The Raring Corporation
TRC GROUP
ADS™ Dust Control Systems

2015

DUST SUPPRESSION SYSTEM

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Glossary

ADS^{TM}: Agglomerative Dust Suppression; the in-situ collection of dust through the use of four elements – *containment, application of fog, retention time and collection surface*.

Array: A grouping of 4-8 nozzles fed from a common water pressure control valve in a panel. A control panel may have more than one array.

Agglomeration: The collection or joining of fog and dust causing dust to gain in size and mass, therefore causing it to fall back to the source product.

Application of Fog: The crucial element in *agglomeration*; the sooner fog is applied, the more efficient the dust control.

Circuit: All components activate or controlled by a single MSCP. A circuit may include individual *nozzles*, *SCPs* and *IPTCs*.

Collection Surface: The dust suppression element upon which wetted dust attaches itself.

Containment: Critical element in dust control involving the enclosure of the points of dust generation.

DCS: Distributed Control System

DP: Distribution Panel

ECP: Electrical Control Panel; electrical panel used to communicate with the *PCS* and containing local logic control.

EIP: Electrical Interface Panel; electrical panel used to communicate with the *PCS.*

HMI: Human Machine Interface

HOA: Hand/Off/Automatic switch; used to select between remote operation, local operation or "off".

IP(XX**):** Ingress Protection; rating used to describe protection against intrusion of solid objects, dust, accidental contact, and water. "IP" is always followed by a number, for example: IP65.

IPTC: Inter-Panel Tubing Conduit; Conduit used to run air and water tubes from panel to panel.

JB: Junction Box

Micron: A unit of measure equal to one millionth of a meter. A human hair is about 100 microns in diameter. The *ADS^{TM}* system is most effective on 0-30 micron dust particles. Dust which is most harmful to human health measures 10 microns or less and is efficiently suppressed by the *ADS^{TM}* system.

MSCP: Main System Control Panel; Control panels housing primary flow control components, both hydro-pneumatic and electric.

NEMA: National Electrical Manufacturers Association; ratings used to describe electrical enclosure protection from elements.

NDP: Nozzle Distribution Panel; Control Panel normally containing only nozzle distribution components.

Nozzle Conduit: Carries multiple air and water tubes from the MSCP to an array of nozzles. A "tee" is placed in the Nozzle Conduit to branch off the tubing for the individual nozzle.

PCS: Plant Control System (also known as PAS – Plant Automation System)

P&ID: Process & Instrumentation Diagram

PLC: Programmable Logic Controller

PRV: Pressure Regulating Valve

Retention Time: Dust suppression element affected by enclosure size; the longer the dust is retained, the more efficiently dust is collected.

SCP: System Control Panel; General term for hydro-pneumatic control panel that includes *MSCP*, *SSCP* or *NDP*.

System: All the components associated with a common zone. The common zone may be defined by a filter skid, physical plant layout or some other unifying elements. A system includes associated circuits, MSCPs, SSCPs, IPTCs, nozzle connecting conduits and the nozzle arrays. A given site may include multiple discrete systems.

TRC: The Raring Corporation; the industry leader in *ADS^{TM}* fog based dust suppression systems.

Introduction

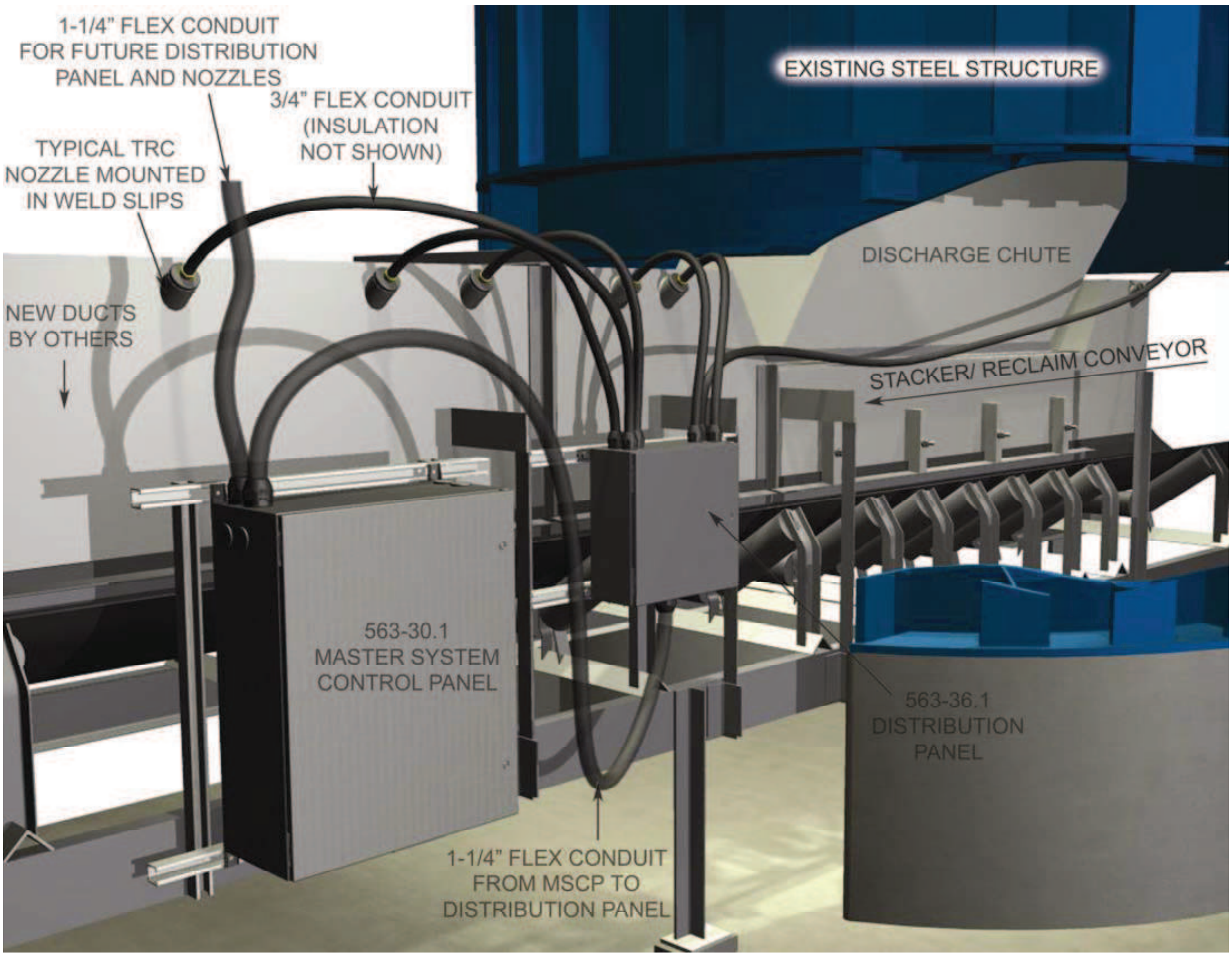
Thank you for purchasing an ADS™ fog based dust control system. We pride ourselves on creating the best and most reliable systems on the market today.

This manual will provide persons who install, operate, and maintain your TRC dust control system with information relating to:

- Operating principles of the systems
- Function and purpose of system elements
- Guidelines for installing the system that facilitate best operation and simplify maintenance
- Commissioning procedures that reduce operating maintenance problems
- Operational theory of the system controls
- Troubleshooting and maintenance procedures that insure the systems operate efficiently

Use this document in conjunction with the system drawings and individual component instruction manuals provided by the component manufacturers.

ADS™ Dust Control System – Typical Nozzle Installation



Theory of Fog

Background

Dust control systems are of two general types, passive and active. Passive systems technologies require no power to operate as seen in engineered chutes, stilling sheds, and large conveyor enclosures. Dust control systems which are permanently installed and which require little or no power can be classified as a passive system. In most cases, passive systems involve no moving parts.

Active systems require power to operate and remove dust from the air. Bag houses, electrostatic precipitators, wet scrubbers, water or chemical dust suppression systems, and fog systems are all examples of active dust control technologies.

Fog and Agglomeration

Fog removes dust from the air by agglomeration of like-sized water and dust particles. As the agglomerates become larger and heavier, they settle back onto the source material, and carry through the process without any special handling.

When water droplets are significantly larger than dust particles, the air displaced by the moving water droplet conveys the dust particle around the water droplet preventing collision and the resulting agglomeration.

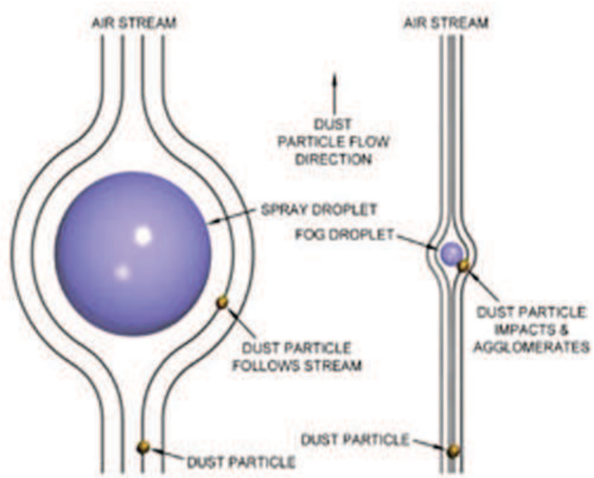


Figure 1 – Agglomeration

Application of Fog

ADS™ fog technology works in hot, cold, humid, and arid climates. The tiny water droplets do not freeze under normal cold weather conditions due to their small size, as clouds do not freeze. In hot, dry climates, the systems produce their own humid environment limiting the amount of evaporation and allowing the system to function efficiently.

Elements of Dust System Design

There are four key elements in the design of a highly functional dust control system:

Containment

The dust source must be contained or sealed to isolate the dust and fog from outside influences. This alone will reduce dust emissions significantly. The need for containment necessitates the presence of enclosures at transfer points, the use of walls and fences around dump pockets, enclosures over screens and bins, etc.

As you inspect your dust control systems, look for signs of compromised containment. Spillage under conveyors, holes in chutes, removed covers, and open doors are all breaches of a good containment system and result in reduced system efficiency.

Figure 2 - transfer point containment

Application of fog

A fog based system collects dust by the agglomeration (coming together) of airborne dust particles with airborne water droplets of like size. The sooner the fog attacks the dust, the faster the process. It is important, therefore, to project fog so that it blankets the dust source and begins the agglomeration process before the dust distributes into the larger volume and becomes harder to capture.

An efficient fog based system locates some nozzles in areas that are not, by themselves, dust sources such as in head boxes of conveyor transfers and above crushers. The fog from these nozzles projects or aspirates into a region of dust generation and facilitates the rapid agglomeration of dust.

Retention time

The third element in dust control is retention time. Dust particles must collide with water droplets several times to grow large enough to settle or attach to a surface; collisions and agglomeration are a matter of probability through time. Containment systems must be sized adequately to provide the retention time required for sufficient agglomeration.

Fog systems generally use larger enclosures than the enclosures used with conventional dust extraction or containment of ore on a conveyor. The larger enclosures used by fog systems increase retention time, and thus agglomeration and efficiency.

Collection surface

The fourth element, collection surface, describes any surface within the containment onto which wetted dust attaches itself upon impact. The containment walls and curtains inside the containment are examples of collection surface.

In summary, all four elements are both necessary and interactive; if containment is exaggerated so that very little dust is generated and there is an abundance of retention time, the quantity of fog can be greatly reduced and there may be no need for additional collection surface. If the quantity and projection of fog is exaggerated, there is less need for containment and retention time. But no amount of fog replaces all containment and no amount of containment replaces all fog.

Airtek Pneumatic ADS™ System

What follows is an overview of your system. There are three conveyors which are being addressed by the ADS™ system. The first is a 42" wide conveyor being serviced by a Master System Control Panel, a Nozzle Distribution Panel and six FP-10 nozzles. The second area consists of two 30" belts being serviced by a single Master System Control Panel, one Nozzle Distribution Panel each and four FP-10 nozzles each.

The Master System Control Panels will regulate the air and water pressure and will activate the system by means of solenoid valves located in their attached Electrical Interface Panels. The Master System Control Panels are insulated and contain a heater, the Nozzle Distribution Panels are insulated and heated by two loops of heat trace inside them and receive air and water from the MSCP by means of heated, insulated InterPanel Tube Conduit.

The Nozzle Distribution Panels should be located within 6 feet of the nozzles that they will service if possible. The nozzles serviced by the Nozzle Distribution panels are insulated and contain heat trace for freeze protection.

The nozzles should be located approximately as shown in drawing 563-10. One nozzle should be in the tail box portion of the conveyor enclosure, upstream of the loading chute. The remainder of the nozzles at each location should be mounted downstream and should project fog into the chambers created by the integrated baffles. By injecting fog upstream of the product discharge chute, we introduce fog at the earliest possible moment, allowing more time for the agglomeration process to work. Each of the following nozzles, in their own chambers downstream, will project fog into the airborne dust and will continue to scrub the air, eventually causing the dust to fall back to the source material.

This system has two operating modes: Active and Purge. When dust is present or potentially being generated, the system should be active and producing fog which projects into the loading zones and transfer points to begin the agglomeration process. When dust is not present and fog is not being called for, the system will be in the purge mode, in which a small amount of air will continually flow through the system, drying the nozzle tips to prevent freezing and ensuring a continual positive pressure to keep dust from plugging the nozzles.

Principal Components

The principal components of your dust control systems are;

- Fog nozzles to reliably produce fog of the right characteristics to capture and settle airborne dust.
- Mounting devices to locate nozzles where they are needed, to connect air and water sources, and to protect nozzles from damage and freezing.
- Hydro-pneumatic control panels to house air and water preparation and control devices and to distribute the controlled air and water to nozzles.
- Air and water supply systems
  - Water pumps and tanks
  - Air compressors and receivers
  - Water filtration and treatment systems appropriate to the quality of air and water available.
- Electrical control panels to house automation devices and terminals for interface to Plant Control System (PCS) and external system electrical control devices.
- Control system to automate operation

All of these components are required by every ADS™ system, although not all may be supplied by TRC.

Nozzles

Fog is produced using sonic-type air assist nozzles capable of producing water droplets in the <1 to 30 micron size range at practical pressures and flows. These nozzles atomize water by exposing it to high frequency acoustic shockwaves created as compressed air is accelerated to sonic velocity through the venturi. The resonator reflects the shockwave back into itself in such a way as to create a high-energy shock zone. Low-pressure water is introduced into the shock zone through a series of liquid ports entering the venturi.

The FP nozzle's spray characteristics are important factors in the performance of the ADS™ system and are controlled by adjusting air and water pressure. Air pressure defines the energy available for atomization. Water pressure with constant air pressure determines atomization quality.

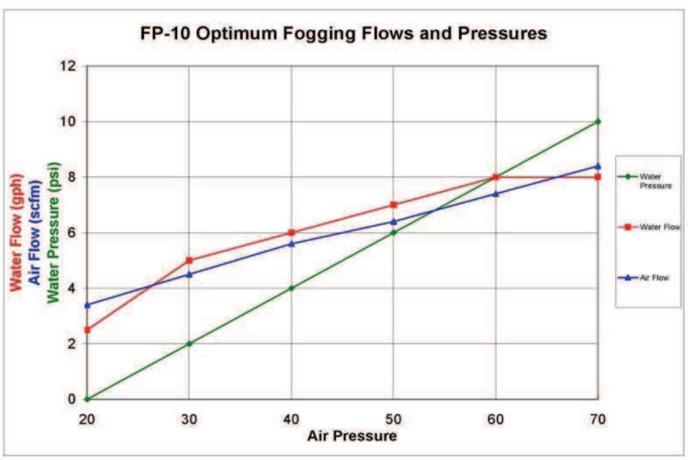


Figure 3 - FP-10 Flow Characteristics

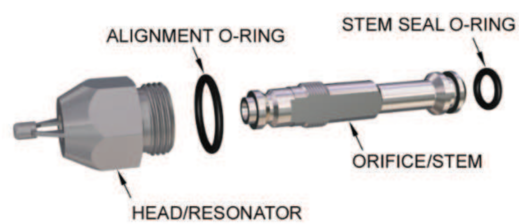


Figure 4 - FP-10 Assembly

Our FP series nozzles are usually operated at air pressures ranging from 35 psig to 70 psig (240 kPa to 480 kPa) and water pressures from 1-15 psig (7 kPa to 100 kPa), depending on the specific application and local conditions.

All fog nozzles in your system are our model FP-2. Flow characteristics are seen in Figure 3. The nozzles are constructed of 303 SS; care must be taken in handling the nozzles as the resonator is delicate.

Nozzle Mounting Devices

Fog Nozzles in Transfers

Fog nozzles installed in the enclosures at transfer points are installed using our nozzle connection conduits and weld holsters as seen in Figure 5. Weld holsters in conveyor enclosures should be as short as possible to minimize accumulation of compacted dust, which tends to bind the nozzle tube adapters in the holsters, and angled to encourage fog and dust mixing. These are a heat traced and insulated assembly of components including air and water tubes, heat trace wire, nozzle adaptor, and weld holster. See drawing 563-10 for general location of nozzles.

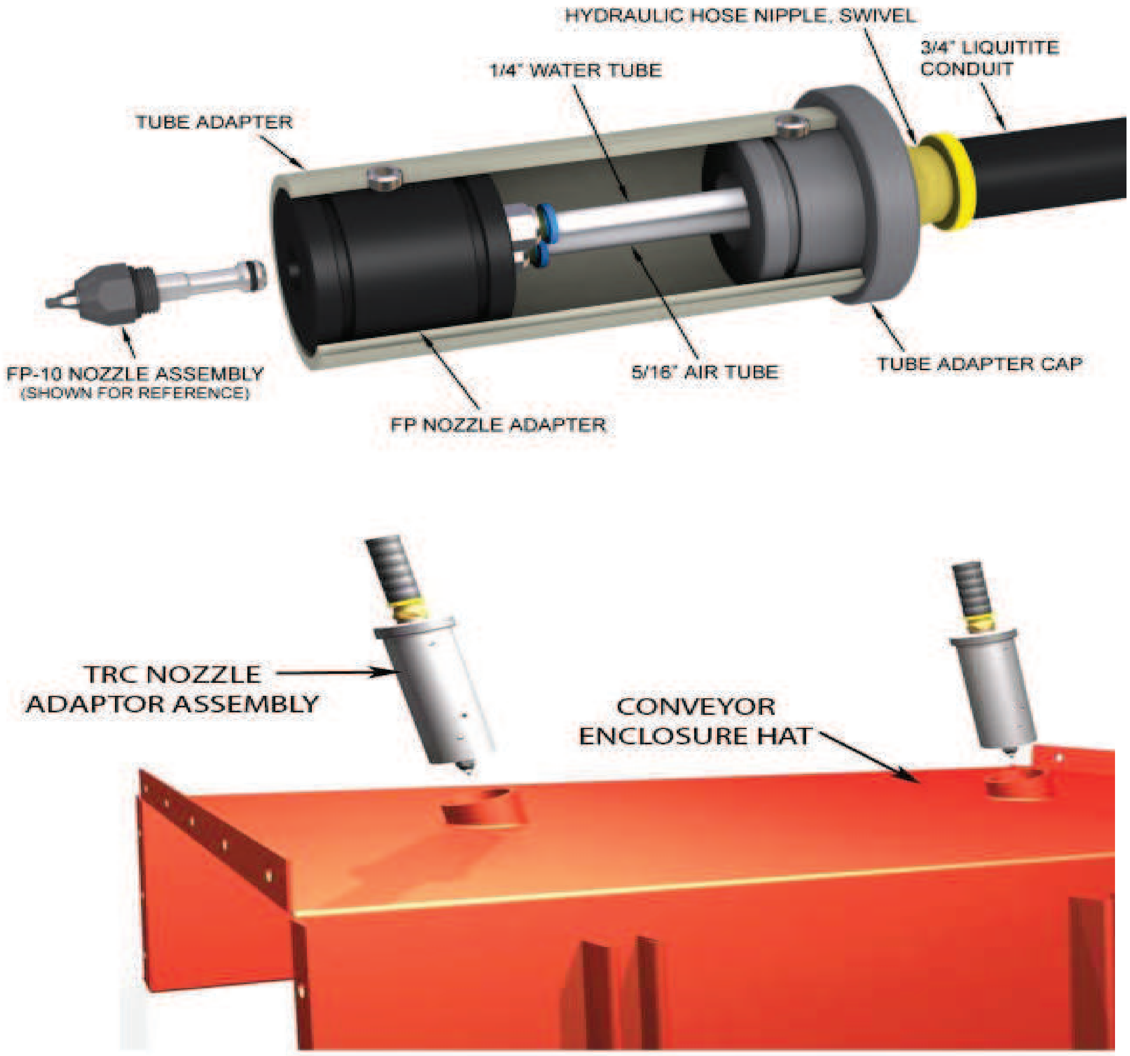


Figure 5 – Nozzle Weld Holster

Hydro-pneumatic (System) Control Panels (SCP)

SCPs house and protect hydro-pneumatic components of the dust control systems. Those panels that contain primary flow control components are referred to as Master System Control Panels (MSCP). They may also contain filtration, pressure regulation and other components. Panels that contain only nozzle distribution and/or secondary control components are referred to as Satellite Control Panels (SCP) or Nozzle Distribution Panels (NDP). Your system may contain one or all types of panels, depending on your application. The panels are designed to encourage and simplify maintenance and to insure that there is adequate control flexibility so that performance is optimized.

Master System Control Panels (MSCP)

Your MSCPs will be located near the conveyors that they service. ensuring that the Inter Panel Tube Cable run is as short as is reasonable. The MSCP will service the Nozzle Distribution Panels at the loading zones of the conveyors addressed by the ADS System. Refer to Figure 6.

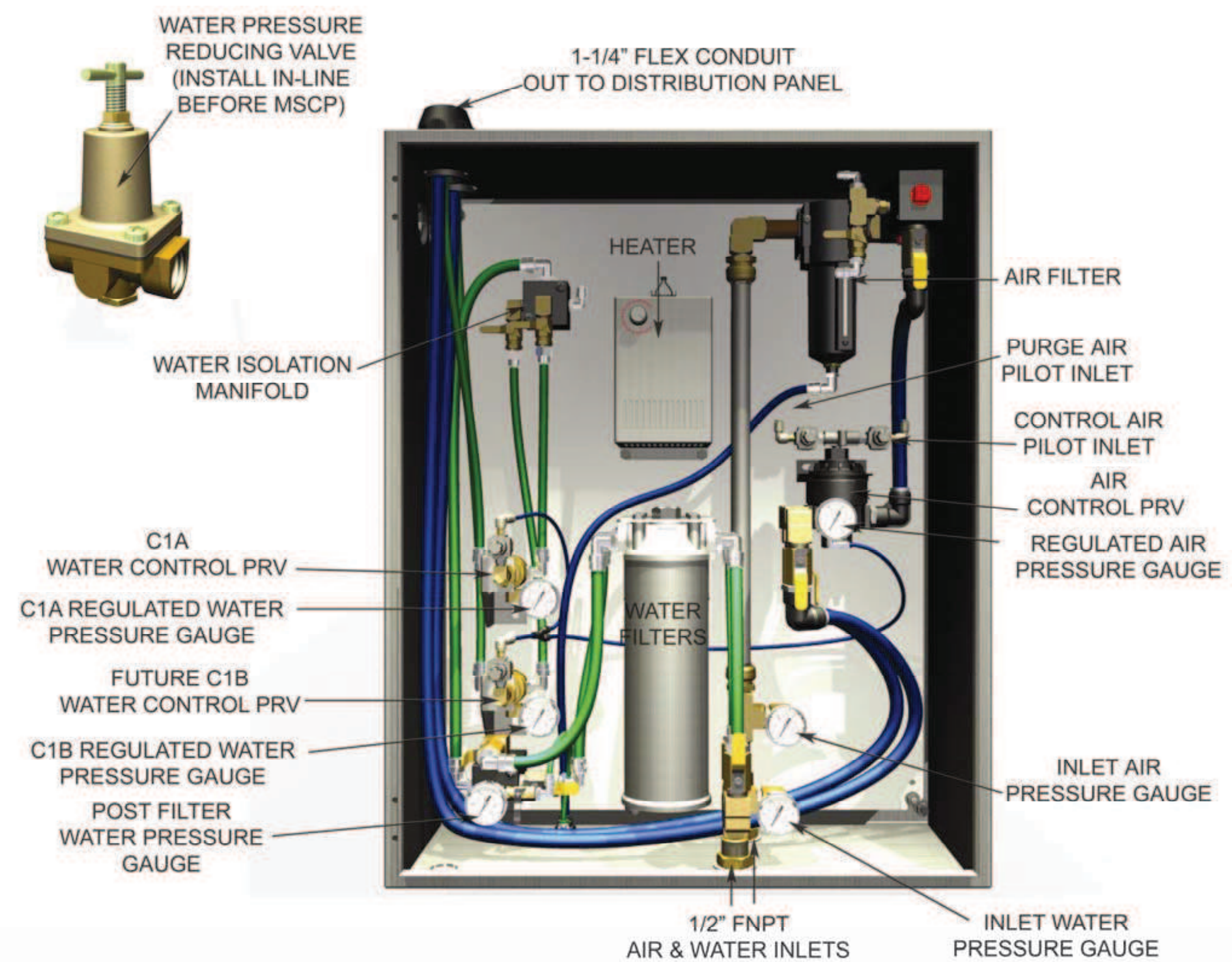


Figure 6 - Master System Control Panel

Your MSCP contains dual cartridge water filters, one air filter, one or two air pressure regulators, and two water pressure regulators to serve independent arrays of nozzles. A single array may have as many as 6 nozzles.

Water pressure is regulated to 60psig with an externally mounted Watts PRV.

Flow control for the air and water fog circuits is done using air piloted pressure control valves. See drawing 563-30 and 563-32 to identify make and model and the Component Manufacturers Instruction Manual section for details of operation and maintenance.

Nozzle Distribution Panels (NDP)

Air and water at controlled pressure are piped from the MSCP (above) to NDPs as seen in Figure 7. The water pressure is controlled locally by the piloted pressure regulator mounted in the MSCP. This panel contains distribution manifolds for air and water and individual nozzle isolation valves for each nozzle connection.

The panel is insulated and is heated by heat trace wire from the main panel and to the nozzles. The heat trace is turned on by the temperature switch located at the main system panel.

Air and water are delivered to the nozzle in plastic tubes housed in flexible conduit. In Figure 7, the blue line is air and the green line is water.

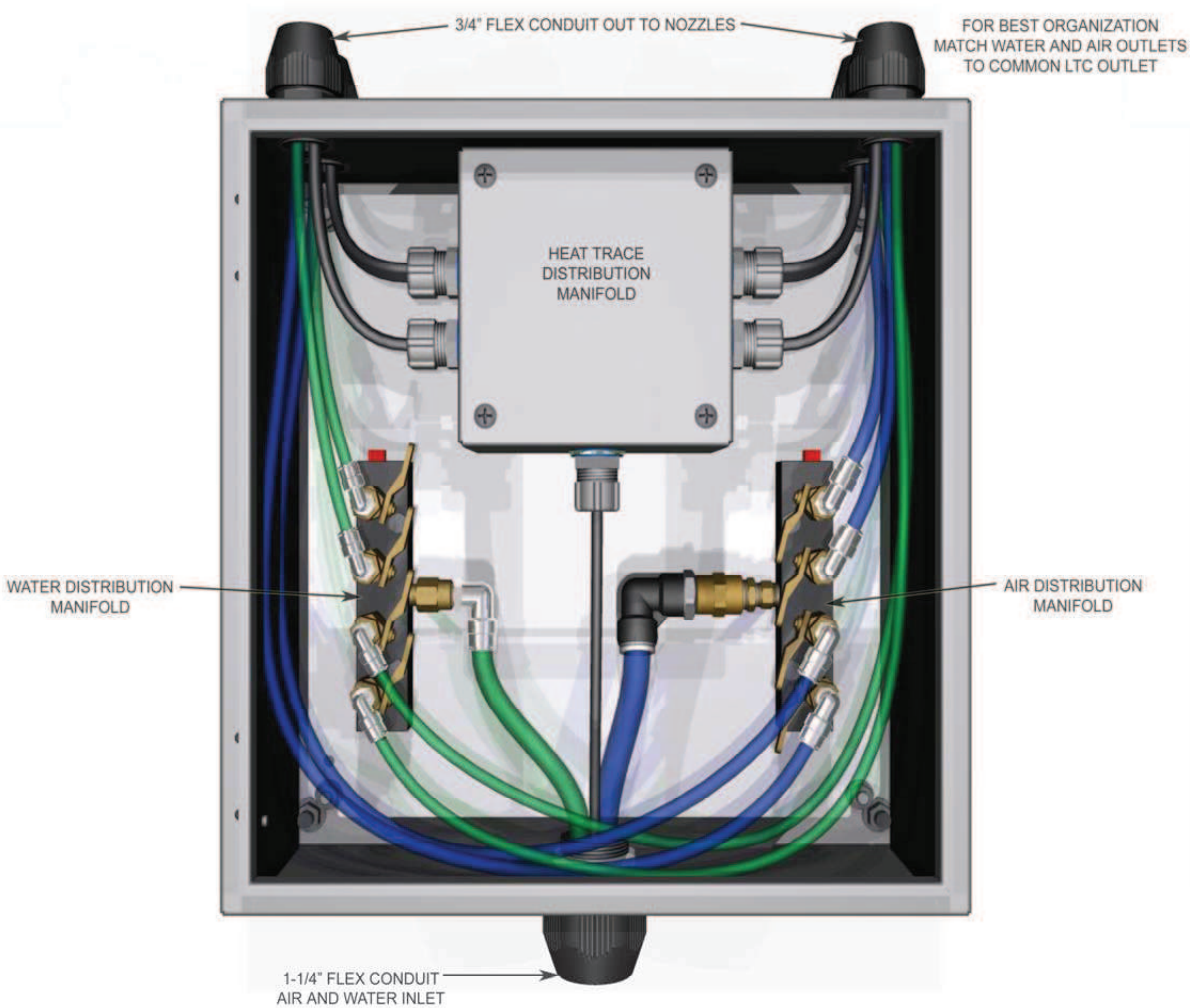


Figure 7– Nozzle Distribution Panel

Electrical Panels

Electrical Interface Panels (EIP)

Most ADS systems are controlled electrically in “Automatic” mode from a remote Plant Control System (PCS). Local operation elements are located in an Electrical Interface Panel (EIP). Your EIPs are mounted on each of the MSCPs. Please refer to drawing 563-25 and 563-26 for EIP layout and schematic details.

Your EIP is shown in Figure 8. It houses two illuminated Hand/Off/Auto (HOA) switches; one for the fog system and the other for the heat system. The HOA switches are used to select between remote mode, local mode and “off”. In addition to the HOA switches, your EIP contains air and water pressure switches which are used to alarm fault conditions and can return a signal to the PCS. Low air and water pressure lights mounted on the EIP door indicate the fault conditions. Other components in the EIP are the temperature switch, air control and purge control solenoids, heat trace terminals, relays and terminals and circuit breakers.

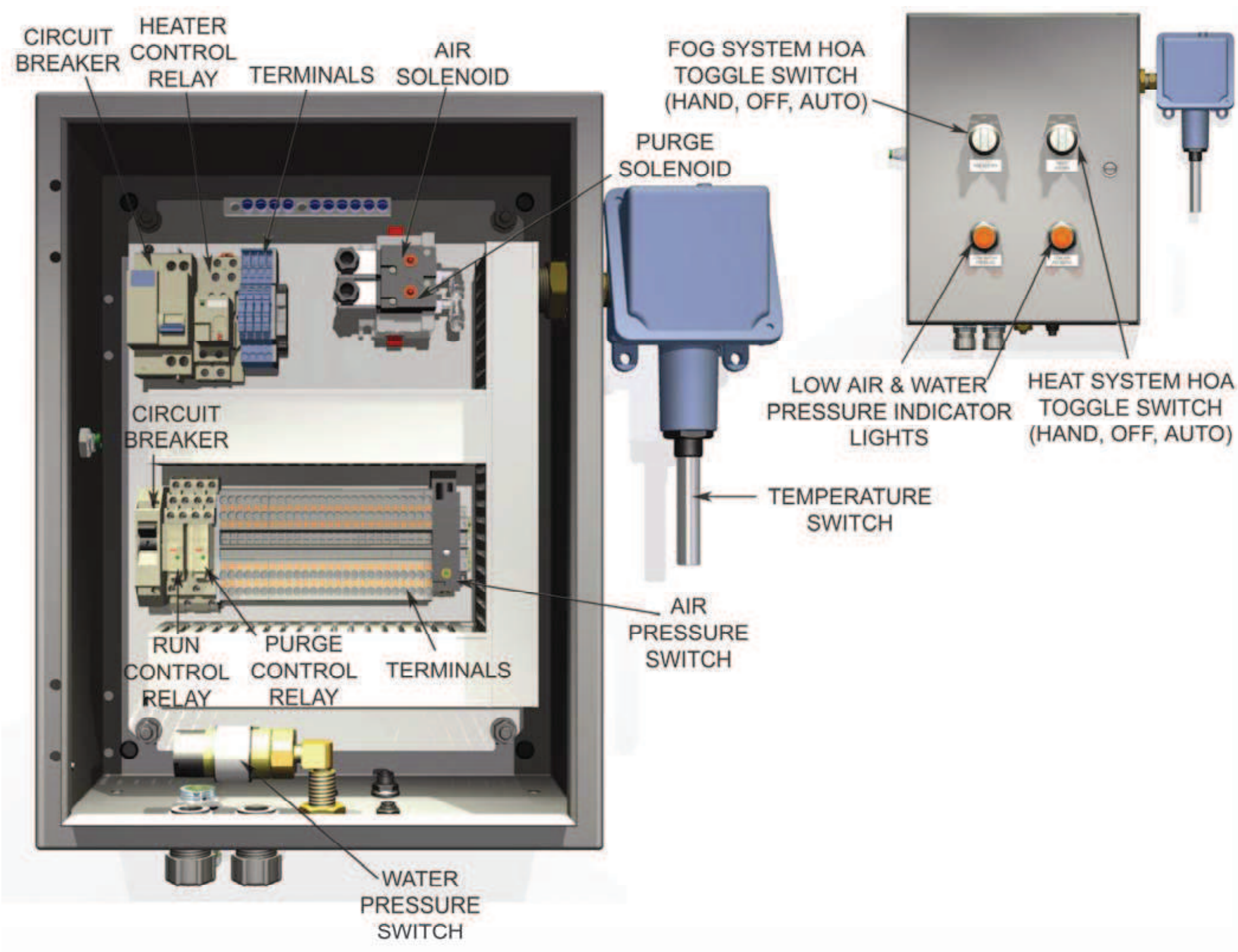


Figure 8 – Typical EIP

Installation Instructions

We assume that the installation contractor will utilize materials, methods, and practices that are appropriate to the site and approved by the project owner and project engineer. We further assume that they will strictly follow all regulations, both public and private, that apply to the work performed. In the event that there is a conflict between the instructions or recommendations contained in this manual and approved methods and practices, the approved methods and practices will take precedence.

This document is not intended as a detailed guide to installation. Please pay attention to the general guidelines below and insure that the installation is done in a neat and workmanlike manner.

Getting Started

Before beginning installation, we recommend that a thorough review of the locations of all TRC supplied equipment be conducted. If the installed location of any equipment was not detailed on TRC provided drawings or if any equipment must be moved from the locations that TRC selected due to physical or other considerations, new locations should be determined and submitted to TRC for approval. Improperly located equipment can negatively affect maintenance and performance.

If TRC or its representatives provide installation and commissioning service, we highly advise a pre-installation site visit to participate in this review.

General Installation Principals

Following is a list of general installation practices that will help insure minimum maintenance and optimum performance. Please follow these guidelines closely.

Installing Individual Nozzles

- Nozzles that are located where they may be subject to physical damage such as around a ship unloading hopper, ROM bin, or where maintenance activities might endanger them, must be properly protected from damage.
- Where nozzles must be located in areas of maintenance, provide an alternate home for the nozzle that is out of the way during periods of maintenance and protected from damage.
- Install nozzle mounting holsters so that the nozzle does not spray directly onto a stationary surface of the containment. This is especially important in cold environments where ice buildup will result in spray impingement on a surface.
- Install nozzle distribution panels so that nozzle connection conduit lengths are balanced between serviced nozzles.

Installing Control Panels

- Locate the MSCPs and EIPs in a temperature controlled environment whenever possible to minimize the risk of overheating or freezing components. Insure that panels that are not installed in a temperature controlled environment are properly specified to withstand the environment that they will be in.
- Insure that there is easy, safe access to all control panels and that there is adequate clearance to open the panel doors and service the components within.
- In cold climates, locate MSCPs where direct exposure to wind and driving rain or snow will be minimized. In hot environments, locate MSCPs in a shaded area where exposure to UV is minimized.
- Locate NDPs as close to the nozzles they serve as possible. We suggest that nozzles not be further than six feet (2 meters) from their distribution panel.
- Install branch shut off valves in air and water feed lines at each MSCP close to the point of entrance into the panel. Install a union between the shutoff valve and control panel connection to facilitate disconnection for line flushing and panel replacement.
- Insure that all panels are properly grounded, that wiring connections are correct and secure, and that fittings used to penetrate our electrical and system panels are of proper specification and installed so as to retain the NEMA rating of those panels.
- When terminating air and water tubing inside of system panels, route tubing more or less as is shown in the models of the equipment used in this document. In general, routing should be neat and should allow easy

visual tracking of tubes from their termination point to their destination. Numbering can be applied by the installer to identify tubes that pass from one panel to another if color coding is not adequate.

Installing Inter-Panel Tubing Conduit (IPTC)

Do not allow system panels, connecting piping, inter panel tube conduit or nozzle connection conduits to block pathways and work areas.

IPTCs carry air and water between control panels or to the Nozzle Tube Adaptor Assemblies. IPTCs are Liquidtite Non-Metallic Type B conduit containing polypropylene air and water tubes.

TRC recommends continuous support of the IPTC through the use of rigid pipe, cable tray, light angle, or channel into which the tubing conduit is laid. If continuous support is not feasible, conventional pipe or conduit support brackets are acceptable if the tubing conduit span is less than 6 ft. (1.8 m) for 1"or larger conduit or 4 ft (1.2 m) for ¾" or smaller conduit. The installer must prevent tight bends or kinks in the conduit both in the conduit layout and when handling the conduit. (See figure 9)

Figure 9 - Typical Neat Nozzle Installation using IPTC

- Refer to drawings to determine the components of each connection conduit. In general, conduits for nozzle connections contain one 5/16" air and one ¼" water tube and a heat trace wire. Conduits connecting panels generally contain larger tubing. Pulling long runs of connection conduit can be difficult. It is made easier by rolling out the conduit so that there are no bends and using a proper pulling tool and lubricant. In extreme cases, it is acceptable to cut the conduit into shorter lengths and join them using conduit couplings or pull boxes.
- Install the ArmaFlex closed cell insulation carefully and properly. Do not slit the insulation sticks to simplify installation, use lubricant and properly sized insulation instead. Glue the sticks together with the correct mastic. The ArmaFlex is sensitive to UV radiation. When insulation is exposed to sunlight, paint it using the correct, manufacturer recommended products.
- Provide adequate support point to avoid excessive sagging of the conduits. In areas of potential damage or in place of painting the insulation, run the conduits inside of oversized plastic or metallic conduit or pipe.

Installing Nozzle Tube Adapter Assembly

- Connect the Nozzle Adapter to the ¾" industrial hose, then pull the air and water tubes about 6 inches beyond the Adapter Tube Cap.
- Trim the 5⁄16" air tube and ¼" water tube to the same length and attach them to the appropriate fittings on the FP Nozzle Adapter.
- Gently press the adapter tube over the FP Nozzle Adapter onto the Adapter Cap twisting until the Spring Plungers in the Adapter Cap engage.
- Allow the slack in the air and water tubes to work back into the ¾" hose

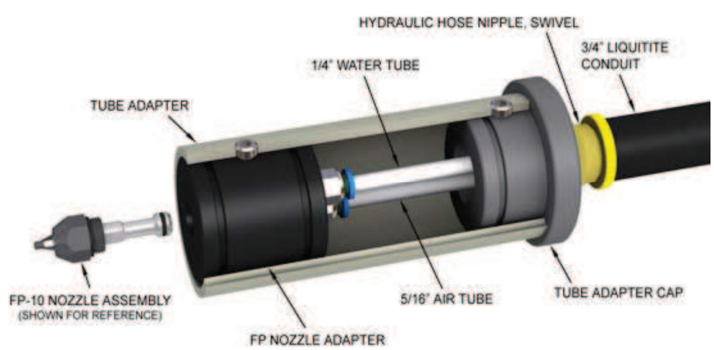


Figure 10 - Nozzle Tube Adaptor Assembly

Neat is Important

Make a neat, easy to service installation. Route air and water tubes and heat trace wires (if supplied) neatly through the system control panel. Make sure tubes from each nozzle associate with the same air and water valve position. Do not leave excessive tube or too little tube in the panel. Make nozzle connections as short as possible but easy to access. Support conduits but do not make them difficult to maneuver.

Preparation for Commissioning

Getting Started

Before beginning the process of commissioning the systems, we recommend that a thorough "final check" of the air, water, and electrical terminations and valve positions be made in all control panels. Improperly terminated tubes and wires and valves that are incorrectly open can cause damage upon energizing the air, water, and power circuits.

If TRC or its representatives provide commissioning service, they should be present from this time until the commissioning is complete and the systems have operated for a few days.

Do not energize air, water, or power circuits before conducting a thorough inspection of all control panels.

Wear proper hearing and eye protection and obey all other plant safety guidelines while performing the following procedures.

Before allowing air and water to enter the control panels and filter systems, the air and water supply lines must be thoroughly cleaned to remove any dirt, welding slag, scale, or other debris that may be in those pipes. Following are our recommended steps:

- Close all branch valves feeding air and water to all system control panels and filter systems.
- Disconnect the supply lines from the control panels.
- Turn on the air and water source valves to pressurize the air and water distribution piping.

CAUTION – RESPECT ALL SAFETY DIRECTIVES RELATIVE TO THE OPEN FLOW OF AIR AND WATER WHEN PERFORMING THIS STEP.

- Beginning at the first control panel or filter system along the distribution system, turn on the air and water branch valves and allow full flow for several minutes or until there is no further indication of contamination.
- Open the panel door and insure that all internal valves are closed. Reconnect air and water supply lines to panels and open the isolation valves to pressurize the control panels.

Main System Control Panel

Refer to drawing 563-30 & 563-32. Open the panel and insure that there are no leaks in the air and water circuits and that no air or water is flowing through the panel. Repair leaks before proceeding. Refer to specific valve catalogs for details on cleaning valves if there is flow through the system.

Before starting this process, place all circuit breakers in TRC supplied electrical panels in the off position.

Commission system control panels

1. *Test electrical operation*

    1. Activate each PCS controlled circuit and test for voltage response at the terminals in the EIP.
    2. If the voltage response is incorrect, troubleshoot the electrical panel and communication cables from the PCS.

With the air and water supplies flushed and all leaks repaired, the MSCPs pressurized on their supply side, all leaks repaired, and the electrical installation checked and functioning correctly, we will proceed to operating the systems in their manual mode to determine the correct operating parameters which will be used by the Plant Control System (PCS).

2. Flush control and nozzle circuits

Before connecting plant air or water supply lines to the control panels thoroughly flush the lines to ensure that all construction debris is removed and the pipes are clean. If connected, disconnect the air and water lines at the Nozzle Distribution Panel. Be sure the FP-10 Nozzle Assemblies are NOT installed in the Nozzle Tube Adapter.

1. Turn on all plant air and water valves.
2. Activate the air solenoids from the PCS (or manually if PCS is not used to control the ADS™)
3. Compressed air and water should now be flowing from the IPTCs attached to the MSCP. Adjust the air and water pressure regulators to achieve maximum air and water flow.
4. Allow the flow to continue for at least 10 minutes or until it is certain all construction debris is cleared from the system.
5. Close the air solenoids from the PCS (or manually if PCS is not used to control the ADS™). Connect the IPTC to the NDP and repeat these steps until all the system panels and Nozzle Adapters have been flushed.

3. Install the nozzles

1. With the air and water lines flushed up to the nozzle mounts and all leaks repaired and pneumatic manual control circuits operating correctly, we will install the nozzles, establishing and documenting correct operating setpoints, and teaching the PCS those values.
2. Installing fog nozzles requires no tools. The nozzles rely on “O” rings to seal and should be threaded only loosely into their adaptors. Install the nozzles but do not allow them to remain in a dusty environment. Leave the nozzle tube adaptors out of the enclosures if the conveyors are running with ore.

Do not use a tool of any kind!
Do not over tighten the nozzles in their adapters. Thread damage will result.

3. With all the fog nozzles installed and all isolation valves open, we will adjust the system pressures using the PRVs in the MSCPs and NDPs to settings that we visually judge to be proper for the application. A TRC representative should be present for this step.

4. Set Fog System Pressures

1. With the nozzles installed, open the air solenoid valves from the PCS.
2. Adjust the air pressure regulating valves in the MSCP to a base setting of 45 psig (310 kPa) and the water regulators to 4 psig (28 kPa).
3. Inspect the spray pattern for uniformity. It is always best to adjust nozzle performance visually rather than relying exclusively on the pressure gauges located on the regulators. Gauges are provided only as a rough setting device and are not absolute indicators of nozzle performance without visual confirmation.
4. Use the images in Table 1 of the Troubleshooting Section for guidance adjusting air and water pressure.

Operation

Manual Operation

Nozzles should not operate for more than a few minutes when equipment is not running or is running unloaded. Excess water may accumulate.

The EIP mounted on each MSCP has a selector switch for each circuit. Turn the selector switch counterclockwise to the HAND mode to activate the nozzle arrays associated to the MSCP and its satellite panels. Use the HAND mode to adjust air and water pressures while holding a nozzle where it can be easily seen.

Normal Startup and Shutdown

When PCS control is used, the PCS controls the normal operation of the ADS™. Little or no intervention by the plant technicians is required for the fog system's proper operation.

The selector switch on the Electrical Interface Panel for each circuit must be in AUTO mode.

The plant technician should monitor the low air and water pressure indicator lights. The corresponding pressure switch settings will be found on the system P&ID drawing. The indicator lights are on the cover of the Electrical Interface Panel.

The system selector switch must be in the AUTO mode for the PCS to start the fog system based on the initiating or secondary events.

Operating Logic

To be certain that the system is on when it is needed and off when it is not, we recommend that the operation of each circuit be dependent on three field inputs: (1) An initiating event (source), such as the operation of a conveyor that must be on for material to enter the process; (2) a dependent event (condition), such as the receiving conveyor operating, and (3) an interlock used as a system override such as a belt scale or position of a flow gate. Adjustable start and stop time delays should be associated with each event.

When purge air is used to prevent dust from migrating into the unused nozzles, the purge air solenoid should be energized whenever either of the systems in the MSCP is not turned on and any of the other systems on the same conveyor are on.

Emergency Shutdown

The PCS controls routine shutdown. To override the PCS and shut the Circuit down move the selector switch on the Electrical Interface Panel to the OFF position. Alternatively, shut the air and water isolation valves inside each Main System Control Panel.

The pump may be deactivated by pressing the Pump Stop switch.

Do not close water supply or discharge valves without disabling pump motor circuit.
Pump will be damaged!

Note that this is not a substitute for proper Lockout-Tagout procedures.

Maintenance

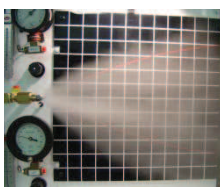
Maintenance of the ADS™ fog based dust control systems is critical to its ongoing performance. The primary points of maintenance are:

- Filters. Your system uses cartridge type water filters. We suggest that you change the cartridges every two weeks or as required by the condition of your water. See the water and air filter assembly models later in this section.
- Nozzles:
    - Repair or replace resonators worn out by abrasion or damaged human error or by impact with rocks or other equipment.
    - Clean nozzles that have become plugged due to scaling, dirt in the water supply, or dirt that migrates into the nozzles while they are at rest.

  See the nozzle performance troubleshooting and repair sections below.
- Regulating valves. Although there are PLC diagnostics that attempt to keep the regulators free of problems, they may collect dirt and require occasional service. See the Regulator repair section below.

Nozzle Performance Troubleshooting

Inspect nozzle performance at least weekly. In most cases, observation of the quality of fog produced is a good indicator of nozzle condition. Air and water pressure variations, resonator wear or damage, and plugging in and around the discharge area of the nozzle are the most common causes of poor performance. If filters are not maintained or if the nozzles are idle while the process is in operation, plugging of internal air and water passages may occur. Occasionally, the seal O-ring may become damaged allowing air to leak into the water passage cutting off water flow.



1 - FP-10 on test stand.

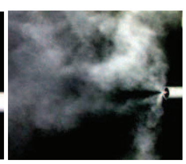
2 - FP-10 in service.

3 - High Air/Water ratio.

4 - Low air pressure

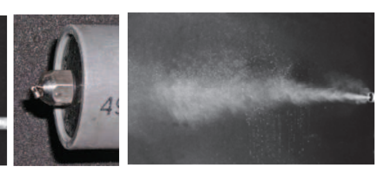
5 - Missing or damaged seal O ring. Replace.

6 - Missing resonator.



7 - Plugged liquid port.

8 – Slightly bent resonator.



9 - Badly bent resonator. Replace.

Table 1 - Nozzle Performance

Cleaning and Repairing Nozzles

When a plugged or damaged nozzle is discovered, turn off the nozzle or nozzle box using the isolation valves in the distribution panel, replace the nozzle, and turn the air and water back on as soon as possible. **Do not leave a nozzle adaptor open in a dirty environment.**

Repair a bent resonator with needle nose pliers. Repair plugged or worn-out nozzles in a clean area. First wash the malfunctioning nozzle in soapy water or solvent prior to disassembly.

Remove the orifice/stem by unscrewing it from the head. Inspect the head and resonator for signs of wear and replace if the resonator legs are badly worn.

Clean the inside of the head and the outside of the orifice with a stiff brush or cloth. Clean the liquid ports and air passage with a torch tip cleaner or small wire. If there is a hard scale buildup, soak the nozzle parts in vinegar or other mild acidic solution and brush well.

Replacing the seal O-rings every time you repair the nozzle is inexpensive insurance that they are in good condition. Lubricating the O-ring with water is good practice. Test nozzles after rebuilding.

Store the rebuilt nozzle in a “bubble” type plastic bag to prevent damage and to keep it clean during storage and transport.

Fixing Leaks

It is important to repair any air or water leaks in control panels immediately. Leaks may result from excessive vibration, freezing, or errors in reassembly of components after repair.

The most common leak condition occurs at quick connect tube fittings. The keys to avoiding leaks at these fittings are:

- Cut the tubing with a sharp knife or tubing cutter so that the tubing is not flattened.
- Be sure the cut is square and not at an angle to the tube.
- When pushing the tube into the fitting, make sure it is fully seated.

If you have difficulty getting a tight connection, trim the end of the tube or replace the tube run. If that fails, replace the quick fitting.

Leaks around brass fittings screwed into plastic manifolds should be repaired by removing the fitting and applying Teflon tape. Over-tightening will strip the threads or split the manifold.

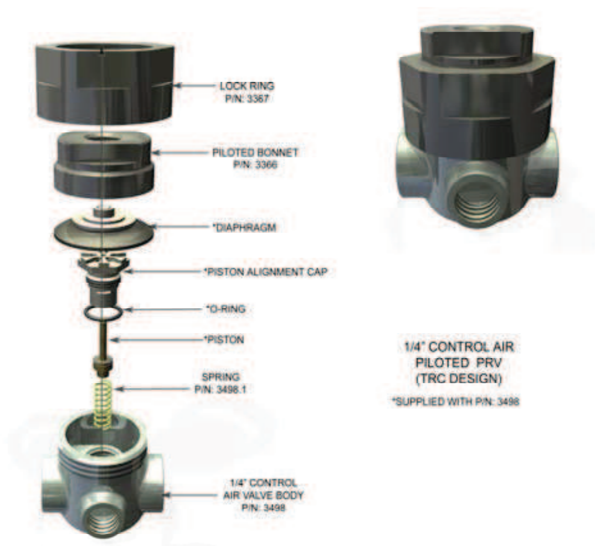
Leaks at a joint with gasket in valves and filters should be repaired by replacing the flat gasket or “O” ring.

Tightening can repair leaks at brass to brass fitting joints but do not apply excessive torque to any other joints. Our panels are designed so that brass assemblies can be easily removed if repairs are necessary.

Pressure Regulator Maintenance

Your system contains four models of pressure regulating valves. Following are comments regarding maintenance. Instructions are included or available on-line from their manufacturer's web site.

Part #	Description	Location	Maintenance Comment
1347.1	Valve, PRV, Water, 1/4", Air-Piloted, Norgren, 11-111-051	Master System Control Panel	Possible pluggage and diaphragm damage. Disassemble, clean, reassemble
3690	Valve, PRV, Water, Watts, 1/2-26A-C, 1/2", 10-125 psi	Master System Control Panel	Possible pluggage and diaphragm damage. Disassemble, clean and install repair kit.
1404	½" Parker model 11R piloted air pressure control valve	Master System Control Panel	Possible pluggage and diaphragm damage. Disassemble, clean, and install repair kit.
3488	5mm SMC spring loaded pressure regulating valve	Master System Control Panel	Maintenance unexpected. Replace if malfunction.



Solenoid Valve Maintenance

Your system contains one style of solenoid valve.

Part #	Description	Location	Maintenance Comment
1254.1	Valve, Solenoid, Pilot, Humphrey's, Valve Mod 120VAC, 3/2 NC	Electrical Interface Panel	Maintenance unexpected. Replace valve is malfunction

Electrical and Miscellaneous Components

There are a few other components that will require occasional maintenance, most notably the instrument air dryers that require annual replacement of their drying element.

Part #	Description	Location	Maintenance Comment
2118	Heater, Hoffman, DAH4001B, 400 Watts, 115V	MSCP	Possible burn-out or fan failure. Replace when failed
0343	TRC pressure gauge, 1-1/2", 0-100 psig, 1/8" back mount	MSCP	Maintenance is not expected for many years unless over pressured. Replace when failed. Specify range
0834	Gauge, Pressure, 0-160#, 1.5", Liquifill	MSCP	Maintenance is not expected for many years unless over pressured. Replace when failed. Specify range
0037	TRC pressure gauge, 1-1/2", 0-100 (0-30) psig, 1/8" back mount	MSCP	Maintenance is not expected for many years unless over pressured. Replace when failed. Specify range

Troubleshooting

Problem	Possible Cause	Remedy
Water pressure high	Water pressure regulator incorrectly set	Adjust regulator
	Water pressure regulator malfunction	Clean or replace water pressure regulator
Water pressure low	Water pressure regulator incorrectly set	Adjust Regulator
	Water pressure regulator malfunction	Clean or replace water pressure regulator
	Water filter fouled	Clean water filters
	Electrically operated water solenoid valve malfunction	See electrically operated air/water solenoid valve malfunction section below
	Manual water valves closed or only partially open	Open manual valves
	System water leak	Repair leak
Electrically operated air/water solenoid valve malfunction	Burned out coil	Replace coil
	No coil power	Trouble shoot electrical system
	Valve plugged	Clean, repair or replace the valve
Air pressure high	Air pressure regulator malfunction	Clean, repair or replace the air regulator
	Air pressure regulator malfunction	Adjust regulator
Air pressure low	Air filter is fouled	Drain accumulated liquids Clean/replace filter element
	Electrically operated air solenoid valve malfunction	See electrically operated air/water solenoid valve malfunction section below
	Air leak	Repair leak
	Air pressure regulator malfunction	Repair or replace air regulator
	Manual valves closed or partially open	Open manual valves

Inspection Report

ADS™ INSPECTION REPORT FORM			
Panel Tag #: _______________________		Date: _________________________	
Number of Operating Nozzles: ____________		Inspector: ________________________________	
Operating Pressures		Leaks	
Air	Water	Air	Water
Reg. 1: ________	Reg. 1: ________	Yes: ______ No: ______	Yes: ______ No: ______
	Reg. 2: ________	Repair Date: _________	Repair Date: _________
	Reg. 3: ________	Repair By: ___________	Repair By: ___________
Observations About Nozzle Operation:			
Observations About Panel Condition:			
Panel Tag #: _______________________		Date: _________________________	
Number of Operating Nozzles: ____________		Inspector: ________________________________	
Operating Pressures		Leaks	
Air	Water	Air	Water
Reg. 1: ________	Reg. 1: ________	Yes: ______ No: ______	Yes: ______ No: ______
	Reg. 2: ________	Repair Date: _________	Repair Date: _________
	Reg. 3: ________	Repair By: ___________	Repair By: ___________
Observations About Nozzle Operation:			
Observations About Panel Condition:			
Panel Tag #: _______________________		Date: _________________________	
Number of Operating Nozzles: ____________		Inspector: ________________________________	
Operating Pressures		Leaks	
Air	Water	Air	Water
Reg. 1: ________	Reg. 1: ________	Yes: ______ No: ______	Yes: ______ No: ______
	Reg. 2: ________	Repair Date: _________	Repair Date: _________
	Reg. 3: ________	Repair By: ___________	Repair By: ___________
Observations About Nozzle Operation:			
Observations About Panel Condition:			

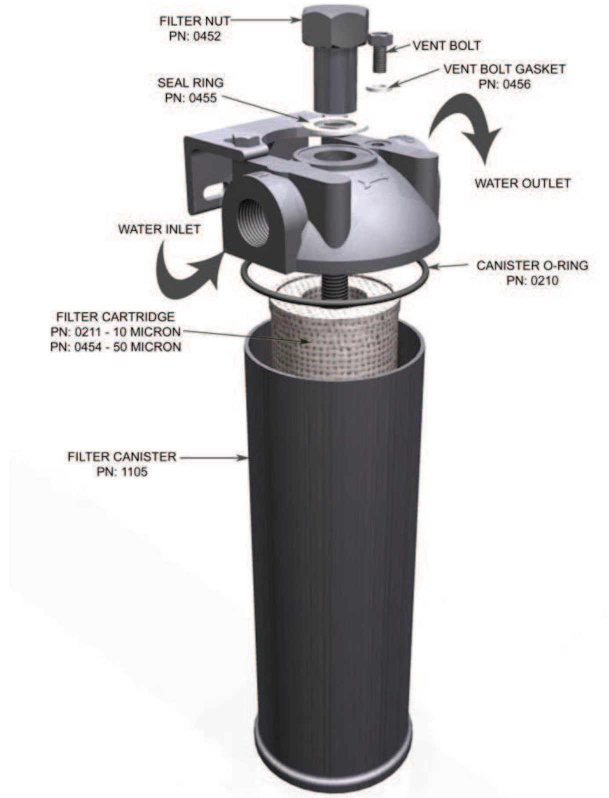
Spare Parts List

The Raring Corporation ADS Dust Control Project Spare Parts List		
Customer: Airtek Pneumatics		
Project Reference: 0328-13		
Engineering House: Enviro Handling		
Part Number	**Description**	**Qty Req'd**
0122	Switch, Pressure, UE, 1/8"npt, D11, Hard Wired, 10-150 PSI	1
0399	Switch, Pressure, Joucomatic, 15-115psi range	1
1254.1	Valve, Solenoid, Pilot, Humphrey's, Valve, 3/2 N.C., 120v	1
0454	Filter, Water, Cartridge, 50 Micron, Wound, SL804B	4
1404	Valve, PRV, Air, 1/2", 11R, Air Piloted, Parker	1
1347.1	Valve, PRV, Water, 1/4", Air-Piloted, Norgren, 11-111-051	1
3488	Valve, PRV, Air, 5mm, SMC, AR10-M5	1
3741	Valve, Shuttle, 1/8, SMC VR1210-N01	1
0107	Valve, Ball, 1/2", SMC	1
0377	Valve, Ball, 1/4" SMC	1
0834	Gauge, Pressure, 0-160#, 1.5", Liquifill	1
0343	Gauge, Pressure, 0-100# 1.5", Liquifill	1
0037	Gauge, Pressure, 0-30#, 1.5", LiquiFill	1
1116.1	Manifold, Air/Water Nozzle Distribution, 6-pt, Universal	1
0103	Valve, Ball, 1/8", SMC	1
0462	Valve, Check, 1/4", Brass, FxM, SMC	1
0843.2	Nozzle, FP10, Assy, 303SS, Head/Res, Orifice/Stem	1
0285.5	Manifold, Air/Water, Dist, Delrin, 2x2x1-3/4,4@1/4",1@1/2"	1
0285	Manifold, Air/Water, Dist, Delrin, 2x2x1-3/4,4@1/4"	1
0284.1	Manifold, Air/Water, Dist, Delrin, 2x1.75x4.5,5@1/2",1@1/4"	1
3690.1	Valve, PRV, Water, Watts, 1/2-26A-C, Repair Kit	1

ADS System Filters

Water Filter Repairs and Media Replacement

TRC Canister Water Filters (if equipped)



Replace the water filter cartridges when pressure drop across the filter exceeds 3 psig during operation or when the cartridge appears dirty through its full cross section. To inspect or replace the cartridge:

- Close the water inlet and outlet valves.
- Drain pressure and water from the drain valve at the bottom of the filter canister.
- Loosen the filter nut and wiggle the filter canister to break seal between the canister and canister head. Additional water may run out through the drain valve.
- When the water stops, loosen the filter nut and remove the canister and filter cartridge.
- Be careful not to allow clumps of dirt to leak by the element when reassembling. Always rinse the inside and outside of the element and the housing before reassembling.
- Replace the cartridge if rinsing does not clean the old cartridge sufficiently. Fine sediment will migrate into the media over time and will not wash out.
- Assemble the filter in reverse order to its disassembly.
- Open the inlet and outlet valves and look for leaks.
- Replace sump and seal O-rings when leakage appears.

Keep adequate filter cartridges and O-rings in spare part inventory.

Air Filter and Regulator Repairs

Air Filters: Norgren F74

The Norgren F74 air filter incorporates an automatic drain device intended to keep condensates below the top of liquid level lens. The device does malfunction occasionally and requires replacement or repair.

Clean or replace filter element when pressure drop across element exceeds 0,7 bar (10 psig).

The filter can be disassembled and repaired without removal from the airline as follows:

- Shut off inlet pressure. Reduce pressure in inlet and outlet lines to zero.
- Disassemble in general accordance with the exploded view. Do not remove the drains unless replacement is necessary. Remove and replace only if they malfunction.
- Clean parts with warm water and soap.
- Rinse and dry parts. Blow out internal passages in body with clean, dry compressed air. Blow air through filter element from inside to outside to remove surface contaminants.
- Inspect parts and replace those found to be damaged.
- Lubricate o-rings with o-ring grease.
- Assemble filter as shown on the exploded view.
- Screw baffle onto center post until contact is made with the filter element, then ¼ turn more.
- Push bowl assembly into the body and turn fully clockwise

F74 Air Filter

Size	P/N:	Seal & Gasket Kit P/N:
1/2"	0085	0367
3/4"	0369	0367

Caution: If filter components were broken or assembled improperly, they may come apart when the system is pressurized. Personal Injury may result.
Shut the SCP door and stand clear of the panel as the system pressurizes.

Keep air filter repair kits and elements in spare part inventory.

Attachments

Humphrey's solenoid valve data sheet

Joucomatic air pressure switch data sheet

United Electric temperature switch data sheet

United Electric water pressure switch data sheet