AUTOMATIC PRESSURIZATION DEHYDRATOR
All APD-C Series

Service Manual

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SECTION 1. DESCRIPTION

The APD20-C and APD70-C Series Automatic Pressurization Dehydrators are designed for reliable pressurization of elliptical waveguide, coaxial cable and rigid line systems. The dehydrators utilize a dual canister, self-reactivating, heatless fractionator process, using high efficiency aluminum-silicate molecular sieve absorbent. The drying system is completely automatic, with no need for replacement or manual reactivation of any absorption material. These units are capable of years of trouble-free service when properly installed, operated and maintained. The APD dehydrators are capable of efficient operation up to 5000 ft in elevation. For service of higher elevation, contact RFS for information.

The APD20-C 60 Hz model is rated at 0.2 SCFM (0.09 liter/sec) and -40°F (-40°C) dry air dew point output at 95°F (35°C) 95% relative humidity input. The APD20-C dehydrator will maintain up to 20000 feet of 3-1/2-inch diameter transmission line.

The APD22-C 50 Hz model is rated at 0.14 SCFM (0.08 liter/sec) and -40°F (-40°C) dry air dew point output at 95°F (35°C) 95% relative humidity input. The APD22-C has a capacity reduction of 17 percent relative to the 60 Hz model.

Both APD20-C and APD22-C dehydrator are available in the normal output pressure range (1.5-10 psig) and special low output pressure range option (1-4 psig).

When used within a 60Hz circuit the APD70-C and APD72-C models are designed for operation in larger systems with up to 1700 feet of 6-inch diameter transmission line. The dehydrator is rated at 0.7 SCFM (0.32 liter/sec) and -40°F (-40°C) dry air dew point output at 95°F (35°C) 95% relative humidity input.

When used within a 50Hz circuit the APD72-C model is rated at 0.58 SCFM (0.27 liter/sec) and -40°F (-40°C) dry air dew point output at 95°F (35°C) 95% relative humidity input. The APD72-C has a capacity reduction of 17 percent relative to use in a 60Hz circuit.

Output pressure is factory set to 3 psig (20.7 kPa) "ON" and 5 psig (34.5 kPa) "OFF". Dehydrator output may be re-adjusted in the field to operate anywhere between 1 and 10 psig (6.9 -69 kPa). Check valves prevent loss of pressure back through the dehydrator and moisture ingress during system idle. A passive low-pressure alarm switch, factory set for 1 psig (6.9 kPa) is included for remote monitoring. A mechanical safety valve to protect the customer system from overpressure is also included.

Standard features include a circuit breaker switch, 0-15 psig pressure gauge, and a visual moisture indicator, which turns dark blue when dry and pink when wet. The dehydrators may be shelf mounted or flush mounted in a standard EIA19" relay rack. The APD70-C Series includes a vented rear cover as standard equipment. Both the APD20-C series and the APD70-C series are IP20 rated. Spare parts are available in section 8.

Figure 1.1  Front view of APD series dehydrator

1. Pressure Gauge (0-15 psi)
2. Moisture Indicator
3. Circuit Breaker (CB)
4. CB Indicator Light
5. Line Voltage Indicator Light
6. Output Pressure Setting
**APD20-C Series Characteristics**

- **Power Source**
  - APD20-C, P/N 920635-C: 115 VAC, 50/60Hz
  - APD22-C, P/N 920637-C: 230 VAC, 50/60Hz

- **Output Ratings**
  - 60 Hz: 0.2 SCFM (0.09 liter/sec)
  - 50 Hz: 0.14 SCFM (0.08 liter/sec)

- **Output Dew Point**
  - -40°F (-40°C)

- **Ambient Inlet Temp.**
  - 33°F-120°F (loC-49°C)

- **Ambient Humidity**
  - 95% Maximum

- **Output Pressure for common Version**
  - Factory Set (on-off): 3-5 psig (20.7 - 34.5 kPa)
  - Field Adjustable range: 1.5-10 psig (10 - 69 kPa)

- **Differential**
  - 2 psig (13.8 kPa) typical

- **Compressor Ratings**
  - ¼ hp

- **Power Consumption**
  - Pumping: 350 watts
  - Idle: 10 watts

- **Low Pressure Alarm**
  - 1 psig (6.9 kPa)

- **High Pressure Alarm**
  - 5 psig (34.5 kPa)

- **Output Fitting**
  - 1/8 NPT x 3/8" OD tubing

- **Dimensions** (in)
  - H x W x D: 12 x 15 x 8

- **Net Weight**
  - 30 lbs (13.5 kg)

- **Shipping Weight**
  - 35 lbs (15.9 kg)

- **Standard Items Supplied:**
  - 20 ft of 3/8" plastic tubing, Swivel Elbow

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**APD70-C Series Characteristics**

- **Power Source**
  - APD70-C, P/N 940019-C: 115 VAC, 0/60Hz
  - APD72-C, P/N 940020-C: 230 VAC, 0/60Hz

- **Output Ratings**
  - 60 Hz: 0.7 SCFM (0.32 liter/sec)
  - 50 Hz: 0.58 SCFM (0.27 liter/sec)

- **Output Dew Point**
  - -40°F (-40°C)

- **Ambient Inlet Temp.**
  - 33°F-120°F (loC-49°C)

- **Ambient Humidity**
  - 95% Maximum

- **Output Pressure for common Version**
  - Factory Set (on-off): 3-5 psig (20.7/34.5 kPa)
  - Field Adjustable range: 1-10 psig (6.9 - 69 kPa)

- **Differential**
  - 2 psig (13.8 kPa) typical

- **Compressor Ratings**
  - ¼ hp

- **Power Consumption**
  - Pumping: 600 watts
  - Idle: 10 watts

- **Low Pressure Alarm**
  - 1 psig (6.9 kPa)

- **Output Fitting**
  - 1/8 NPT x 3/8" OD tubing

- **Dimensions** (in)
  - H x W x D: 12 x 15 x 8

- **Net Weight**
  - 37 lbs (16.8 kg)

- **Shipping Weight**
  - 44 lbs (20 kg)

- **Standard Items Supplied:**
  - 20 ft of 3/8" plastic tubing, Swivel Elbow

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**APD70-C Maximum Dehydrator Capacity Ratings**

- **Base on 2 psi leakage in 24 hrs and 5% running time**

<table>
<thead>
<tr>
<th>Transmission Line</th>
<th>Approximate Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>7/8&quot; 73,000</td>
<td>21,000 feet</td>
</tr>
<tr>
<td>1-5/8&quot; 24,000</td>
<td>7,000 feet</td>
</tr>
<tr>
<td>3-1/8&quot; 7,300</td>
<td>2,100 feet</td>
</tr>
<tr>
<td>6-1/8&quot; 1,700</td>
<td>500 feet</td>
</tr>
<tr>
<td>6 to 12 GHz waveguide 28,000</td>
<td>8,000 feet</td>
</tr>
<tr>
<td>4 to 5 GHz waveguide 14,000</td>
<td>4,000 feet</td>
</tr>
</tbody>
</table>

**Optional Accessories for All APD series**

- P/N 916814-010 High Pressure Alarm
- P/N 920717-001 Press. & Humidity Monitor (115 V)
- P/N 920717-003 Press. & Humidity Monitor (230 V)

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**CAUTION! Remove power before servicing**
SECTION 2. INSTALLATION

2.1 Incoming Inspection

This instrument was inspected and tested mechanically, electrically, and for performance prior to shipment. Before putting it into service, inspect for possible mechanical damage received in transit. If there is damage or deficiency, notify the carrier and Radio Frequency Systems immediately. Shipping damage is unusual but not totally avoidable. Do not accept delivery of containers which show shipping damage.

READ THE MANUAL THOROUGHLY, then, with the manual as a reference, examine the dehydrator. Inspect for any loose parts, as described in figure 7.1 in section 7.

2.2 Mounting

The dehydrators may be installed as portable on its rubber feet. Where the installation requires it, the rubber feet may be replaced with shock/vibration isolating mounts. Wall shelves and relay rack mounting bracket kits are available as optional. (See page 3 for part number.)

The APD series dehydrator requires a firm, level surface with a minimum of 3” clearance on the back for heat release. The site should not be subject to freezing or extremely high temperature as specified in the characteristics section. A reasonably clean location will enhance the service life of the dehydrator.

2.3 Electrical

Connect the dehydrator to appropriate power source. Be sure to connect the power cord only to an electrical outlet that complies with the electrical specification of the dehydrator. Check the label (figure 7.1) for the electrical characteristics. Units powered by 230 VAC, 50/60 Hz will require the addition of an electrical plug purchased locally.

All pressure alarm contacts are passive and power must be supplied externally to the alarm devices. All alarm and monitoring systems are factory installed only.

2.4 Outlet Pressured Air connection

The dehydrator outlet is connected to the customer system using the supplied connectors and tubing. The connectors are push-on quick-connect type, which have a standard 1/8 NPT thread to a 3/8 OD tubing. See figure 2.1 for connection and disconnect. Install the fitting to the waveguide system, but do not connect the dehydrator until after start-up session in 2.5.3. Make sure a threaded connection being made to the dehydrator and the system are made with Teflon sealing tape to prevent unnecessary air leakage.

Leaky system can cause excessive running and reduced compressor life.

2.5 Operation

2.5.1 Purging

The transmission line system should be purged of moisture with dry nitrogen before the dehydrator is placed into service. This will save excessive dehydrator running time during start up.

2.5.2 Capacity Ratings

The dehydrator should be of sufficient output capacity to accommodate the calculated line volume and anticipated leak rate. A duty run cycle between 1 and 5 percent per day should be maintained for lowest possible line humidity. A unit too large for the line volume may not operate long enough to purge the system of moisture. A dehydrator should run for a minimum of 3 minutes to recover from a line drop of 2 psig. The dehydrator running time (minute per day) can be calculate as following:

\[
\text{Run Time} = \left[ \frac{\text{Air Lost Volume}(\text{ft}^3/\text{day})}{\text{Dehydrator Output}(\text{ft}^3/\text{min})} \right]
\]

See "Maximum Dehydrator Capacity Ratings" table on page 3 for recommended transmission line length.

2.5.3 Start-Up

Turn the circuit breaker switch ON. Allowing the unit to initially operate, exhausting to the atmosphere until the visual humidity indicator turns to dark blue color. This insures the proper dry air delivery. After this drying period, turn the circuit breaker switch OFF.

Connect the unit's outlet to the line to be pressurized using the polyethylene tubing provided (see figure 2.1). After making connection, turn the switch ON. Operation is completely automatic; no further attention should be required.

2.5.4 Shut-Down

Turn the circuit breaker switch OFF.

2.5.5 Humidity Indicator

The humidity indicator provides a visual means to determine whether the dehydrator is furnishing dry air to the system. The indicator contains a substance that changes color from dark blue when dry to pink when wet.
SECTION 3. PRINCIPLES OF OPERATION

The Automatic Pressurization Dehydrators consist of the following major components:

- 3.1 Self-lubricated compressor
- 3.2 Time delay relay and solenoid valve
- 3.3 Drying chambers (cylinder assembly)
- 3.4 Check valves
- 3.5 Pressure switch
- 3.6 Humidity indicator
- 3.7 Low pressure alarm contacts
- 3.8 Outlet pressure gauge
- 3.9 Circuit breaker and light indicators
- 3.10 Rear Cover
- 3.11 Various Markings and Symbols

Ambient air flows through the intake filter into the compressor. The compressed air then travels to the cylinder assembly, where moisture is absorbed. A small portion of dry air will be used to flush the cylinder of moisture, and the rest will go to the customer line.

3.1 Compressor

The compressor's bearings are pre-lubricated ball bearings. No additional lubrication is necessary. The compressor has an integral safety relief valve to prevent over-pressure. It also has an internal thermal-protected circuit breaker, which trips when overheated.

3.2 Solenoid Valve and Timer

The four-way solenoid valve admits compressed air from the compressor to the drying chambers where moisture is absorbed. A small portion of the dry air leaving the active drying chamber is directed downward through the idle chamber, purging the moisture it had absorbed during its last drying cycle. As the solenoid valve switches the chamber, the air pressure in the drying chamber flushes the moisture through the exhaust port of the solenoid valve. The flushing and continuous purging will ensure the chamber is dry before its next drying job.

Solenoid valve switching cycle is controlled by the timer relay (Timer), which alternates the solenoid valve every 45 seconds. The switching from drying to purging is evidenced by a rush of air from the chamber that is being vented out of the solenoid exhaust. At no time should this vent be restricted.

3.3 Drying Chamber (Cylinder Assembly)

The dehydrator consists of two cylindrical desiccant chambers, which contain moisture absorption agents to dehydrate the air before sending it to the customer system. At any instance, one chamber will act as drying while the other is being purged. In the consecutive cycle, the drying becomes the venting and visa versa. The purging operation will flush the trapped moisture to the atmosphere through the solenoid valve exhaust port.

3.4 Check Valves

An inline check valve isolates low pressure from high pressure within the dehydrator, and also prevents loss of system pressure when the dehydrator is at idle.

Another check valve is located at the solenoid valve exit port called "POP-OFF" valve. This valve will only allow wet air to leave the dehydrator, and block moisture ingress during system idle when the compressor is not running.

A third safety relief valve is located just before the connection. (See figure 7.2). This valve provides a mechanical means of protection against overpressure; in case the pressure switch malfunctions. The safety valve was set at the factory to 15 psig for standard systems and 5 psig for low pressure operation.

3.5 Pressure Switch

The pressure switch monitors the pressure in the external system. When the unit has pumped the system up to a preset pressure, the switch automatically shuts off the pumping operation. When pressure drops to a lower preset figure, the switch restarts the pump.

3.6 Humidity Indicator

The humidity (moisture) indicator is located on the front panel of the dehydrator. The visual moisture indicator is dark blue when dry air is being delivered and pink when wet.

3.7 Low Pressure Alarm

The low-pressure alarm is a normally close (NC) single pole, single throw (SPST) circuit switch, which preset to 1±0.3 psig. The alarm contacts are passive and power must be supplied externally to the alarm device.

High-pressure (HP) alarms are available as optional. The HP alarms normally open (NO) single pole, single throw (SPST) circuit switch. See page 3 for part number.

All alarm terminals are located on the lower right back of the dehydrator. (See figure 7.1).

3.8 Outlet Pressure Gauge

The pressure gauge is located on the front panel and has a range of 0-15 psig. The pressure gauge monitors the external pressure, which is the same pressure that the pressure switch (3.5) is operated.

3.9 Circuit Breaker (On/Off Switch) and Indicator Light

The circuit breaker is a single pole thermal over-current circuit breaker with press-to-reset, tease-free, trip-free, snap action mechanism. The switch shipped in its OFF position (the white strip exposed); to turn on, press the switch once, the breaker switch indicator light (red) should be lit. Press the switch again to turn off. To reset the switch after it has tripped, press off then press again to turn it on.
3.10 Rear Cover
The dehydrator should always be operated with the rear cover secured properly in place. Exceptions to operating the dehydrator without the rear cover in place would be limited to when the dehydrator is located and operated within a properly ‘locked out’ cabinet or panel.

3.11 Explanation of Markings (Symbols)

**Hazardous Voltage:** Disconnect power before opening.

**Automatic Equipment:** Equipment starts automatically.

**Maximum Outlet Pressure:** Will not exceed 20 PSI.

**Read Service Manual:** Read Service Manual before opening.

**Hot Surface:** May exceed 65°C. Allow to cool before servicing.
SECTION 4. ADJUSTMENTS AND MAINTENANCE

4.1 Changing ON/OFF pressure

The unit is delivered factory pre-set as shown in table on page 3. The output pressure may be field adjusted to settings between 1 and 10 psig (6.4 & 68.9 kPa). Note that the maximum output pressure is limited to the pre-set safety relief valve (3.4). Also, the differential between ON and OFF is not adjustable.

The pressure setting port is located on the lower right on the front panel. See figure 4.1. To change the output pressure setting, turn setting screw using a small flat screwdriver clockwise to increase and counterclockwise to decrease. Typically, an increase of about 5 psi for every 90 degree turn.

![Figure 4.1: Output Pressure Setting](image)

4.2 Compressor

The compressor inlet filter is located on the compressor head. This must be kept clean and should be inspected on a regular basis. A monthly schedule is recommended for checking.

Unscrew the die-cast metal body and remove the felt pad. Wash the pad thoroughly in solvent; dry completely before re-installing back into the body. Replace the filter when the pad is worn.

Never operate the unit without an inlet filter, as this will allow dust and foreign particles to enter the compressor head, which will reduce the compressor performance and life. Depending on the environment for dehydrator service, we recommend the filter be replaced every two years.

4.3 Dehydrator Maintenance Kit (p/n 920641)

The dehydrator service kit contains (2) swivel elbows (1/8 NPT to 3/8 OD tubing); 20 ft of 3/8 OD plastic tubing; 3 ft of ¼ OD plastic tubing; (2) light indicators (amber and red); and a filter for the compressor.

Other replacement parts are also available.

Again anytime threaded connectors are undone and replaced or rethreaded, new Teflon tape should be used on the threads.

SECTION 5. TROUBLESHOOTING

5.1 Failure to Start

5.1.1 Check the power source. The "line voltage indicator" light should be lit if the power source is connector properly. Measure and confirm the supply voltage.

5.1.2 If the breaker indicator light is off when the circuit breaker switch is in the ON position, the circuit breaker has tripped and must be reset. (See section 3.9).

5.1.3 The compressor may be overheated. Let the motor cool down for a few minute, then restart the dehydrator. The motor overheating may be an indication of excessive run time due to system leak or blockage.

5.1.4 Check internal wiring.

WARNING: Remove the power before accessing the bottom box to check for internal wiring.

5.2 Humidity Indicator Shows Pink

5.2.1 Disconnect the polyethylene tubing from the line and operate the unit discharging the air to atmosphere until the indicator shows blue.

5.2.2 The compressor filter may be worn.

5.2.3 The desiccant chambers may require service.

5.3 Unit turns ON& OFF rapidly before line is pressurized

5.3.1 Tubing may be kinked and/or blocked.

5.3.2 The line being pressurized is too restrictive (pneumatic resistance too high). Introduce a surge volume (pneumatic cushion) between the unit and the line.

5.4 Unit runs excessively (more than 30%)

5.4.1 Check both the transmission line and the interconnecting tubing for leaks. Repair any leak found.

5.4.2 Check the dehydrator internal system for leakage. Block the outlet port, then pressurize the system up to approximately 9 psi, and then watch the dial gauge. This can be done by blocking the outlet port and watching the pressure gauge. Repair any leak found.

WARNING: Remove the power before accessing the bottom box to check for internal leak or repair.

5.5 Low System Output Pressure

5.5.1 Check pressure at the cylinder assembly. The cylinder pressure in drying cycle should be greater than 40 psig.

5.5.2 Compressor may be worn out.

5.5.3 Leak at connection from the Compressor to the cylinder and solenoid valves. Make sure threaded joints are taped properly.

5.5.4 Site ambient pressure is too low. Site altitude may be higher than 5000 ft.
SECTION 6. SCHEMATIC DIAGRAMS

Figure 6.1: Electrical Schematic Diagram

Figure 6.2: Pneumatic Schematic Diagram
SECTION 7. ILLUSTRATION

1. Label, Dehydrator Info.
2. Compressor Inlet Filter
3. Cylinder Assembly
4. Compressor
5. 3/8 OD Tubing (20 ft)
6. Straight Connector (outlet)
7. Power Input (shown 115V)
8. Alarm Terminal

Note: For 115V, power cord and wall plug is attached as standard. For 230V, cord with connection IEC plug is shipped loose. 230V wall plug is not included.

Figure 7.1 Back view of APD series dehydrator

Figure 7.2 is intended for illustration purpose only - Do not open this bottom cover unless it is necessary for replacement of parts.

WARNING: Remove Power before Opening the Bottom Cover.

1. Time Relay Delay
2. Solenoid Valve
3. Pop-off Valve
4. Pressure Switch
5. Safety Relief Valve
6. Main Terminal with cover
7. Manifold
8. Low Pressure Alarm
9. 40 PSI in-line Check Valve

Figure 7.2 Bottom view of APD series dehydrator with cover removed
## SECTION 8. SPARE PARTS LIST

**WARNING:** Remove the power before access to the bottom box for service.

<table>
<thead>
<tr>
<th>Item</th>
<th>Qt/Unit</th>
<th>P/N</th>
</tr>
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<tbody>
<tr>
<td>Lens O-ring (moisture indicator)</td>
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<td>520681-023</td>
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<tr>
<td>Felt pad (moisture indicator)</td>
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<tr>
<td>Color Change Moisture Ind. Gel</td>
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<td>Lens (moisture indicator)</td>
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<tr>
<td>Wire Screen (moisture indicator)</td>
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<tr>
<td>Coupling Nut (moisture indicator)</td>
<td>1</td>
<td>914057-004</td>
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<td>Pressure Switch (for normal pressure)</td>
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<td>Pressure Gauge</td>
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<td>Compressor 115V (for APD-20)</td>
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<td>Compressor 230V (for APD-22)</td>
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<td>Compressor 115V (for APD-70/73)</td>
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<td>Compressor 230V (for APD-72)</td>
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<td>Compressor Vibration Isolator</td>
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<td>Compressor Filter Assembly¹</td>
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<td>Dehydrator Rubber Feet</td>
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<tr>
<td>Red Light (breaker indicator light)¹</td>
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</tr>
<tr>
<td>Amber Light (line voltage indicator)¹</td>
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<td>913654-002</td>
</tr>
<tr>
<td>Circuit Breaker Switch, space terminal¹</td>
<td>1</td>
<td>916812</td>
</tr>
<tr>
<td>3/8&quot; OD Polyethylene Tubing (black)¹</td>
<td>20 ft</td>
<td>913348-240</td>
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<tr>
<td>3/8&quot; OD Nylon (white)</td>
<td>1 ft</td>
<td>913928-012</td>
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<tr>
<td>Male Elbow, Swivel, 1/8 NPTm to 3/8 tubing¹</td>
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<td>Male Elbow, Swivel, 1/4 NPTm to 1/4 tubing</td>
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<tr>
<td>Dehydrator maintenance parts kit</td>
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<tr>
<td>Low pressure alarm, (black terminal)</td>
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<td>916814-001</td>
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</tbody>
</table>

1) Included in the maintenance parts kit, p/n 920641

**CAUTION!** Remove power before servicing
WARRANTY

The Seller warrants that, at the time of shipment, the products manufactured by the Seller are free from defects in material and workmanship. The Seller's obligation under this warranty is limited to replacement or repair of such products within one year from the date of shipment.

The Seller is in no event liable for consequential damages, installation cost or other costs of any nature as a result of the use of the products manufactured by the Seller, whether used in accordance with instruction or not. This warranty is in lieu of all others, either expressed or implied. No representative is authorized to assume for the Seller any other liability in connection with the Seller's products.