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Revision E

Product Manual

AUTOMATIC PRESSURIZATION DEHYDRATOR
APD-D Series

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1 WARNINGS, CAUTIONS & NOTES

NOTE: Read this manual before installation or operation of the dehydrator.

NOTE: Removing the unit's cover will void the warranty.

W A R N I N G

The APD-D series dehydrators are not compatible with single-phase systems utilizing two Line conductors and one neutral conductor (such as North American 240VAC service). Earth ground must always be connected.

The APD-D series dehydrators are designed for 120/230VAC use at 50/60Hz. The AC Mains configuration must be **1/N/PE**, meaning 3 conductors:

1.) **[1]** Single phase Line power. (wire color: black or brown)
2.) **[N]** Neutral (phase return) tied to Earth ground at the local power panel. (wire color: blue or white)
3.) **[PE]** Protective Earth ground. (wire color: green with yellow stripe or green)

Hazardous voltages exist inside the unit. Unplug the power before servicing.
Do not energize or operate the unit with the lid removed.

The unit starts automatically when power is applied. Do not operate unit without cover secured properly in place.

2 INSTALLATION

2.1 System Purging:

Proper purging of the site's distribution system prior to dehydrator installation is important. Failure to do so may result in moisture being present in the system when the dehydrator is installed. This moisture will remain in the system until the dehydrator's normal operation purges it from the system.

If the purging is left to normal operation of the dehydrator, then the process may take days, weeks, or longer depending on the dehydrator's installed options, system size, moisture levels, and other variables. If configured, humidity alarms may result until the humidity is purged from the system.

Manually purging the pressure from the system every 24 hours and letting the dehydrator refill the system with dry air can accelerate the moisture removal process.

2.2 Flow Restrictions:

Care must be taken to ensure that no flow restrictions exist in the site's pressurized dry air distribution system. Small restrictions can cause pump times to be shorter than calculated, unit duty cycle to increase, and system upper operating pressures to be reduced.

Large restrictions can cause continuous cycling of the dehydrator, which can cause issues in the waveguide or cable system and will significantly reduce the performance and service life of the unit.

2.3 Installation Location:

The dehydrator is designed for free-standing operation on its vibration isolating rubber feet. The dehydrator should be placed on a firm, level surface. An accessory wall / rack mount shelf is available for alternative mounting methods and locations.

The APD series dehydrator requires a minimum of 2" clearance on the sides and top for proper heat dissipation.

2.4 Installation Procedure:

2.4.1 Ensure that the site's distribution system has been properly installed, purged with Nitrogen and sealed.

2.4.2 Unpack the dehydrator in the environmentally controlled location where it will be installed. Place the unit on a flat, stable surface.

2.4.3 Make sure that nothing is connected to the dehydrator's output fitting.

2.4.4 Energize the dehydrator and let it run with nothing connected to the dry air output fitting for 3-5 minutes.

2.4.5 At this point the only indicators illuminated should be POWER, COMPRESSOR and LOW PRESSURE.

2.4.6 De-energize the dehydrator and install it in its final location.

2.4.7 Connect the dehydrator's output to the site distribution system using a properly sized section of supplied 3/8" tubing.

2.4.8 Open all necessary distribution system valves and energize the dehydrator.

2.4.9 The dehydrator will pressurize the distribution system. Monitor the time it takes to pressurize the system. If the unit run time alarm option is configured, then verify that the run time alarm setting is above the unit's measured run time.

2.4.10 Installation is now complete. Once normal operation is confirmed, then an alarm monitoring system can be connected.

2.5 Installation Troubleshooting:

Symptom: POWER indicator flashing once per second and compressor will not start.

Possible Solution: Check for correct input voltage. The unit senses input voltage, and it will not start if it is outside the range of the specifications.

Symptom: Distribution system pressure is lower than the configured upper operational pressure immediately after unit active operation stops.

Possible Solution: Check for flow restrictions in the distribution system. All tube sizes should be 3/8". Minimize tube lengths. Make sure all valves are fully open.

Symptom: Distribution system pressure drops quickly and continuously after active operation stops.
Or duty cycle is more than 5%.
Or active operation occurs more often than once every 48 hours.

Possible Solution: Check for leaks in the distribution system.

Symptom: Distribution system pressure does not increase during active operation.

Possible Solution: Check that the unit's output fitting is connected to the distribution system with a 3/8" tube. Check for leaks in the distribution system.

Symptom: Run time alarm is issued before distribution system reaches the configured upper operating pressure.

Possible Solution: Check for leaks in the distribution system. Any leaks will increase the active operation run time.

Possible Solution: Run time to pressurize the distribution system may have been miscalculated. Please recalculate the run time, record the unit's model and serial numbers and contact RFS Support to reconfigure the run time alarm.

Symptom: Run time exceeds 4 hours before distribution system reaches the configured upper operating pressure.

Possible Solution: Check for leaks in the distribution system. Any leaks will increase the active operation run time.

Possible Solution: Altitude of installation may be too high. Verify model used is specified for operation at the altitude of installation.

Possible Solution: Distribution system volume may be too large for the dehydrator model installed. Please recalculate the run time, record the unit's model and serial numbers and contact RFS Support.

Symptom: Alarm monitoring system shows an alarm but dehydrator alarm indicator not illuminated. Or alarm monitoring system shows no alarm but dehydrator alarm indicator is illuminated.

Possible Solution: Check for correct alarm monitor wiring. Both normally open (NO) and normally closed (NC) connections are supplied for each alarm. Incorrect connection will reverse the alarm logic.

Symptom: Log file is not written to USB device when it is inserted and the power is cycled.

Possible Solution: Verify that the USB device is USB 2.0 compliant. Verify that the USB device is formatted for the FAT32 file system, and that it has only one active partition. Verify that the USB device is not full.

3 TERMS & DEFINITIONS

3.1 **Relative Humidity (RH)** is the moisture content of the air relative to the maximum possible moisture content at the current air temperature. RH is measured in percent (%). 100% RH represents saturation, and is the point at which condensation occurs.

Since RH is relative to temperature, the RH of the air in the waveguide or cable will fluxuate with the changes in air temperature. As the air temperature increases, RH will fall; as the air temperature decreases, the RH will rise. The air's actual moisture content remains constant.

3.2 **Dew Point Temperature (Td)** is the temperature at or below the current temperature at which the air would be saturated with moisture (100% RH). Td is measured in the same unit as ambient temperature, typically Fahrenheit or Celsius.

Dew point temperature is not affected by air temperature fluxuations. Instead, it is directly linked to the actual moisture content in the air. For that reason, dew point temperature is the measurement most applicable to dehumidification processes.

Dew point temperature is fairly constant over time. Weather systems and seasonal changes are the primary cause of dew point temperature fluxuation over time.

When dew point temperature and ambient air temperature are equal, then the air is saturated (100% RH), and condensation can form. Therefore, it is important to keep the dew point temperature of the air inside the waveguide or cable below the ambient temperature outside the waveguide or cable to avoid condensation.

3.3 **Dew Point Reduction (Tdr)** is the reduction of the dew point temperature that results from the dehumidification process. The larger the Tdr, the more efficient the dehumidification process is.

3.4 **Distribution System** is the system of air tubes, distribution manifolds, valves, and RF lines to be pressurized with dry air from the dehydrator's output fitting.

3.5 **Active** dehydrator operation is when the unit's compressor is on and pressurized dry air is being supplied from the unit's output fitting.

3.6 **Run Time** is the time that the unit spends in active operation to pressurize the distribution system.

3.7 **Standby** dehydrator operation is when the unit is energized but the compressor is not on. The distribution system pressure is in the unit's configured operational range, and is being monitored by the unit's control board. This is the predominant operational condition.

3.8 **Duty Cycle** is the time in active operation vs. standby operation, measured in percent.

$$Duty\ Cycle\ \% = \frac{Active}{Standby}\ X\ 100$$

3.9 **Lower Operational Pressure (LOP)** is the configured pressure at which the dehydrator will switch from standby to active operation to re-pressurize the system.

3.10 **Upper Operational Pressure (UOP)** is the configured pressure in psig at which the dehydrator will switch from active to standby operation. This is also the system pressure, or the maximum pressure desired in the distribution system.

4 OPERATION

4.1 General Description:

It is important that the dew point temperature (Td) inside the distribution system is maintained below the lowest ambient outdoor temperature expected. The local average yearly low temperatures should be taken into account. This will ensure that no condensation occurs, which could negatively affect the electrical performance of the system.

The APD-D Series Automatic Pressurization Dehydrators are designed for reliable dry air pressurization of waveguide, coaxial cable and rigid line systems. Dry pressurized air in the distribution system ensures that condensation is avoided.

The dehydrators utilize a pressure swing adsorption (PSA) process using a high efficiency alumino-silicate molecular sieve to remove moisture from the input air.

The dehydration system is completely automatic, with no need for periodic media replacement or reactivation. These units are capable of years of trouble-free service when properly installed, operated and maintained.

The APD-D series dehydrator performance is dependent on the ambient environmental conditions. The less moisture present in the air, the drier the output air will be. Cooler, drier, cleaner environments will result in better performance, a longer service life and less maintenance. Heavy dust or particulates in the air, corrosive gasses in the air, dripping water, and condensation must be avoided.

The APD-D series dehydrators are designed for operation in enclosed climate controlled spaces. The operational climatogram is shown below. The ambient environment must fall within the gray area.

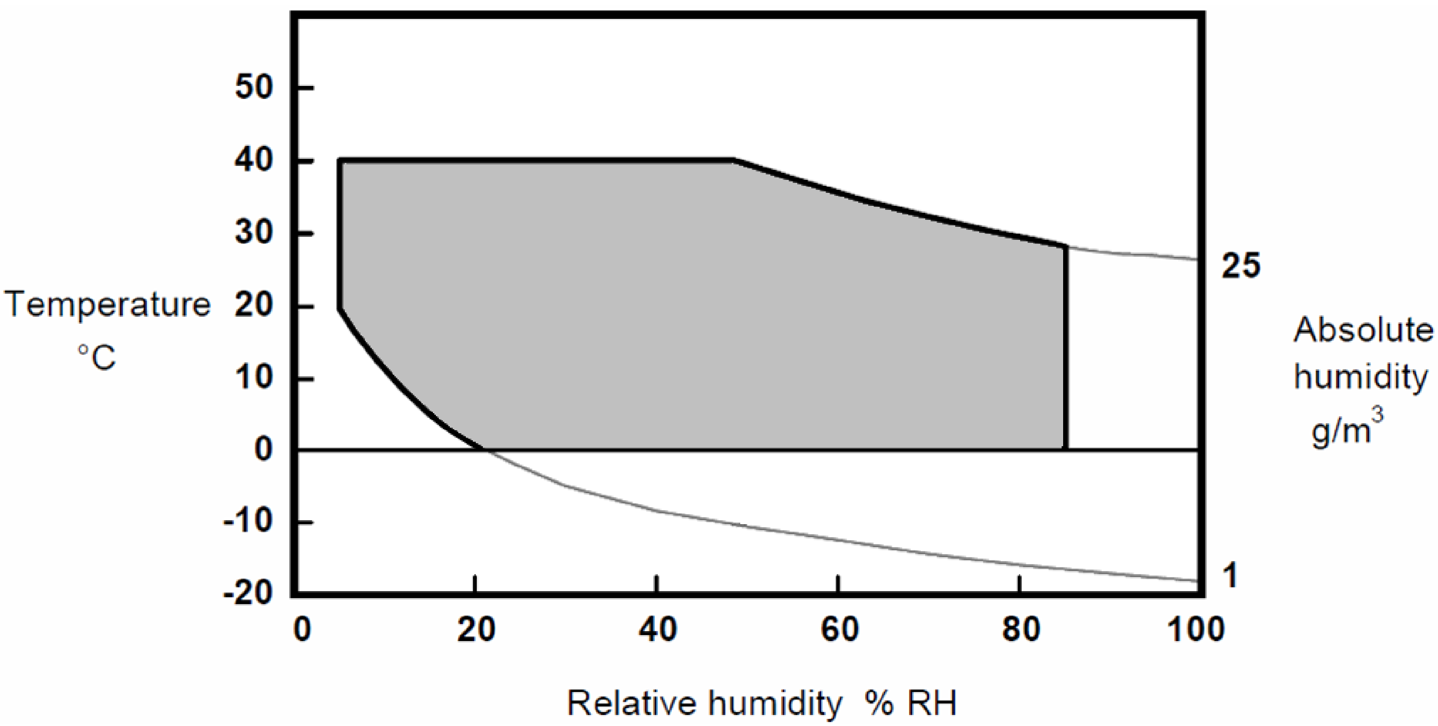


Figure 4.1 - APD-D Operational Climatogram

The APD-D series dehydrators are fully automatic when energized. The system pressure is monitored in real-time during standby operation. When the system pressure is at or below the lower operational pressure, then the unit will activate and re-pressurize the system with dry air. The unit will return to standby operation when the upper operational pressure is reached.

A dehydrator duty cycle of less than 5% is recommended. Maximum continuous active operation must not exceed 4 hours. Any leaks in the distribution system should be small enough to ensure that active operation does not occur more often than once every 48 hours (2 days).

4.2 <u>Detailed Operation:</u>

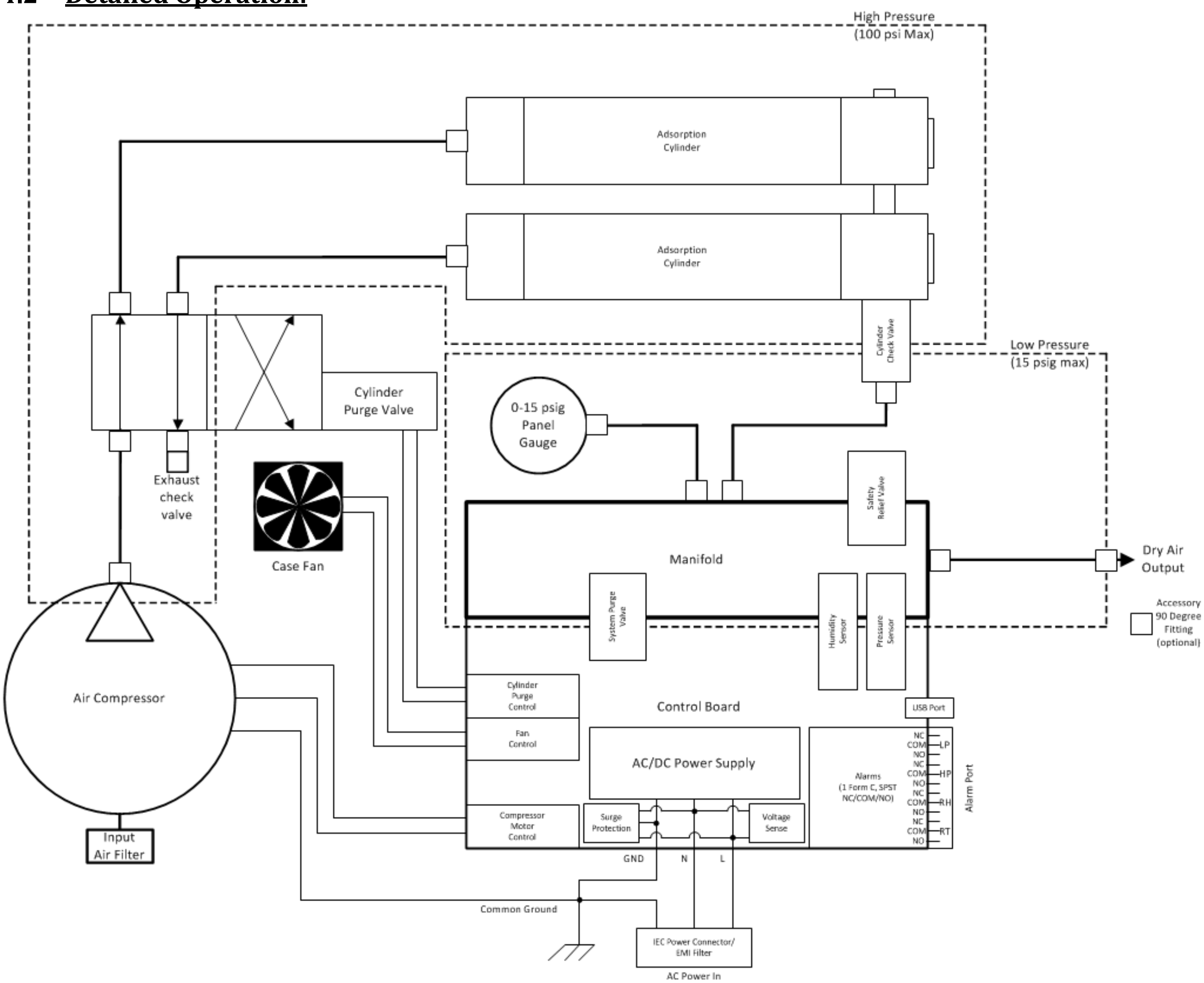


Figure 4.2 – System Diagram

Ambient air flows through the input air filter into the air compressor. The pressurized air is directed to the active cylinder by the cylinder purge valve. The active cylinder adsorbs moisture from the air, and provides a small purge flow of dry air through the unused cylinder in the reverse direction. The cylinder purge valve directs the purge flow through the exhaust check valve. During and immediately after active operation the exhaust flow is audible and represents normal operation.

The exhaust check valve allows moist air to be purged from the unit during active operation while blocking moist ambient air from reaching the cylinders.

The cylinder check valve isolates the high pressure cylinder dehumidification process from the low pressure dry air output section. This check valve also prevents loss of system pressurized dry air when the unit is not actively pumping.

When necessary, the unit will switch the active cylinder to purge the adsorbed moisture. When this occurs, an audible rush of pressurized air will exit through the exhaust check valve in a short period of time. Air flow at the unit's output fitting will be interrupted for a short time until the newly active cylinder is pressurized and air starts to flow through the cylinder check valve.

The safety relief valve is a mechanical ASME-rated relief valve. If for any reason the low pressure dry air output section is over pressurized, then the safety relief valve will open to prevent an unsafe pressure condition.

The control board and the humidity and pressure sensors monitor the low pressure dry air output and adjust unit operation accordingly.

The system purge valve allows for periodic purge and repressurization of the waveguide or cable system. This optional feature requires the humidity alarm option or system purge option to be installed and configured.

The LOW PRESSURE alarm is standard on all models. The alarm is set to 0.5psi below the configured lower operational pressure for standard pressure configurations, and a fixed 0.25psig for low pressure configurations. If the system pressure drops to the low pressure alarm threshold, then the LOW PRESSURE front panel indicator will be lit and the NC/COM/NO alarm connector pins (pins 1, 2 and 3) will switch states. This alarm is non-latching and will clear if the pressure rises above the alarm threshold.

4.3 Choosing the Appropriate Model:

The appropriate model dehydrator should be chosen based on local power source and required output flow. Altitude of installation, desired system lower & upper operating pressures, and system volume must be taken into account to ensure proper application. The run time calculator in **Section 11** can be used to help determine the most appropriate model. RFS Customer Service can help determine the correct model.

4.4 Available Options and Configurations:

4.4.1 High Pressure Alarm: High pressure can damage waveguide and pressure windows. The optional high pressure alarm can be used as a warning that the distribution system pressure is too high. It must be configured at a value of at least 1psi above the configured upper operational pressure.

If the system pressure rises to the high pressure alarm threshold, then the HIGH PRESSURE front panel indicator will be lit and the NC/COM/NO alarm connector pins (pins 4, 5 and 6) will switch states. The compressor will be disabled to avoid any further pressure increase. This alarm is non-latching and will clear if the pressure drops below the alarm threshold.

4.4.2 Humidity Alarm: Elevated humidity can cause condensation, which could affect system performance. The optional humidity alarm can be used as a warning that the dryness of the air in the waveguide or cable may not be sufficient to avoid condensation if the air temperature drops.

If the distribution system air relative humidity rises above the humidity alarm threshold, then the HUMIDITY front panel indicator will be lit and the NC/COM/NO alarm connector pins (pins 7, 8 and 9) will switch states. This alarm is non-latching and will clear if the humidity drops below the alarm threshold.

Since the alarm occurs well below the point where condensation would occur, isolated short duration RH alarms are typically used as a warning. Increasing alarm occurrences over a period of time or a constant RH alarm for 24 hours or more indicates that the dehydrator should be checked for proper operation.

Based on unit duty cycle, operational environment and age, more frequent RH alarms may indicate the need to replace the desiccant cylinders.

The humidity sensor requires air flow for accurate measurement. In order to accurately measure the system air humidity level, humidity monitoring is only active during pumping and purging cycles. For this reason, the system purge option is required when the humidity alarm option is present.

4.4.3 Run Time Alarm: The optional run time alarm can be used as a warning that the active operation duration of the dehydrator is too long. The occurrence of this alarm typically indicates a leak in the distribution system.

The run time alarm must be configured based on a calculation or measurement of how long the unit will take to fill the system volume during active operation. If the active operation time to pressurize the distribution system to the upper operational pressure exceeds the configured run time, then the RUN TIME and COMPRESSOR indicators will flash once per second and the NC/COM/NO alarm connector pins (pins 10, 11 and 12) will switch states. This alarm is non-latching and will clear when the unit is able to pressurize the system to the upper operational pressure.

NOTE: Active operation durations exceeding the Maximum Continuous Active Operation specification may damage the unit and will void the unit's warranty.

4.4.4 System Purge: The system purge option allows the distribution system to periodically be purged (drained) and refilled with pressurized dry air. At the configured set time, the system purge valve will be opened and the distribution system air will be released until the dehydrator's lower operational pressure is reached.

The COMPRESSOR indicator will flash once per second during the purging process. The escaping air is audible inside the dehydrator during this time. The purge event ends when the lower operational pressure is reached. The purge valve will then close, and the unit will activate to re-pressurize the system.

If there is a leak in the distribution system that causes the pressure to drop to the lower operational pressure prior to the scheduled system purge event, then the scheduled event will not occur and the system purge timer will be reset.

5 CONTROLS AND INDICATORS

Picture 5.1 – APD-D Series Front Panel

5.1 **<u>PRESSURE Gauge:</u>** A 0-15 psig (0-1 bar) pressure gauge is provided. This gauge indicates pressure at the APD-D dehydrator output fitting.

5.2 **<u>Operational Indicators:</u>** LED indicators are provided to monitor unit operation.

POWER (green): Illuminated when mains power is present and unit is energized.

COMPRESSOR (yellow): Illuminated when compressor is active and pressurized dry air is being supplied.

LOW PRESSURE (red): Illuminated when the system pressure has dropped below the low pressure alarm threshold.

HIGH PRESSURE (red): Illuminated when the system pressure has exceeded the high pressure alarm threshold. This indicator is only active on models configured with the high pressure alarm option.

HUMIDITY (red): Illuminated when the system relative humidity has risen above the humidity alarm threshold. This indicator is only active on models configured with the humidity alarm option.

RUN TIME (red): Illuminated when the system run time (active pumping time) has exceeded the run time alarm threshold. This indicator is only active on models configured with the run time alarm option.

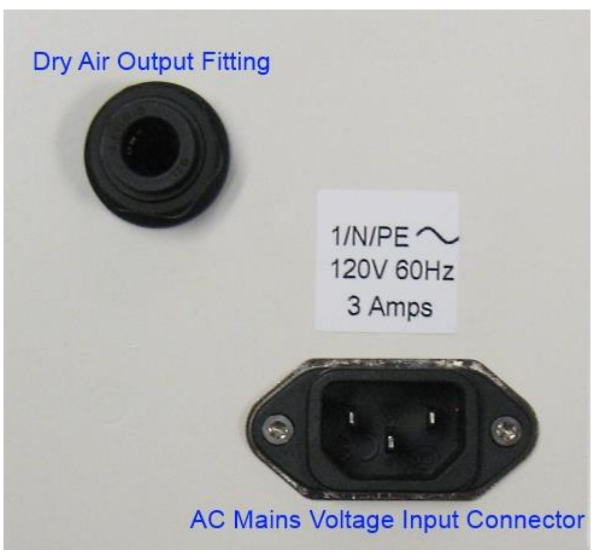
5.3 **<u>DATA PORT:</u>** A USB port is supplied to allow for downloading operational logs, updating the unit's installed options and configuration, and updating the operational software in the field. These features allow for option upgrades without having to return the unit to the factory, as well as remote troubleshooting of the system using the operational logs.

Inserting a USB 2.0 compliant memory stick into the DATA PORT and cycling unit power will initiate the following processes based on the USB stick contents:

- In all cases, an operational log is written to the USB stick. The RUN TIME indicator will flash once per second during this process.

- If the USB stick contains an updated configuration image that is valid for the unit's serial number, then the unit's configuration settings will be reprogrammed. The HIGH PRESSURE indicator will blink 5 times to indicate success.
- If the USB stick contains an updated software image that is valid for the unit's serial number, then the unit's firmware will be reprogrammed. The HUMIDITY indicator will blink 5 times to indicate success.
- In all cases, after completion of data processes, the unit will restart and run normally. Make sure that the USB stick read/write indicator stops blinking, then the USB stick can be removed.

5.4 **BREAKER:** The circuit breaker is located on the front panel in the bottom left corner. If an overload occurs, then the circuit breaker will open and the button with a white bar on top will be visibly protruding. To reset the circuit breaker, wait for at least one minute after the overload occurred, then press the button back in. The unit will resume normal operation.

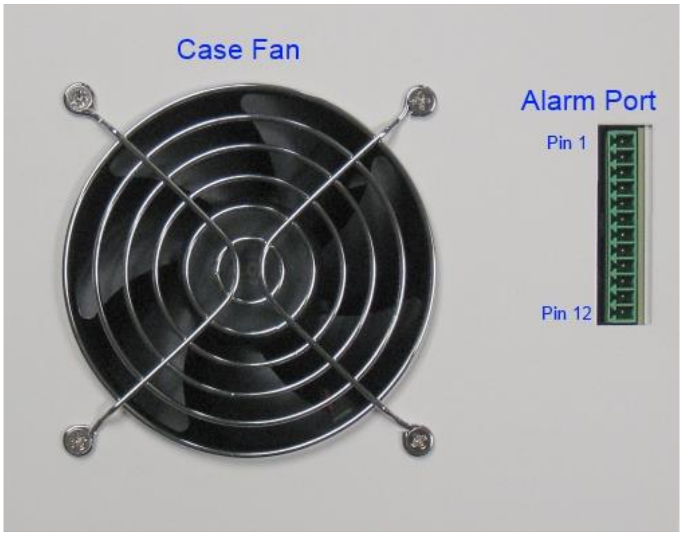


Picture 5.2 – APD-D Series Rear Panel Connections

5.5 **AC Mains Voltage Input:** The IEC C14 type AC Mains voltage input connector is located in the lower right corner of the rear panel. The APD20-D and APD70-D are supplied with a 2 meter NEMA 5-15 to IEC C13 right angle power cord. The APD22-D and APD72-D are not supplied with a power cord, and a cord with a locally compliant plug and IEC C13 type connector rated for a minimum of 250V and 15A is required.

5.6 **Dry Air Output Fitting:** The dry air output fitting is located in the lower right corner of the rear panel, above and to the left of the AC Mains input connector. The dry air output fitting is a push-to-connect tube fitting that can be reused many times. All APD-D models are supplied with 10' of 3/8" polyurethane tube.

- To connect tube to fitting: Make sure that the end of the tube is clean and cut square. Push the tube straight into the fitting firmly. Inside the fitting is a ring of stainless steel gripping teeth and a sealing O-ring. As the tube is pushed into the fitting, both teeth and O-ring will provide resistance. Ensure that the tube is fully inserted, and then give the tube a gentile tug to verify proper insertion.
- To remove tube from the fitting: Make sure that there is no pressure in the tube. Push the tube and the outer release ring of the fitting in to release the internal gripping teeth. Hold the release ring down while pulling the tube out of the fitting.



Picture 5.3 – Case Fan and Alarm Port

5.7 **Case Fan:** The case fan provides positive pressure cooling air to the unit. The fan is operational only when the unit is actively pumping. At least 2 inches of clearance is required for proper cooling air flow.

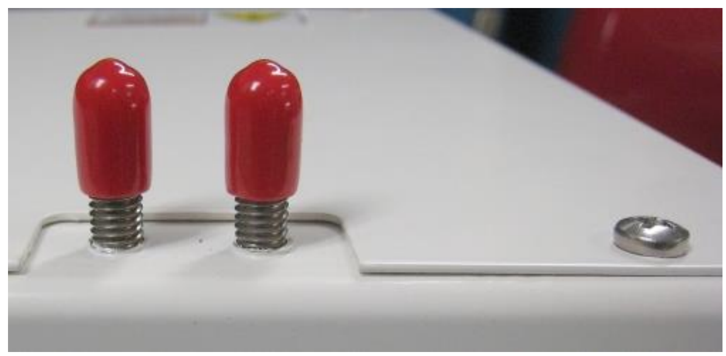
5.8 **Alarm Port:** The alarm port allows for customer-supplied remote monitoring equipment to monitor the dehydrator for configured alarms. The alarms are provided using 1 Form C relays. All alarm contacts are passive and power must be supplied externally to the alarm devices if necessary.

Picture 5.4 – Alarm Connector

5.9 **Alarm Connector:** The alarm connector provides easy screw-terminal wire connections, and plugs into the alarm port.

Alarm Pin-out:

Pin No.	Alarm	Configuration
1	Low Pressure	Normally Closed (NC)
2	Low Pressure	Common (COM)
3	Low Pressure	Normally Open (NO)
4	High Pressure	Normally Closed (NC)
5	High Pressure	Common (COM)
6	High Pressure	Normally Open (NO)
7	Humidity	Normally Closed (NC)
8	Humidity	Common (COM)
9	Humidity	Normally Open (NO)
10	Run Time	Normally Closed (NC)
11	Run Time	Common (COM)
12	Run Time	Normally Open (NO)



Picture 5.5 – APD-D Series Site Grounding Studs

5.10 **Site Grounding Studs:** For installations requiring supplemental equipment earth grounding, dual chassis ground studs are provided. They are located on the top of the unit near the rear left corner. The studs are stainless steel with M6x1 threads spaced 0.625” center to center. RFS offers a site grounding kit which includes a ground lug and 2ea. stainless steel M6x1 hex nuts and M6 star lock washers. Examples of compatible lugs are Thomas&Betts 54852BE and SitePro GL610.

6 MAINTENANCE

If properly installed and operated, the Dehydrator will not require any maintenance for the length of the warranty period. After that, the only preventative maintenance requirements are a check of the compressor's input air filter element, and dust & debris removal once per year.

6.1 Taking the Unit Out of Service and Removing the Lid:

6.1.1 Disconnect the input power cord from the rear panel of the unit.

6.1.2 Close any isolation valves in the distribution system to hold the pressurized dry air in the system.

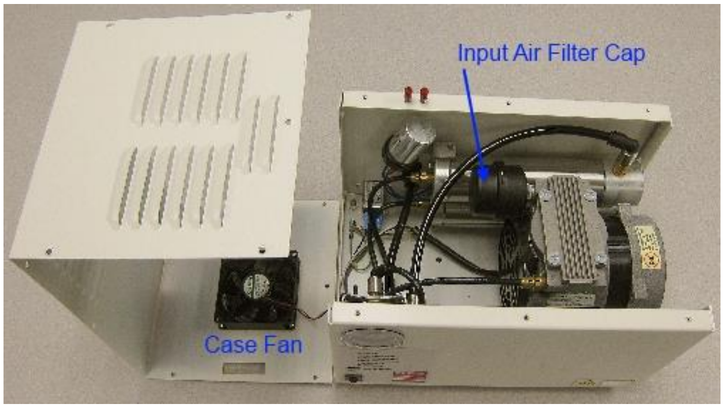
6.1.3 Disconnect the 3/8" air tube from the rear panel of the unit. (See section 5.6).

6.1.4 If present, disconnect the site ground lug from the top of the unit.

6.1.5 If present, disconnect the alarm connector from the unit's alarm port.

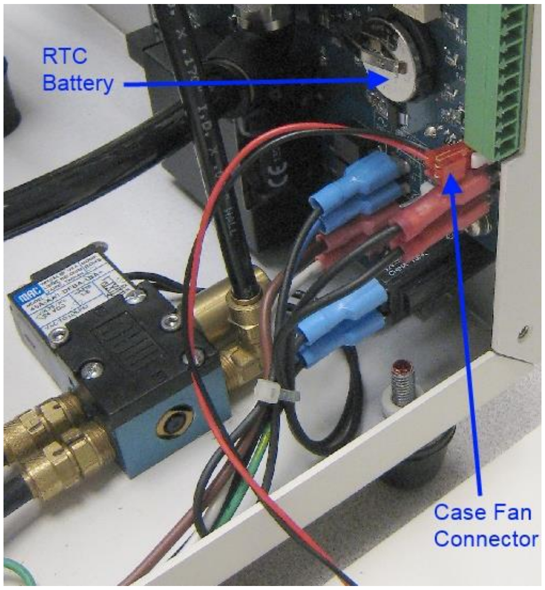
6.1.6 Move the unit to a flat work surface.

6.1.7 Remove all screws in the unit's lid. Carefully lift the lid no more than 4 inches, then pivot the lid towards the fan and set it on the work surface.



Picture 6.1 – Lid Removal and Filter Location

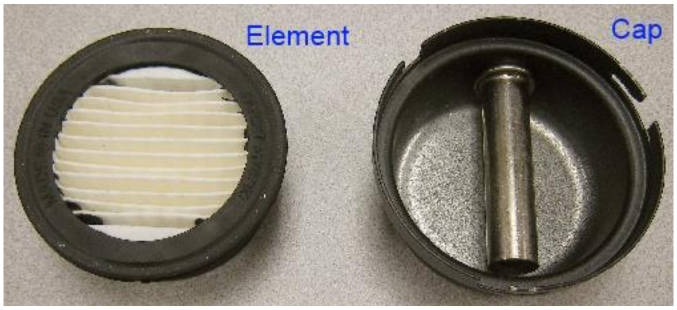
6.1.8 Unplug the case fan connector from the control board, and then the lid can be moved if necessary.



Picture 6.2 – Case Fan Connector and RTC Battery Locations

6.2 Inspecting or Replacing the Input Air Filter Element:

6.2.1 Apply pressure to the compressor's input air filter cap towards the compressor and turn it clockwise to release it. Remove the cap and filter element. Inspect the filter element and replace it if necessary.



Picture 6.3 – Air Filter Element & Cap

6.2.2 Clean any dust or debris from the unit's inside surfaces using low pressure air. Reverse the procedure to place the unit back in service. The lid screws should be retightened to 10 inch-pounds (1.13 Newton-meters).

6.2.3 When the unit is placed back in service, verify that the case fan is operating correctly during active operation.

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6.3 Replacing the RTC Backup Battery:

The battery should last many years. It is only used to maintain the unit's Real-Time Clock (RTC) when the unit is not energized. After replacement, the RTC date and time should be reset. Refer to **Picture 6.2**.

6.3.1 Remove the old battery by gently lifting the retaining clip. The battery should slide out of the holder easily.

6.3.2 Install the new battery by pushing it under the clip until it snaps into the holder.

WARNING

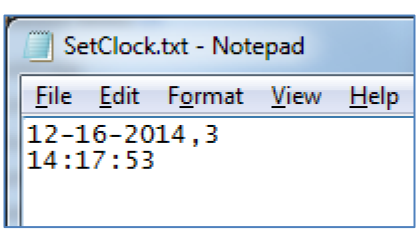
The following steps should be completed only after section 6.4. The unit must never be energized or operated without the lid secured in place.

6.3.3 To reprogram the RTC date and time, a PC and a USB2.0 compliant memory device formatted as FAT32 with a single partition are required.

6.3.4 Create a new text file (i.e. with Notepad) and name it "SetClock.txt". Two lines are required:

Line 1 format: ***MM-dd-yyyy,x***
- ***MM***: 2-digit month
- ***dd***: 2-digit day
- ***yyyy***: 4-digit year
- ***x***: Single digit day of week (Sunday=1)

Line 2 format: ***HH:mm:ss***
- ***HH***: 2-digit hour (24H format)
- ***mm***: 2-digit minute
- ***ss***: 2-digit second



Picture 6.4 – SetClock.txt Notepad Example

NOTE: Once the "SetClock.txt" file has been created, it is important to follow the steps below as quickly as possible to ensure a minimum RTC time error exists.

6.3.5 Save the "SetClock.txt" file on the USB device, and then move the USB device to the dehydrator's front panel USB port.

6.3.6 To update the RTC, cycle power on the dehydrator using the power cord.

6.3.7 The dehydrator's RUN TIME indicator will flash as a log file is written to the USB device. Then the RTC date and time will be updated.

6.3.8 The dehydrator's LOW PRESSURE indicator will flash 5 times (once per second) to indicate successful RTC update.

6.3.9 The unit will then start normally.

6.4 Replacing the Lid & Placing the Unit Back In Service:

6.4.1 Refer to **Picture 6.1** and **Picture 6.2**. Place the lid next to the unit, fan down. Connect the case fan connector to the control board's fan header, wires facing in.

6.4.2 Pivot the lid onto the unit, making sure not to pull or bind the fan wires.

6.4.3 Replace the lid screws. Insert all loosely at first, and then torque each screw to 10 inch-pounds (1.13 Newton-meters).

6.4.4 Replace the unit in its original installation location. If present, reattach the alarm port connector. If present, reconnect the site ground stud. Reconnect the 3/8" air tube to the unit's output fitting on the rear panel. (See section 5.6).

6.4.5 Open any distribution system valves that were closed when the unit was removed.

6.4.6 Plug the unit in and verify that it starts and runs normally. Verify that the case fan is operating correctly.

7 REPLACEMENT PARTS AND ACCESSORIES

Replacement parts and accessories that can be field-installed:

Item	Part Number	Description	Model Compatibility
1	30033358	3/8" polypropylene tubing, 10' roll	All APD-D Models
2	30033428	Elbow fitting, 3/8" stem to tube	All APD-D Models
3	356105150900	Alarm port connector, 12-pin	All APD-D Models
4	20040615	Installation Kit (includes items 1, 2 & 3)	All APD-D Models
5	30033267	Compressor input air filter element	All APD-D Models
6	30032552	Power cord, 120VAC, 13A, NEMA 5-15 to IEC C13 right angle, 2 meter (6'-7")	APD20-D, APD70-D
7	30032130	Bulkhead fitting, 3/8" quick connect	All APD-D Models
8	30032127	Exhaust check valve	All APD-D Models
9	20041370	0-15psig Panel Gauge Assembly	All APD-D Models
10	20041874	Fan assembly	All APD-D Models
11	399105034900	RTC backup battery, CR2032	All APD-D Models
12	30032487	2 Amp circuit breaker	APD22-D
13	30032486	3 Amp circuit breaker	APD20-D
14	30032485	4 Amp circuit breaker	APD72-D
15	30034590	5 Amp circuit breaker	APD70-D
16	20039457	Desiccant cylinder subassembly	APD20-D, APD22-D
17	20041903	Desiccant cylinder subassembly	APD70-D, APD72-D
18	30032091	Rubber bumper foot, M6 stud	All APD-D Models
19	20041902	Site Ground Kit (6AWG crimp terminal)	All APD-D Models
20	20040835	Wall/Rack Mount shelf (mounting hardware not included)	All APD-D Models
21	10042341	Field Configuration Upgrade Kit	All APD-D Models

8 OPTION / CONFIGURATION / SOFTWARE UPGRADE

The APD-D Dehydrator can be upgraded in the field via the USB 2.0 compliant DATA PORT on the front panel. Options can be added or reconfigured, and updates to operational software can be installed without returning the unit to the factory.

Option upgrades and configuration updates are matched to each individual unit. Please have the model and serial number(s) available when contacting RFS Customer Support.

8.1 <u>Upgrade procedure:</u>

The steps and indications during the upgrade process happen fast. Before starting the upgrade process, please read through and familiarize yourself with the procedure.

8.1.1 Ensure that the serial number of the unit matches the serial number on the upgrade kit's USB device label.

- ➢ *The upgrade files are encrypted and matched to each individual dehydrator.*

8.1.2 Plug the USB device into the dehydrator's front panel USB connector and cycle the unit's power. The unit's POWER indicator will be illuminated throughout this process.

a. In all cases, the unit's current operational log file will be written to the USB device. During this operation, the unit's RUN TIME indicator will flash.

b. If the version of the Operational Software (E_Image.s19) on the upgrade USB device is newer than the unit's installed software, then it will be updated. The unit's RUN TIME, HUMIDITY and HIGH PRESSURE indicators will illuminate solid and the LOW PRESSURE indicator will flash during this process. When programming is complete, then the LOW PRESSURE and COMPRESSOR indicators will illuminate solid momentarily and then all indicators will extinguish.

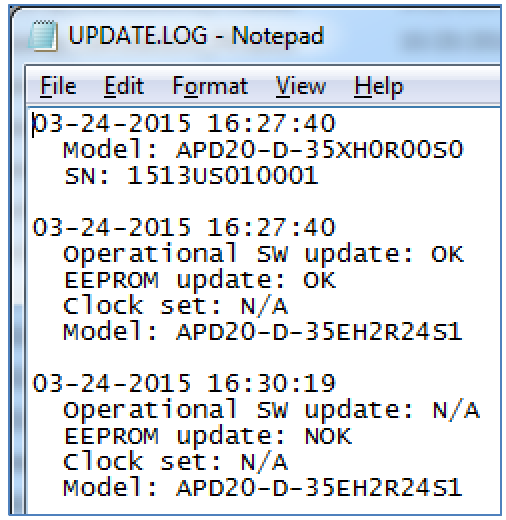
c. The upgraded configuration (eeprom.eep) will be written to the unit. There is no indication of this process occurring because it happens very quickly.

d. Once all programming is complete, the following indications will occur. If more than one condition exists, then the indicators will flash together.

- *The LOW PRESSURE indicator flashes 5 times indicating successful RTC clock update.*
- *The HIGH PRESSURE indicator flashes 5 times to indicate successful configuration upgrade.*
- *The HUMIDITY indicator flashes 5 times to indicate successful firmware update.*

8.1.3 The unit will then restart normally (indicators light top to bottom, then extinguish bottom to top). The USB device can now be removed.

8.1.4 To verify the upgrade process, plug the upgrade USB device into a PC and open the "UPDATE.LOG" file on the USB device. The following is a sample of the file contents:



UPDATE.LOG - Notepad

File Edit Format View Help

```
03-24-2015 16:27:40
  Model: APD20-D-35XH0R00S0
  SN: 1513US010001

03-24-2015 16:27:40
  Operational SW update: OK
  EEPROM update: OK
  Clock set: N/A
  Model: APD20-D-35EH2R24S1

03-24-2015 16:30:19
  Operational SW update: N/A
  EEPROM update: NOK
  Clock set: N/A
  Model: APD20-D-35EH2R24S1
```

Picture 8.1 – UPDATE.LOG File

a. The log indicates success (OK), failure (NOK) or not present/not processed (N/A) for the two upgradeable items and the RTC clock setting.

b. The first log entry indicates the unit model and serial number, and represents the configuration of the unit before the upgrade process.

c. The second entry is an example of a successful upgrade of the operational software, a successful upgrade of the EEPROM (unit configuration), and that there was no SetClock.txt file to process. The model number represents the options and/or configuration upgrade, and this number should match the provided upgrade product label.

d. The third entry is an example of a failed EEPROM (unit configuration) upgrade. The Operational Software will only be upgraded if the version on the upgrade USB device is newer than the unit's installed version.

8.1.5 Upon successful completion of the upgrade process, place the provided upgrade product label over the existing product label on the dehydrator's rear panel.

9 SPECIFICATIONS

	Model			
GENERAL	**APD20-D**	**APD22-D**	**APD70-D**	**APD72-D**
Output Flow, Minimum, Nlm (SCFM)	5.65 (0.2)	4.8 (0.17)	19.8 (0.7)	16.4 (0.58)
Max System Volume, liters (ft^3), @ 34.5 kPa (5 psig)	3500 (123)[1]	3000 (106)[1]	16500 (582)[1]	13500 (477)[1]
Output Dew Point, Minimum, Celsius (Fahrenheit)	Ambient dew points <= 10° (50°): -40° (-40°) dew point Ambient dew points > 10° (50°): 50° (72°) dew point reduction			
Operational Pressure, psig (kPa)	Firmware configurable from 1-10 (6.9-68.9)			
Pressure Deadband, psig (kPa)	Firmware configurable from 2-9 (13.8-62.1)			
Ambient Operational Temperature Range	0-40°C (32-104°F) [2]			
Ambient Operational Humidity Range	5-85% relative, non-condensing (maximum absolute humidity = 25 g/m^3) [2]			
Operational Noise, dBA @ 1 meter, Standby	0			
Operational Noise, dBA @ 1 meter, Active	60		66	
Output Pressure Safety Relief	Fixed at 15 psig (103.4 kPa)			
Output Fitting Type	Quick-Connect, 3/8" OD Plastic Tube [3]			
Maximum Continuous Operation, Active	4 Hours			
ELECTRICAL				
Operating Voltage, AC	120V +/-10%	230V +/-10% [4]	120V +/-10%	230V +/-10% [4]
Source Frequency, Hz, Nominal (Range)	60Hz (47-63Hz)	50Hz (47-63Hz)	60Hz (47-63Hz)	50Hz (47-63Hz)
Max. Standby Current, Amps	0.5			
Max. Active Current, Amps	3	2	5	4
Max. Active Power Consumption, Watts	320	280	500	420
Max. Active Power Consumption, Volt-Amps	380	290	520	440
Power Factor Correction, typical	0.8			
Electrical Feed Circuit Configuration	Single Phase, 3-Conductor (Phase/Neutral/Ground) [4]			
Electrical Feed Circuit Size Recommendation	15 Amps [5]			
Electrical Inlet Connector	IEC 320 Type C14			
ALARMS				
Alarm Configuration	1 Form C relay contacts, screw terminal connector			
Alarm Contact Rating, Maximum	30VDC, 1A			
Low Pressure Alarm (Standard on all units)	Standard configurations: Fixed at 0.5 psi (3.4 kPa) below lower operational pressure Low Pressure configurations: Fixed at 0.25 psig (1.7 kPa)			
SIZE AND WEIGHT				
Dimensions, H x W x D, inches (mm)	9.5 x 13.5 x 9.5 (242 x 343 x 242)			
Net Weight, pounds (kilograms)	25 (11.4)		30 (13.6)	
ENVIRONMENTAL				
Max. Operational Altitude @ 5 psig, feet (meters)	6,500 (1,930)	6,000 (1,830)	12,400 (3,780)	11,500 (3,500)
Max. Operational Altitude @ 10 psig, feet (meters)	5,000 (1,525)	4,500 (1,370)	10,900 (3,325)	9,500 (2,900)
Derating per 1000ft (305m) above MSL, CFM (lm)	0.024 (0.68)	0.022 (0.62)	0.07 (1.98)	0.06 (1.70)
Options: (Field Configurable)				
Low Pressure Operation	Software configurable from 1-2.5 psig (6.9-13.8 kPa) in 0.5 psig (3.4 kPa) increments [6]			
High Pressure Alarm	Software configurable from 3-11 psig (20.7-75.9 kPa) in 1 psig (6.9 kPa) increments			
Humidity Alarm	Software configurable from 20-50% RH in 10% RH increments			
Run Time Alarm	Software configurable from 10 minutes to 4 hours in 10 minute increments			
System Purge	Software configurable from 2-10 days in 2 day increments			
Compliance				
CE (EMC, MD, PED, RoHS) IEC 60529-IP20				

NOTES:

1) All specifications at 23°C (73 F) and 50% Relative Humidity at mean sea level (MSL) unless otherwise noted.
2) For indoor use only. IEC 60721-3-3 Class 3k3 (temperature-controlled enclosed locations, humidity not controlled), Humidity: 25 g/m3 Absolute Humidity @ 85% RH = 29.4°C, 40°C @ 25 g/m3 Absolute Humidity = 48.8% RH.
3) Tubing used must be polyurethane (durometer 95A), polyethylene (durometer 44D), or nylon (durometer 50D).
4) Voltage source per IEC 60038 (1/N/PE) ***Not for use with North American 240VAC service***
5) Electrical supply circuit must remain within operating voltage specifications at all times.
6) Lower Operational Pressure fixed at 0.5 psig (3.4 kPa), Low Pressure alarm fixed at 0.25 psig (1.7 kPa).

10 MODEL CONFIGURATION

Model Numbering Structure for RFS Digital Dehydrators

The dehydrator **model series**

The dehydrator **lower and upper pressure**

The dehydrator **high pressure alarm**

The dehydrator **humidity alarm**

The dehydrator **run time alarm**

The dehydrator **system purge**

APD20-D 3 5 X H0 R00 S0

APD20-D

DIGITAL DEHYDRATOR SERIES	
APD20-D	120 VAC 60Hz 0.2 CFM
APD22-D	230 VAC 50Hz 0.17 CFM
APD70-D	120 VAC 60Hz 0.7 CFM
APD72-D	230 VAC 50Hz 0.58 CFM

3

LOWER OPERATIONAL PRESSURE	
1	1 psig
2	2 psig
3	3 psig
4	4 psig
5	5 psig
6	6 psig
7	7 psig
8	8 psig
L	Low Pressure Option

Notes:

1. Low Pressure option uses a fixed Lower Operational Pressure of 0.5 psig.
2. Humidity Alarm option requires System Purge option to be configured.
3. Run Time Alarm should be configured for at least 150% of the calculated run time.

5

UPPER OPERATIONAL PRESSURE*	
3	3 psig
4	4 psig
5	5 psig
6	6 psig
7	7 psig
8	8 psig
9	9 psig
1	10 psig

LOW PRESSURE OPTION	
1	1 psig
2	1.5 psig
3	2 psig
4	2.5 psig

* Must be at least Lower Operational Pressure +2

X

HIGH PRESSURE ALARM* (1 PSIG INCREMENTS)	
X	Not Configured
A	3 psig
B	4 psig
C	5 psig
D	6 psig
E	7 psig
F	8 psig
G	9 psig
H	10 psig
I	11 psig

* Must be at least Upper Operational Pressure +1

H0

HUMIDITY ALARM (10% RH INTERVALS)	
H0	Not Configured
H2	20% Relative Humidity
H3	30% Relative Humidity
H4	40% Relative Humidity
H5	50% Relative Humidity

R00

RUN TIME ALARM (10 MINUTE INTERVALS)	
R00	Not Configured
R01	10 Minutes
R02	20 Minutes
R03	30 Minutes
R04	40 Minutes
.	
.	
.	
R24	240 Minutes

S0

SYSTEM PURGE (2 DAY INTERVALS)	
S0	Not Configured
S2	2 Days
S4	4 Days
S6	6 Days
S8	8 Days
S1	10 Days

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11 RUN TIME CALCULATIONS

The following calculation can be used to estimate the amount of run time an APD-D series dehydrator will take to pressurize a given volume. This calculation is a simplified best-fit estimate. Actual pump times will be dependent on many variables, such as:

- APD-D flow variations. Each dehydrator has flow variations. The specifications indicate the minimum flow for each model.
- APD-D service condition. How old the unit is, how well maintained.
- APD-D environmental conditions. The environment in which the dehydrator is operating has an effect on its performance.
- System flow restrictions. Any restrictions in the distribution system which the dehydrator is pressurizing can have pronounced performance consequences.
- System air tightness. Any leaks in the distribution system which the dehydrator is pressurizing can have pronounced performance consequences.
- And other variables…

$$\boldsymbol{T = \frac{V_v\left(\frac{U-L}{14.696}\right)}{f}}$$

$$\boldsymbol{f = \frac{\left(F_{fc^U} - E_{ep^U}\right) + \left(F_{fc^L} - E_{ep^L}\right)}{2}}$$

T = Total system run time in minutes
V = Volume of system in m^3, ft^3, gallons, or liters
v = Volume conversion factor to cubic feet
  $v = 35.314$ for Volume in cubic meters (m^3)
  $v = 1.0$ for Volume in cubic feet (ft^3)
  $v = 0.1337$ for Volume in gallons
  $v = 0.0353$ for Volume in liters
L = Lower operational pressure, psig (where compressor starts)
U = Upper operational pressure, psig (where compressor stops)
f = Effective flow (linearized average)
F = Dehydrator output flow, CFM (cubic feet per minute @ MSL, 0 psig, 23° Celsius, 50%RH)
  $F = 0.22$ for APD20-D
  $F = 0.19$ for APD22-D
  $F = 1.0$ for APD70-D
  $F = 0.85$ for APD72-D
fc = Flow correction factor for pressures above 0 psig
  $fc = 0.91$ for APD20-D, APD22-D, APD72-D
  $fc = 0.92$ for APD70-D
E = Elevation AMSL (above mean sea level) in feet
e = Elevation correction factor for flow
  $e = 0.000024$ for APD20-D
  $e = 0.000022$ for APD22-D
  $e = 0.000070$ for APD70-D
  $e = 0.000060$ for APD72-D
p = Pressure correction factor for elevation
  $p = 0.94$

Excel Formulas:

Assume APD20-D with 33 meters of E65 elliptical waveguide.

	A	B	C
1	27.72	V	
2	0.0353	v	
3	0	L	
4	5	U	
5	0.2	F	
6	0.91	fc	
7	0	E	
8	0.000024	e	
9	0.94	p	
10	0.162	f	
11	2.05	T	minutes
12	0:02:02	T	h:mm:ss

f calculated in cell A10:

```
=((A5*A6^A4-A7*A8*A9^A4)+(A5*A6^A3-A7*A8*A9^A3))/2
```

T calculated in cell A11 in fractional minutes:

```
=A2*A1*((A4-A3)/14.696)/A10
```

T calculated in cell A12 in [h:mm:ss] format.

```
=INT(A11/60)&":"&TEXT(INT(MOD(A11,60)),"00")&":"&TEXT(
INT(MOD(A11*60,60)),"00")
```

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12 TRANSMISSION LINE VOLUMES

The tables below contain estimated volume per linear unit for the most common transmission lines.

RFS Elliptical Waveguide volumes:

Waveguide Type	Liters per meter (l/m)	Cubic foot per foot (ft^3/ft)
E38	2.58	0.0275
E46	1.83	0.0196
E60	1.05	0.0113
E65	0.840	0.00904
EP70	0.718	0.00773
E78	0.590	0.00635
EP100	0.368	0.00396
E105	0.292	0.00314
E130	0.212	0.00229
E150	0.153	0.00165
E185	0.0797	0.000858
E220	0.0543	0.000585
E250	0.0374	0.000403
E300	0.0236	0.000255
EO38	0.0636	0.000685
E380	0.0130	0.000140

RFS Air Dielectric Coaxial cable volumes:

Cable Type	Liters per meter (l/m)	Cubic foot per foot (ft^3/ft)
HCA38	0.107	0.00115
HCA12	0.134	0.00144
ICA12	0.131	0.00142
HCA58	0.252	0.00272
HCA78	0.447	0.00481
HCA118	0.753	0.00810
HCA158	1.43	0.0154
HCA214	2.11	0.0227
HCA295	2.91	0.0313
HCA300	3.44	0.0371
HCA400	4.79	0.0516
HCA495	7.79	0.0839
HCA550	12.86	0.138
HCA618	17.09	0.184
HCA800	30.15	0.325
HCA900	40.16	0.432

Commscope/Andrew Elliptical Waveguide volumes:

Waveguide Type	Liters per meter (l/m)	Cubic foot per foot (ft^3/ft)
EW17	6.60	0.0710
EW20	5.62	0.0605
EW37	1.96	0.0211
EW43	1.69	0.0182
EW52	1.045	0.0112
EW63	0.855	0.0092
EW64	0.725	0.0078
EW77	0.585	0.0063
EW85	0.39	0.0042
EW90	0.334	0.0036
EW127A	0.25	0.0027
EW132-137	0.167	0.0018
EW132-140	0.167	0.0018
EW132-144	0.167	0.0018

EIA Rectangular Waveguide (TE10 mode) Volumes:

Waveguide Type	Liters per meter (l/m)	Cubic foot per foot (ft^3/ft)
WR340 / WG9A	3.73	0.0401
WR284 / WG10	2.46	0.0264
WR229 / WG11A	1.70	0.0183
WR187 / WG12	1.05	0.0113
WR159 / WG13	0.816	0.00878
WR137 / WG14	0.551	0.00593
WR112 / WG15	0.360	0.00387
WR90 / WG16	0.232	0.00250
WR75 / WG17	0.181	0.00195
WR62 / WG18	0.125	0.00134
WR51 / WG19	0.0839	0.000903
WR42 / WG20	0.0461	0.000496
WR28 / WG22	0.0253	0.000272
WR22 / WG23	0.0162	0.000174
WR19 / WG24	0.0114	0.000123
WR15 / WG25	0.00707	0.0000761
WR12 / WG26	0.00480	0.0000517

Rigid Coaxial Transmission Line (50-ohm) volumes:

Line Size	Liters per meter (l/m)	Cubic foot per foot (ft^3/ft)
7/8”	0.255	0.0027
1-5/8"	0.958	0.0103
3-1/8"	3.77	0.0405
4-1/16"	6.36	0.0685
6-1/8"	14.70	0.158
7-3/16"	22.80	0.245
8-3/16"	29.77	0.320
9-3/16"	33.30	0.358

13 CE DECLARATION OF CONFORMITY

RADIO FREQUENCY SYSTEMS
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CE Declaration of Conformity

We,

Radio Frequency Systems
200 Pond View Drive
Meriden, CT 06450
USA

declare under our sole responsibility that the below product(s) conform with the stated standards provided that they are installed, maintained and used in the application for which they are made, with respect of the "professional practices", relevant installation standards and manufacturer's instructions.

EQUIPMENT TYPE:

APD-D Series Automatic Pressurization Dehydrators.

EQUIPMENT MODEL NO.:

APD20-D
APD22-D
APD70-D
APD72-D

APPLICATION OF COUNCIL DIRECTIVE(S) WITH STANDARD(S) TO WHICH CONFORMITY IS DECLARED:

2004/108/EC, Electromagnetic compatibility (EMC)

IEC 61000-6-2:2005	Immunity for industrial environments.
IEC 61000-6-3:2007, +A1:2011	Emission standard for residential, commercial and light-industrial environments.

2006/42/EC, Machinery Directive (MD)

IEC 60204-1:2009	Safety of machinery – Electrical equipment of machines –Part 1: General requirements
IEC 60529:2001	Degrees of protection provided by enclosures (IP Code)

2011/65/EU, Restriction of the use of certain hazardous substances (RoHS)

97/23/EC, Pressure Equipment (PED)

NOTE: Maximum vessel PS•V of 2.5 Bar•L, maximum PS of 6.9 bar and maximum pipe size of 8 DN are less than Group 2 fluid limits of Article 3 Section 1.1(a), Annex II Table 2 and Article 3 Section 1.3(a), Annex II Table 7. Article 3 Section 3 applies: Equipment is designed and manufactured in accordance with sound engineering practice, includes instructions for use, and bears markings identifying manufacturer and/or authorized representative.

12/11/2014
Date of Issue

Xiangqing Xu, Director of Engineering, RFS USA

12/11/2014
Date of Issue

Gary Marquis, VP of Quality Assurance, RFS USA

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