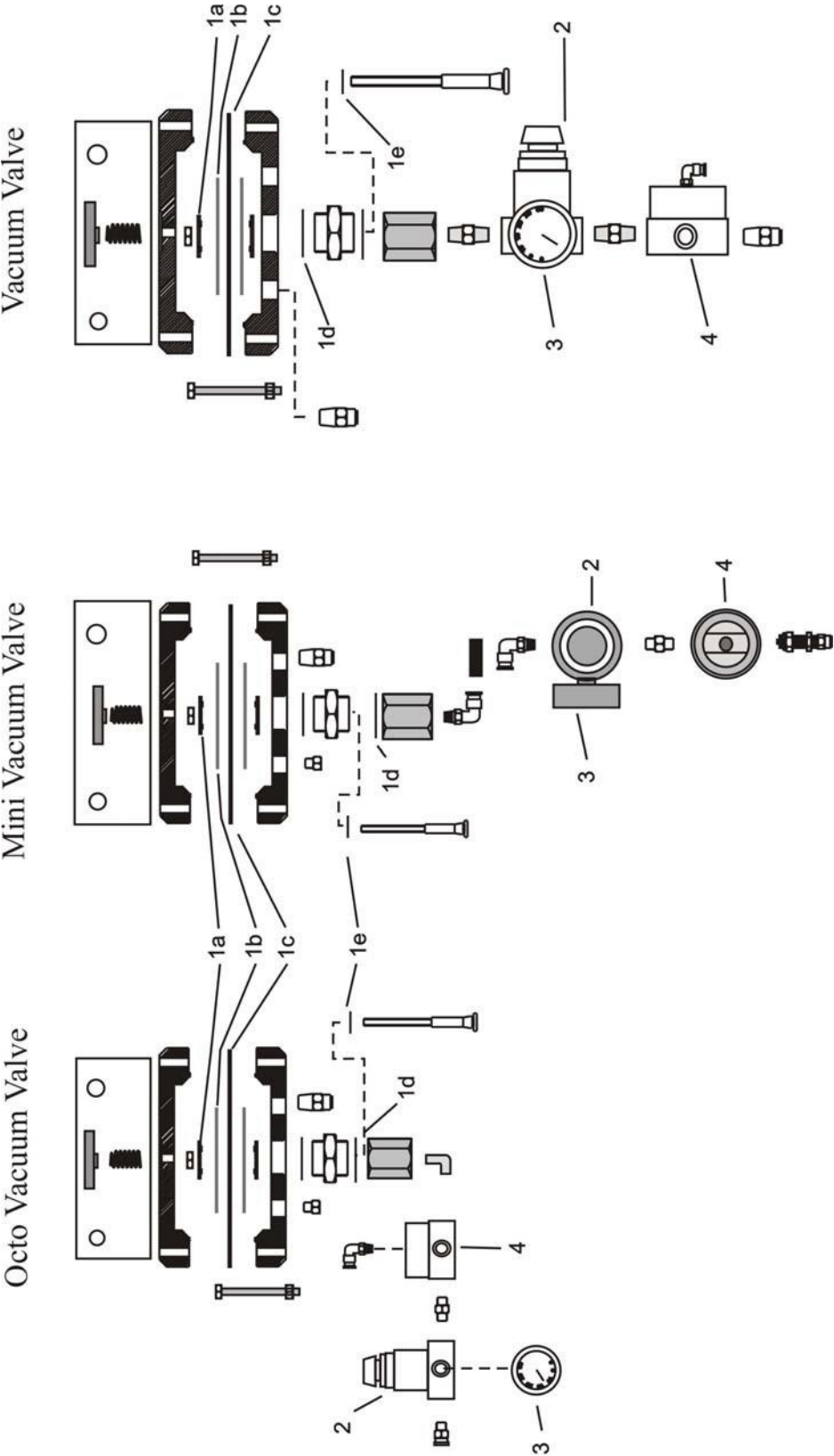


Figure 29: Vacuum Valve Exploded View

Vacuum Valve Exploded View & Spare Parts - Continued

Item #	Part #	Description	Octo	Mini	Standard
1	1603122	Vacuum Valve Repair Kit	1	1	1
1a		Washer Self Sealing	2	2	2
1b		Polypropylene Disc	2	2	2
1c		Diaphragm 1/16 Neoprene	1	1	1
1d		O-Ring Body Valve #118	2	2	2
1e		O-Ring	1	1	1
2	1603002*	Panel Mount Water Reg. 1/4" P	1	1	1
	1603119	Repair Kit for 1603002 Water Regulator	1	1	1
	1603114	Panel Mount Water Reg. 1/4" P SST for DI	1	1	1
3	1603008	Pressure Gauge 1-1/2" 1/8 CB 0-30	1	1	1
4	1603004*	Pilot Water Regulator, Brass	1	1	1
	1603110*	Pilot Water Regulator SST for DI	1	1	1
	1603116	Repair Kit for 1603004 Pilot Water Regulator, Brass	1	1	1
	1509351	Repair Kits for 1603110 Pilot Water Regulator, SST	1	1	1

* Denotes replacement for complete part, repair kits exist for these parts.

Control Panel Exploded View & Spare Parts

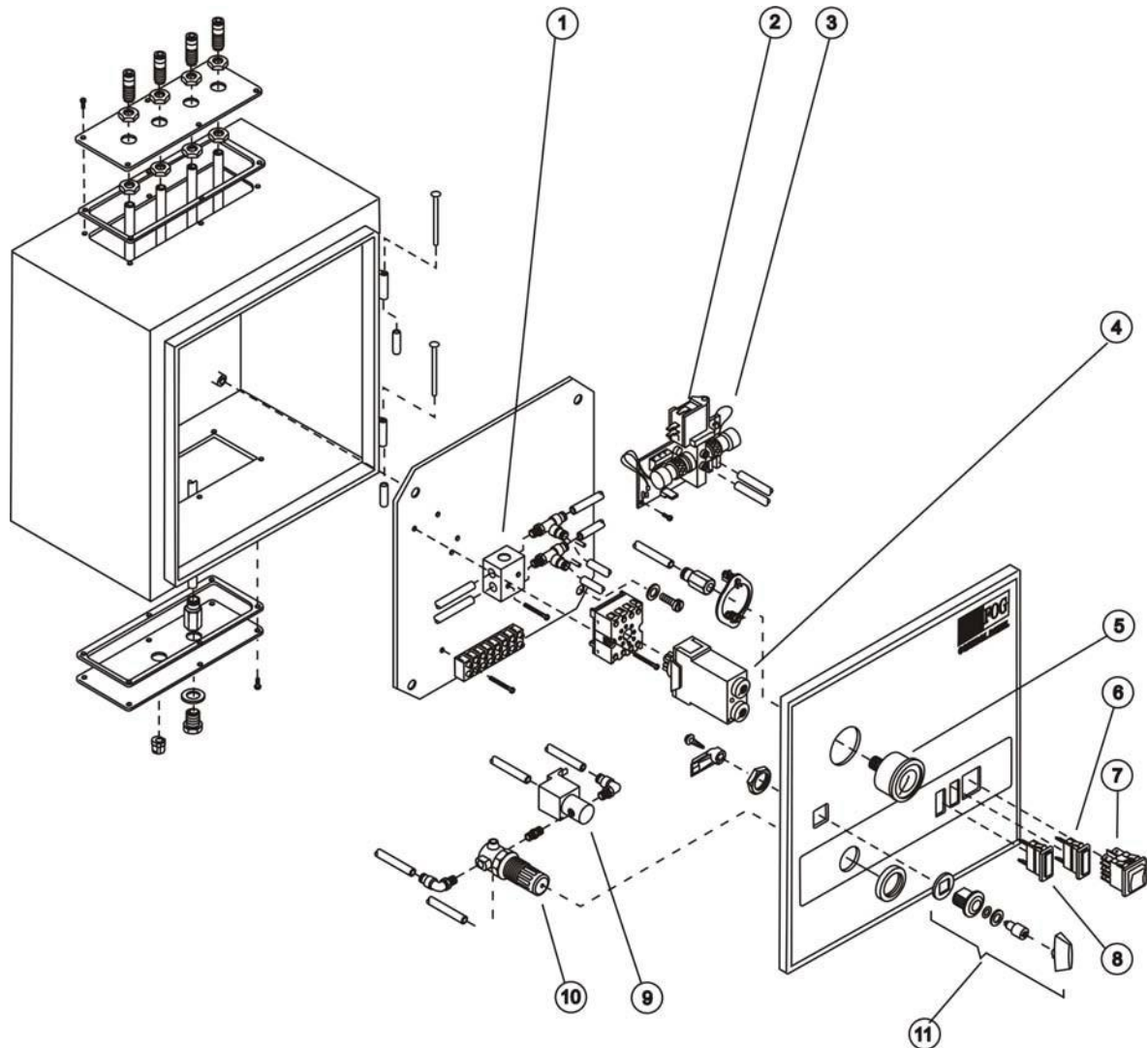


Figure 30: Control Panel Exploded View

Item #	Part #	Description	Qty	
			MINI I/II	AFE
1	1600027	Valve 4-way 24 Vac Solenoid	0	1
2	1603081	Pressure Switch, Screw-on (Modulating Control Panel Only)	0	1
3	1506260	E/P Converter Module (Modulating Control Panel Only)	0	1
4	1603050	Repeat Cycle Timer	1	1
5	1603200	Pressure Gauge Panel MTG Bars	1	1
6	1493096	Lamp Green Indicator	1	1
7	1453001	Switch On/Off	1	1
8	1603023	Lamp Amber Indicator	1	1
9a	1603063	2-way solenoid valve, 24 Vac (AFE mini models only)	1	0
9b	1603064	3-way solenoid valve, 24 Vac Replacement Kit (control panel only)	0	1
10	1603001	Air Regulator Panel Mount	1	1
11	1853104	Lock c/w 2 keys	1	1

Warranty

Nortec Humidity Inc. and/or Nortec Humidity Ltd. (hereinafter collectively referred to as THE COMPANY), warrant for a period of two years after installation or 30 months from manufacturer's ship date, whichever date is earlier, 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 the companies 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 makes no warranty and assumes no liability whatsoever for damage resulting from freezing of the humidifier, supply lines, drain lines, or steam distribution systems.

THE COMPANY makes no warranty and assumes no liability whatsoever for equipment that has failed due to ambient conditions when installed in locations having climates below 14 °F (-10 °C) during January or above 104 °F (40 °C) during July.

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

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