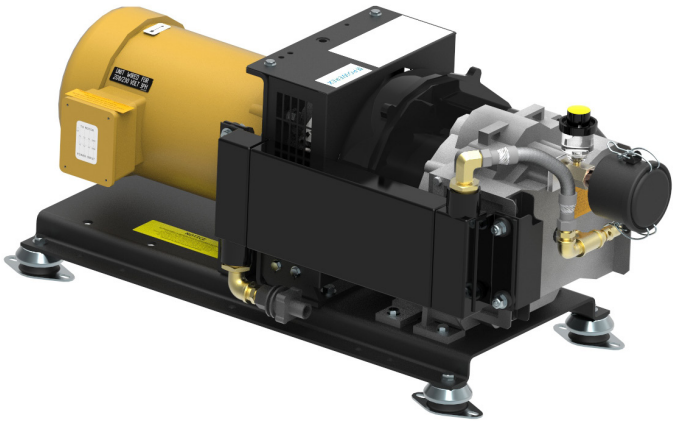
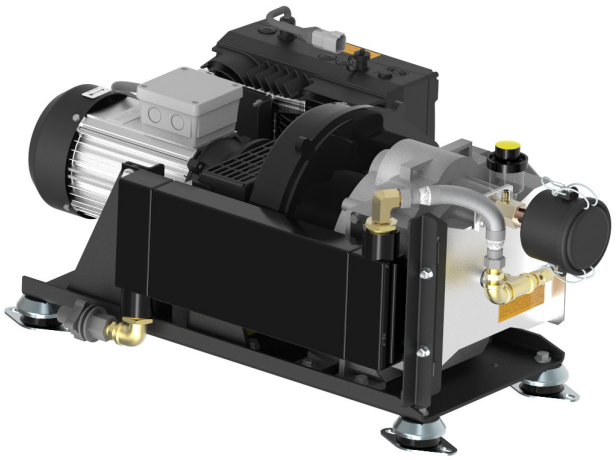
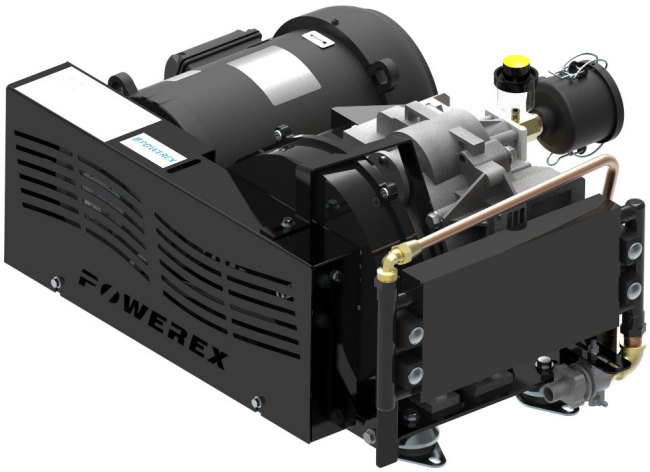
# 5HP Transportation Air Compressors
## Operating & Maintenance Manual

*Please read and save these instructions. Read carefully before attempting to assemble, install, operate or maintain the product described. Protect yourself and others by observing all safety information. Failure to comply with instructions could result in personal injury and/or property damage! Retain instructions for future reference.*







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# 1. General Information

This manual focuses on the two major compressor architectures that Powerex provides for Transportation applications: Scroll Direct Coupled (SDC) and Scroll Basemount Beltdrive (SBB).

The Powerex compressor in its simplest state is a motor connected to a scroll air end via either a coupling or a belt. From there, Powerex has many variations from that basic setup to systems with an enclosure, built-in controls, and an air dryer. The system you have purchased or received on a vehicle may vary from the images found in this manual due to minor differences in configurations. The following is a list of optional components which may or may not be included:

- Direct mounted inlet air filter
- Air filter restrication indicator
- Isolator mounts
- Aftercooler
- Belt guard
- Check valve
- Pressure relief valve
- Power Inverter

Along with the various add-ons listed above, Powerex also has a variety of baseplates due to varying customer needs. Though the baseplate may look different, the same maintenance requirements and procedures apply.

## Safety Guidelines

This manual contains information that is very important to know and understand. This information is provided for SAFETY and to PREVENT EQUIPMENT PROBLEMS. To help recognize this information, observe the following symbols:

**⚠DANGER** Danger indicates an imminently hazardous situation which, if not avoided, WILL result in death or serious injury.

**⚠WARNING** Warning indicates a potentially hazardous situation which, if not avoided, COULD result in death or serious injury.

**⚠CAUTION** Caution indicates a potentially hazardous situation which, if not avoided, MAY result in minor or moderate injury.

***NOTICE*** Notice indicates important information, that if not followed, may cause damage to equipment.

NOTE: Note indicates information that requires special attention.

## Breathable Air Warning

**⚠WARNING** This compressor/pump is NOT equipped and should NOT be used "as is" to supply breathing quality air. For any application of air for human consumption, you must fit the air compressor/pump with suitable in-line safety and alarm equipment. This additional equipment is necessary to properly filter and purify the air to meet minimal specifications for Grade D breathing as described in Compressed Gas Association Commodity Specification G 7.1 - 1966, OSHA 29 CFR 1910. 134, ANSI and/or Canadian Standards Associations (CSA).

### DISCLAIMER OF WARRANTIES

IN THE EVENT THE COMPRESSOR IS USED FOR THE PURPOSE OF BREATHING AIR APPLICATION AND PROPER IN-LINE SAFETY AND ALARM EQUIPMENT IS NOT SIMULTANEOUSLY USED, EXISTING WARRANTIES ARE VOIDED, AND POWEREX DISCLAIMS ANY LIABILITY WHATSOEVER FOR ANY LOSS, PERSONAL INJURY OR DAMAGE.

**⚠WARNING** Never operate compressor without protective guards. This unit can start automatically without warning. Personal injury or property damage may occur from contact with moving parts.

**⚠WARNING** Always follow appropriate lockout tagout procedures to isolate the compressor from electrical and pneumatic energy prior to doing any work on the air compressor.

## 1.1 Oil-less Scroll Technology

Our innovative scroll technology is completely oil-less, extremely quiet, and energy efficient. The scroll pump has few moving parts, making it reliable and easier to maintain. The self-lubricating tip seals and absence of a gearbox means the pump is completely oil-less.

### 1.1.1 Scroll Compression Cycle

The Powerex oil-less rotary scroll air compressor is based on the theory of scroll compression. A scroll is a free standing, intricate spiral bounded on one side by a solid, flat plane or base. A scroll set, the basic compression element of a scroll compressor, is made up of two identical spirals which form right and left-hand parts. One of these scroll components is indexed or phased 180° with respect to the other so the scrolls can mesh. Crescent-shaped gas pockets are formed and bounded by the spirals and the base plate of both scrolls. As the moving scroll is orbited around the fixed scroll, the pockets formed by the meshed scrolls follow the spiral toward the center and diminish in size as shown in Figure 1. The moving scroll is prevented from rotating during this process, so the 180° phase relationship of the scrolls is maintained. The compressor's inlet is at the outer boundary of the scrolls. The compressed gas is discharged through the outlet at the center of the fixed scroll, so no valves are needed.

### 1.1.2 Oil-less Benefits

By using surface coatings and self-lubricating seals, the process air path is completely free of oil. Some advantages of an oil-less compressor are:

- Reduced compressor maintenance
  - Oil-less compressors still require maintenance, but there is no need to worry about oil leaking out and requiring frequent checks and replenishment
- No risk of oil fires associated with oiled compressor technologies
- Extended dryer desiccant cartridge life
  - Eliminating oil from the compressed air path eliminates dryer desiccant fouling due to compressor oil.

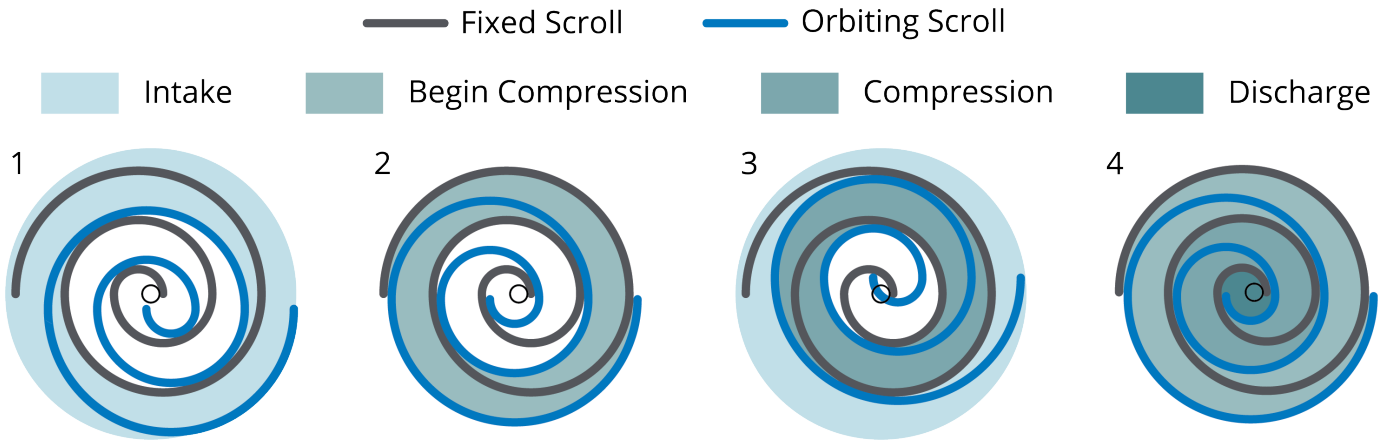


Figure 1: Scroll Compression Cycle


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## 1.2 Terminology

**Air end** – mechanical component of the air compressor which does the work of compressing air. May also be referred to as the pump.

**Aftercooler** – heat exchanger used to remove heat from compressed air.

**Direct Coupled** – Air end and motor coupled via an in-line torsional coupling

**Fixed Scroll (FS)** – cast aluminum component of the air end which is comprised of scroll wraps and cooling fins which is installed in a fixed position (see Figure 2)

**Ingress Protection (IP) Rating** – a standard guideline to the degree of protection provided by electrical enclosures against intrusion, dust, accidental contact, and water.

**Oil-less** – no oil used anywhere in the machine

**Orbiting Scroll (OS)** - cast aluminum componenet of the air end which is comprised of scroll wraps and cooling fins which is installed on bearings that allow orbital motion which is caused by an input shaft throw (see Figure 2)

**Pump** – see air end

**PMAC** – Permanent Magnet Alternating Current

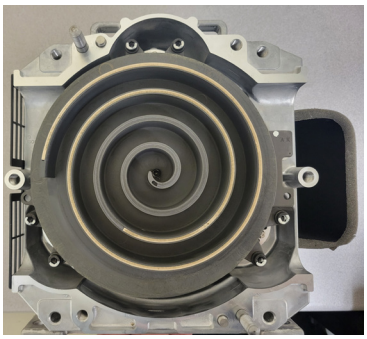
**Pressure -** Powerex scroll compressors are available in two pressure ratings:

**Standard Pressure -** 116 PSI-G (0.8 MPa-G)

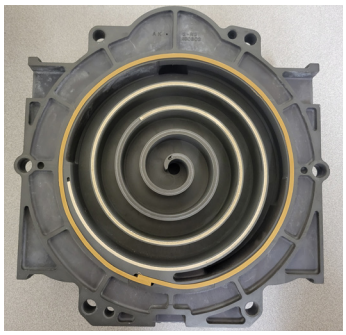
**High Pressure -** 145 PSI-G (1.0 MPa-G)

**Scroll Wrap** – spiraled wall in the scroll air end (see Figure 3). May also be referred to as a scroll fence.

**Tip Seal** – PTFE seal that prevents air from escaping the compression pocket as the air is pushed through the scroll. This seal is seated in the groove on top of the scroll wraps. (See Figure 4)



Orbiting Scroll



Fixed Scroll

Figure 2

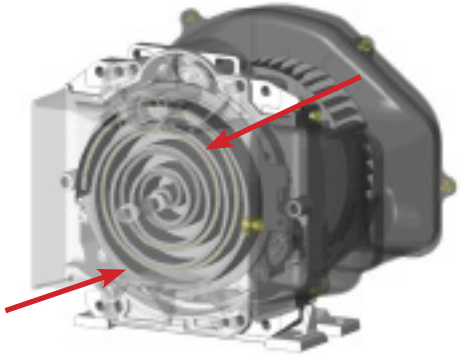


Figure 3

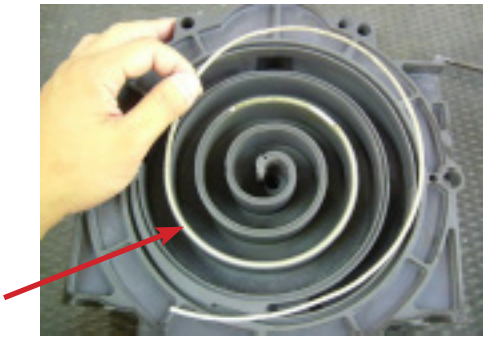


Figure 4

## 1.3 Application Guidelines

### 1.3.1 Ambient Temperature and Duty Cycle

Powerex Transportation compressors are rated for 100% duty cycle up to 40°C ambient temperature. Ambient temperature is defined as the temperature of the air directly surrounding the air compressor. Above 40°C, it is acceptable to rate in a linear relationship up to the rating of 30% duty cycle at 60°C as show in Figure 5 below. Powerex recommends that the vehicle designer analyze and test to verify that these conditions are met to ensure reliable compressor operation.

$$duty\ cycle\ \% = -\ 7/2\ (Temp\ °C) + 240$$

Equation 1: Duty Cycle Calculation Above 40°C and up to 60°C

$$duty\ cycle\ \% = 7/36\ (140 - Temp\ °F) + 30$$

Equation 2: Duty Cycle Calculation Above 104°F and up to 140°F

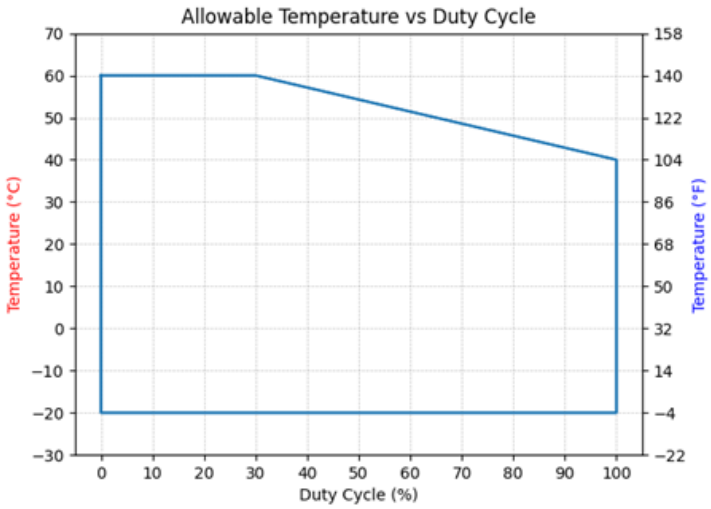



Figure 5: Maximum Temperature at Duty Cycle Limits

Example Duty Cycle and Hourly Runtime Calculation:

Determine the maximum allowable duty cycle at 53°C:

$$duty\ cycle\ \% = -\ 7/2\ (53\ °C) + 240 = 54.5\%$$

$$hourly\ run\ time = 54.5\% * 60\ min/hr = 32.7\ minutes$$

Therefore at 53°C, the maximum allowable duty cycle is 54.5% and the runtime is not to exceed 32 minutes every hour.

Determine the maximum allowable duty cycle and maximum hourly run time at 125°F:

$$duty\ cycle\ \% = 7/36\ (140\text{-}125) + 30 = 59.2\%$$

$$hourly\ run\ time = 59.2\% * 60\ min/hr = 35.5\ minutes$$

Therefore at 125°F, the maximum allowable duty cycle is 59.2% and the runtime is not to exceed 35 minutes every hour.

### 1.3.2 Altitude Performance Characteristics

Powerex performance figures are rated up to an altitude of 1,000 m (3,281 ft) above Mean Sea Level. Consultation with Powerex about performance is mandatory **PRIOR TO OPERATION** for operation in elevations above 1,000 m (3,281 ft).

### 1.3.3 Inlet Air

The process air intake should be located a clean environment, relatively free of dust, salt, debris, liquids, or other contaminants. This helps prevent the pump from ingesting these materials, which can damage the scrolls and lead to pump failure. Additionally, air that is too dirty can prematurely clog the intake filter. An extremely clogged filter, while unlikely to happen, can cause enough intake vacuum to cause pump failure. Some compressor models include a restriction indicator on the intake path that provides a visual signal to indicate this condition without removal of the filter housing lid.

Additionally, for best performance inlet air should be relatively cool. Not only is cooler air less likely to cause wrap damage, but hotter air is less dense than cooler air is. As a result of the decreased density in higher temperatures, compressor mass flow will be reduced when intake air temperature is high. If the compressor is in a location where the temperature is greater than the outside ambient temperature, it may be beneficial to use a snorkel to bring in ambient air that is cooler than the air around the compressor. However, any snorkel design must be approved by Powerex prior to operation.

### 1.3.4 Compressed Air Plumbing

Discharge lines should be routed such that pooling of liquid water is discouraged. Condensate in the discharge, if allowed to accumulate, can freeze when the compressor is used in cold weather. It is possible for ice to build up enough to create a blockage. Figures 6 and 7 can be used to give an approximation of how much water will be discharged at 100% duty cycle but are to be used for **REFERENCE ONLY** as they may not reflect actual operational discharge condensation. Note that maximum condensation will occur at 100% humidity at 40°C (104°F) as temperatures above this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require decreasing the duty cycle which will result in less water condensation.

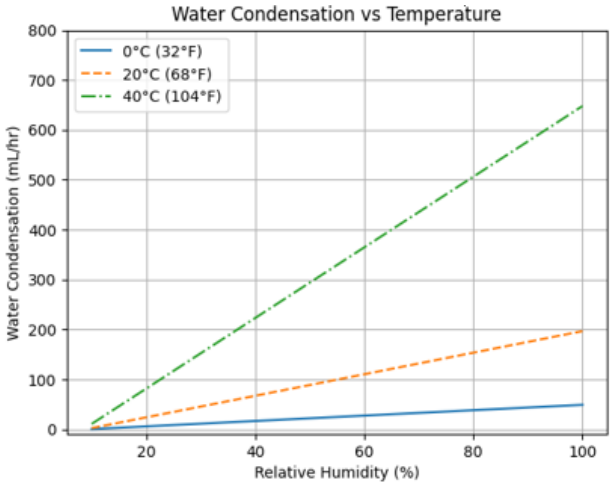


Figure 6: High Pressure Approximate Hourly Water Condensation at Discharge 100% Duty Cycle

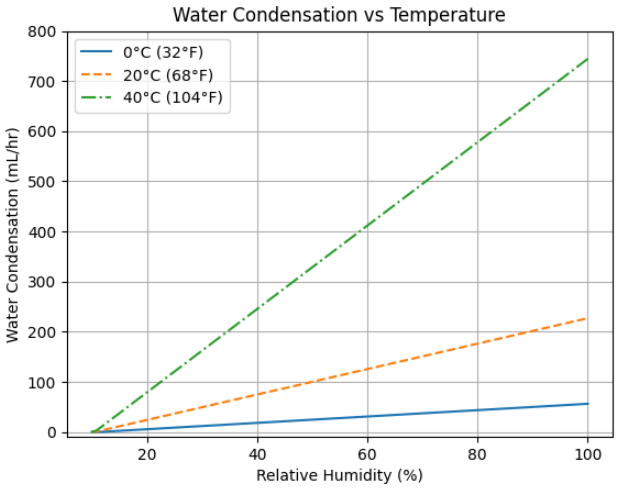


Figure 7: Standard Pressure Approximate Hourly Water Condensation Discharge at 100% Duty Cycle

Systems supplied without an aftercooler require a check valve and ASME pressure relief valve to be installed downstream of the compressor discharge to prevent damage from extended reverse rotation of the compressor and over pressurization due to downstream blockages, respectively.

### 1.3.5 Water Exposure

For a long service life, Powerex recommends installing the compressor in a location that is protected from direct road spray.

Powerex transportation compressors are currently available with a variety of IP ratings. These ratings must be reviewed and understood by the end user so that they are not violated. Powerex does not recommend use of high-pressure water to clean the compressor.

**NOTICE** This compressor is not designated for immersion in water or for washing with high pressure jets.

### 1.3.6 Starts per hour

To maintain the service life of the motor, air receiver volume and compressor control strategy should be designed to ensure that the compressor is not started and stopped excessively. Powerex recommends the target of less than 16 starts per hour with a 40 second rest period between starts. If the control strategy involves soft starting, the number of starts per hour may be increased and the rest period decreased.

### 1.3.7 Maintenance Considerations

Unless removing the compressor to perform standard maintenance is expected, all the procedures in Section 3 of this manual should be reviewed and clearance sufficient for completing those procedures should be provided around the air end portion of the compressor. One example of this is the orbital scroll grease access point called out in Figure 8 and Figure 9. If needed, Powerex offers an optional air end with a second orbital scroll grease access point as shown in Figure 10.

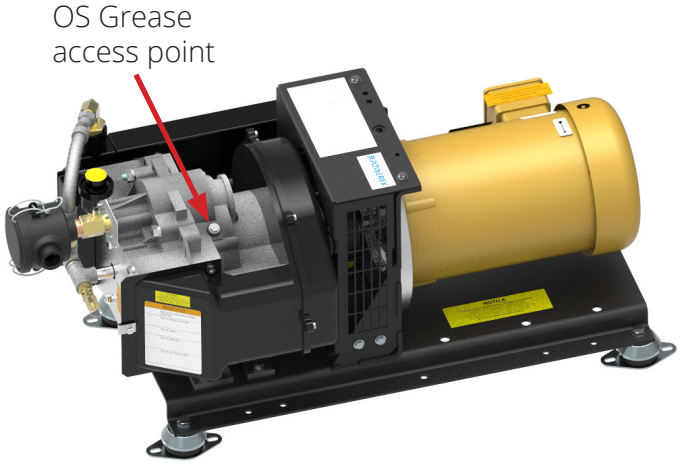


Figure 8

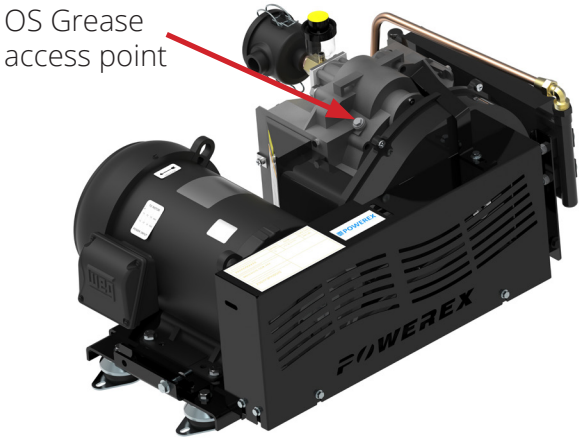


Figure 9

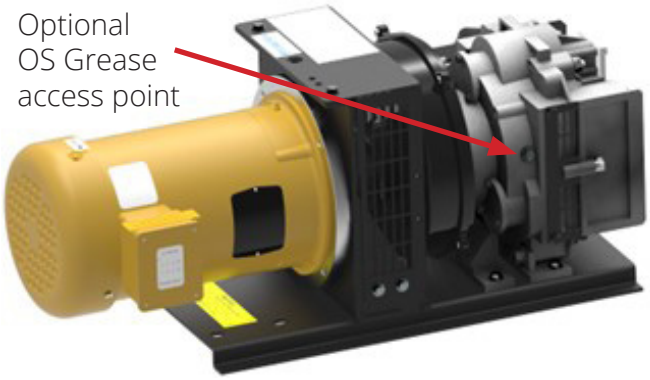


Figure 10

All Powerex maintenance intervals are based on hours of compressor operation. Performing maintenance based on bus hours or miles is not ideal. Powerex strongly recommends that the vehicle OEM monitor and log the time that the compressor operates. This will assist the end user in determining the appropriate time to complete the required compressor maintenance.

If direct measurement of operation time is not possible, compressor operating hours may be estimated as follows:

*Vehicle Operating Hours x Compressor Duty Cycle = Compressor Operating Hours*

To complete this calculation, the vehicle manufacturer may be able to provide the expected duty cycle based on their air system design and testing.

DISCLAIMER: Due to variation in vehicle design and use case, the above formula is only an estimation. Without care and diligence in its application, results may or may not be sufficient in determining compressor operating hours. It is the responsibility of the vehicle OEM to provide the end user with a method of correctly determining when a maintenance interval has been reached.

### 1.3.8 Uncrating

Standard crating for Powerex Transportation compressors consists of a plywood crate to protect the compressor during shipping. For best results, the top and all four sides of the crate should be removed prior to removing the compressor. Guidelines for lifting and handling the unit may be found in Section 2. The compressor will be mounted to the pallet with bolts to prevent movement during shipping and handling—be sure to remove all compressor to pallet fasteners prior to lifting to avoid damaging the compressor.

**NOTICE** Be sure to remove all compressor to pallet fasteners prior to lifting to avoid damaging the compressor.

Upon receipt of the compressor system, the unit should be inspected for any damage which may have occurred in shipment. Any shipping damage must be immediately filed with the freight carrier. Repair or replace damaged items before use.

**⚠WARNING** Do not operate unit if damaged during shipping, handling, or use. Damage may result in bursting and cause injury or property damage.

**NOTICE** Should you need to return a compressor to Powerex, please be sure to fasten it to the pallet to prevent damage during shipping and handling. Powerex will not be responsible for damages caused by failing to secure or improperly securing a compressor for return shipment.

**NOTICE** When replacing a pump or compressor, all plumbing must be thoroughly cleaned out or replaced. This includes all fittings and hoses on the intake side of the pump up to and including the air filter assembly. It also includes all plumbing and components downstream of the air end (pump), up to and including the nearest check valve. If any debris is left in those areas, the new pump is likely to ingest this debris and fail.


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### 1.3.9 System and Major Component Identification

This section highlights the location of key information on the various decals and nameplates found on a Powerex compressor. For the specific locations of these labels, see the Typical System and Major Component Identification Locations for each system architecture in Section 2.

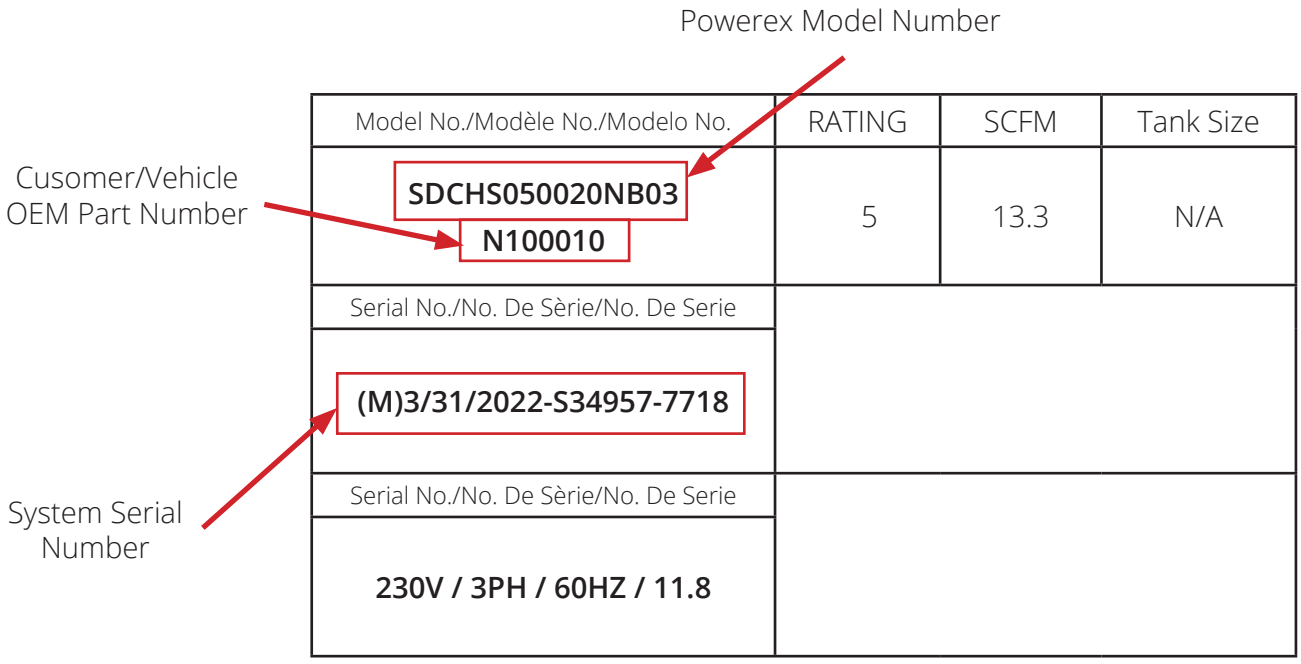


Figure 11: Powerex System Spec Decal

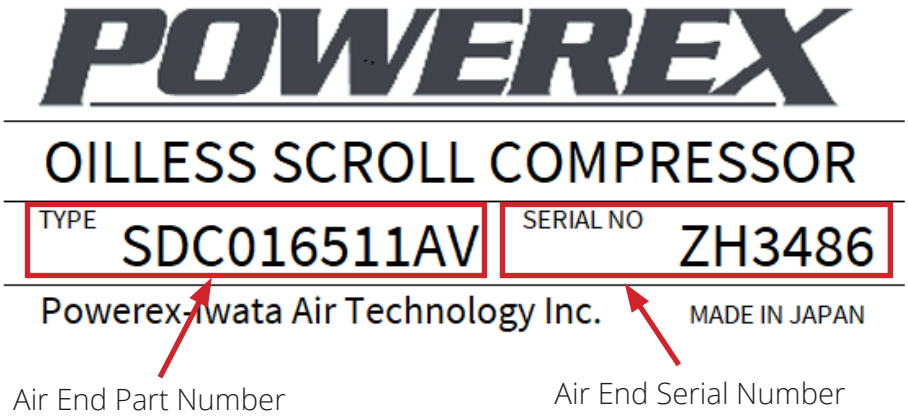


Figure 12: Air End Nameplate

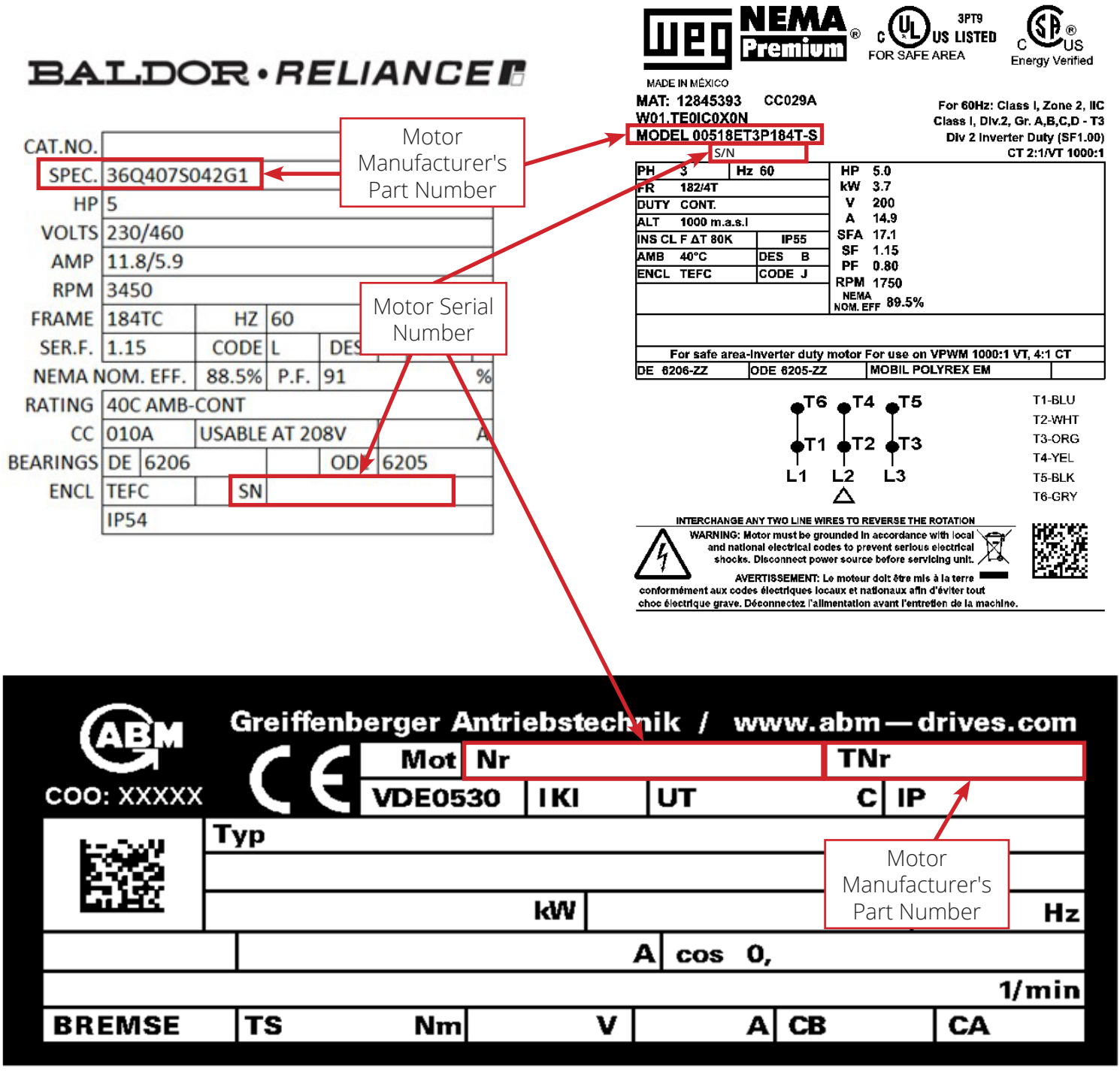


Figure 13: Examples of Motor Nameplates found on Powerex Compressors


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### 1.3.10 Powerex Transportation Model Numbering

The compressor Model Number contains a variety of information about the compressor. The diagram below shows what each segment of the Model Number indicates.

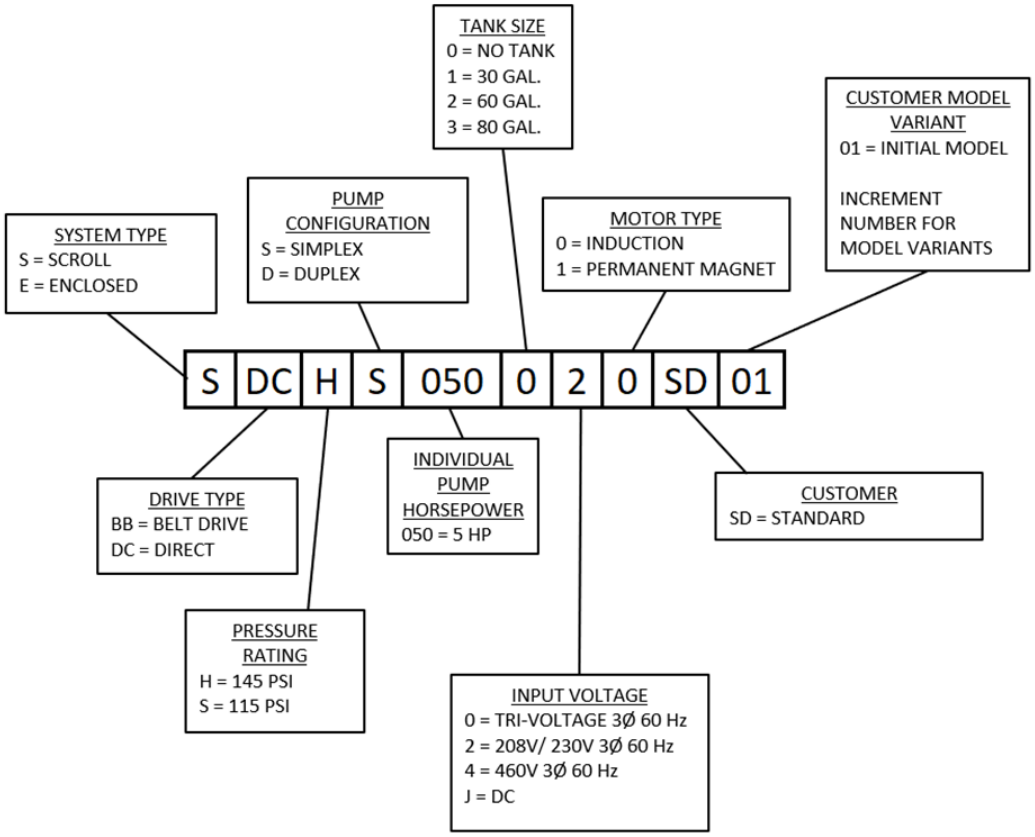


Figure 14

# 2. Architecture Specific Information

## 2.1 Scroll Direct Coupled (SDC)

### 2.1.1 Maintenance Schedule

Table 1 and Table 2 below indicate the maintenance required based on hours of compressor operation. Please refer to Section 1.3.7 or the vehicle OEM for additional information on how to determine the compressor's operating hours.

Please note that the maintenance intervals vary based on the model of compressor you have. Compare the Powerex Model Number found on the Powerex System Spec Decal (see Figure 11 and Figure 16) to the Powerex Transportation Model Numbering Diagram found in Section 1.3.10. If the Pressure Rating is 145 PSI, follow the intervals in Table 1. If the Pressure Rating is 115 PSI, follow the intervals in Table 2.

Table 1: High Pressure (145 PSI-G) SDC Compressors

| Item | Action Required | Operating Hours | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 2,000 | 4,000 | 6,000 | 8,000 | 10,000 | 12,000 | 14,000 | 16,000 |
| Inlet Air Filter | Replace | Δ | Δ | Δ | Δ | Δ | Δ | Δ | Δ |
| General Inspection | Clean | Δ | Δ | Δ | Δ | Δ | Δ | Δ | Δ |
| Cooling Fan | Clean | | Δ | | Δ | | Δ | | Δ |
| Fan Duct | Clean | | Δ | | Δ | | Δ | | Δ |
| Scroll Cooling Fins | Clean | | Δ | | Δ | | Δ | | Δ |
| Bearings | Grease | | Δ | | Δ | | Δ | | Δ |
| Tip Seals | Replace | | Δ | | Δ | | Δ | | Δ |
| Check Valve (If equipped) | Replace | | | | Δ | | | | Δ |
| Heat Insulation Pipe | Replace | | Δ | | Δ | | Δ | | Δ |
| Drive Coupling | Replace | | | | | | | | Δ |

Table 2: Standard Pressure (116 PSI-G) SDC Compressors

| Item | Action Required | Operating Hours | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 2,000 | 4,000 | 6,000 | 8,000 | 10,000 | 12,000 | 14,000 | 16,000 |
| Inlet Air Filter | Replace | Δ | Δ | Δ | Δ | Δ | Δ | Δ | Δ |
| General Inspection | Inspect | Δ | Δ | Δ | Δ | Δ | Δ | Δ | Δ |
| Cooling Fan | Clean | | Δ | | Δ | | Δ | | Δ |
| Fan Duct | Clean | | Δ | | Δ | | Δ | | Δ |
| Scroll Cooling Fins | Clean | | Δ | | Δ | | Δ | | Δ |
| Bearings | Grease | | | | Δ | | | | Δ |
| Tip Seals | Replace | | | | Δ | | | | Δ |
| Check Valve (If equipped) | Replace | | | | Δ | | | | Δ |
| Heat Insulation Pipe | Replace | | | | Δ | | | | Δ |
| Drive Coupling | Replace | | | | | | | | Δ |

Notes:

1. This maintenance schedule is a standard schedule for Powerex compressors. Vehicle OEM's may work with Powerex to adjust this to be specific to vehicle design, causing minor differences between Powerex and OEM maintenance intervals and instructions. Consult the vehicle OEM as needed for clarification.

2. If the air end reaches 3 years and has not yet accumulated the minimum run hours specified in the tables above, perform the greasing operation for the bearings, with the amount of grease reduced by 25%.


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### 2.1.2 SDC with Induction Motor

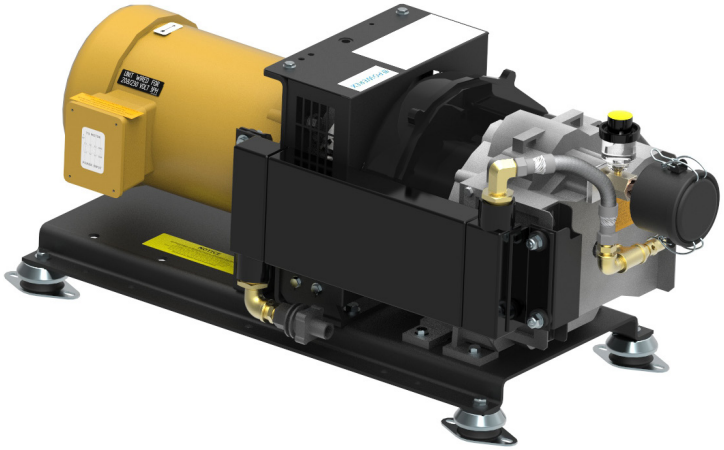

Figure 15

#### 2.1.2.1 Typical System and Major Component Identification Locations

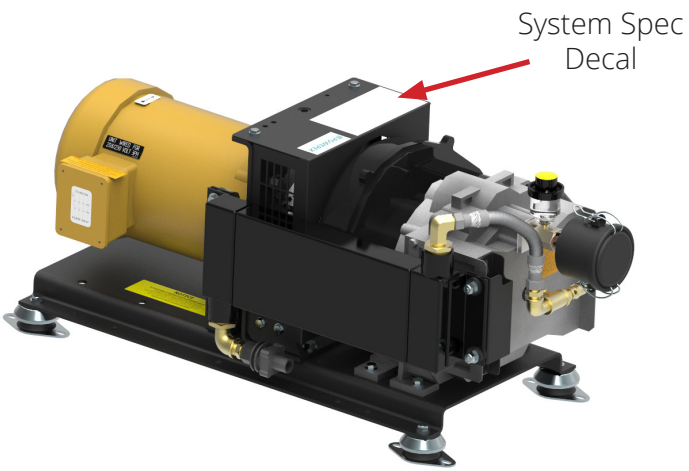


Figure 16

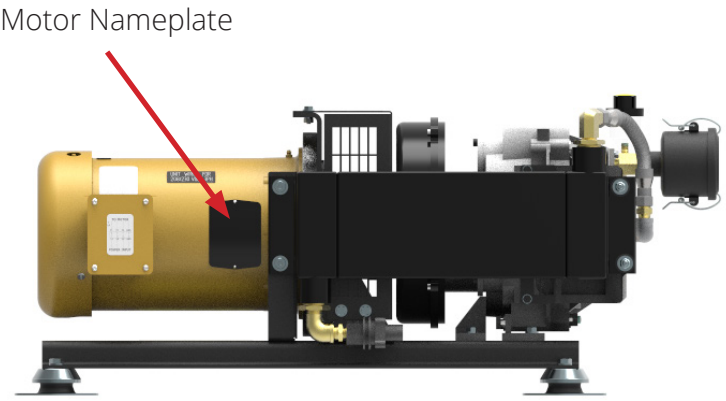


Figure 17

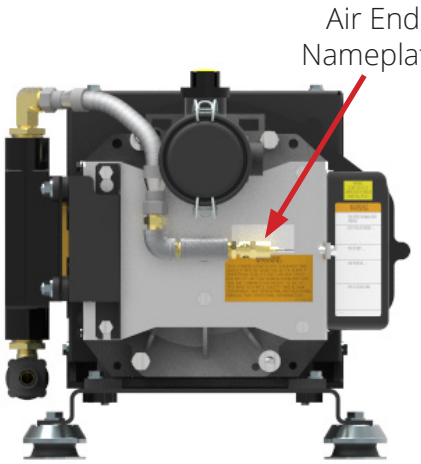


Figure 18

### 2.1.2.2 Lifting/Handling

To lift the SDC unit out of the shipping crate, please adhere to the following instructions. This will require the use of a mechanical lift, heavy duty industrial straps and hooks rated appropriately for the system being lifted.

1. Loop a strap around the motor between the motor's junction box and the motor fan shroud.
2. Place a hook through each eyehole on the top of the air end. Alternatively, you can thread a strap through both holes if no hooks are available.

Figure 19

3. Ensure that the four bolts holding the unit to the shipping pallet are removed and proceed to lift the unit out of the crate with caution.

**NOTICE** Be sure to remove all compressor to pallet fasteners prior to lifting to avoid damaging the compressor.

### 2.1.2.3 Motor Replacement Procedure

To replace the motor on an SDC unit, please adhere to the following instructions. This will require the use of basic hand tools. A mechanical lift and heavy-duty industrial straps are recommended for lifting the motor and positioining it.

**⚠WARNING** To prevent unexpected compressor operation while performing this procedure, perform the appropriate lock out and tag out procedures to isolate the compressor from electric and pneumatic energy sources.

4. Remove the electric connections from the motor.
5. Remove the aftercooler (if equipped).
6. Remove the coupling guard. Loosen the screws that secure the coupling rubber element radially to the drive hub.

**NOTICE** Do not loosen the set screw that secures the drive hub to the motor shaft.

7. Loosen the screws that hold the motor to the adapter plate (the four bolts highlighted in red in the image below). Support the body of the motor so it can be pulled straight back. The drive coupling hub will come free with the motor.

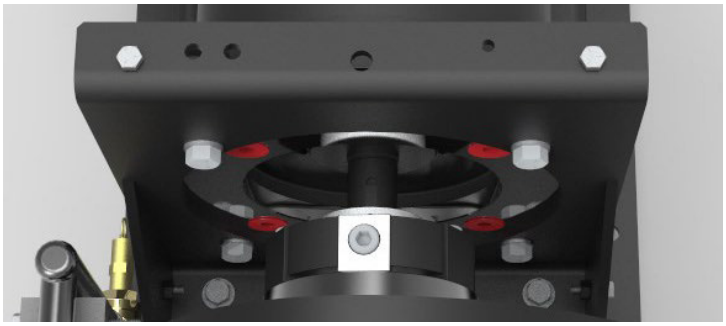

Figure 20

**NOTICE** Do not loosen the hex head screws that secure the adapter plate to the motor support. See Figure 21 for clarification.


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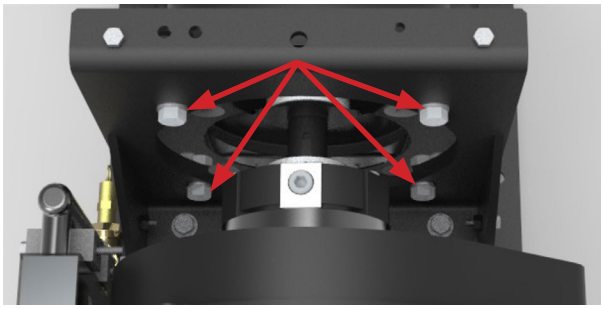

Figure 21: These hex head screws are NOT to be loosened during motor replacement.

5. Measure the position of the drive hub relative to the existing motor shaft. Loosen the setscrew and place the hub on the new motor and position the hub in the same location on the new motor. Make sure the key is in place. Fully remove the setscrew and fill the hole with Loctite 294 (green). Re-install the setscrew, tightening it to 66 in-lbs.

6. Installation is the reverse of removal.

7. Install and tighten the screws to secure the rubber element to the motor drive hub.

8. Reinstall the coupling guard.

9. Reinstall the aftercooler (if equipped).

10. Reconnect the electric power and verify proper rotation before running the compressor more than a few seconds.

### 2.1.2.4 Air End (Pump) Replacement

To complete this procedure, please obtain the appropriate Pump from Powerex or through your vehicle OEM. Compare the Powerex Model Number found on the Powerex System Spec Decal (see Figure 11 and Figure 16) to the Powerex Transportation Model Numbering Diagram found in Section 1.3.10. If the Pressure Rating is 145 PSI, order Powerex part number SDCAE05EHP. If the Pressure Rating is 115 PSI, order Powerex part number SDCAE05E.

To properly align the unit, also purchase Powerex part number ST300000AJ. The tool comes with a user guide illustrating how to properly align the unit, so alignment will not be covered in this section.

To replace the air end on an SDC unit, please adhere to the following instructions. This will require the use of a basic hand tools.

**⚠WARNING** The following instructions assume that you have already removed the compressor from the vehicle thus removing all energy sources. If that is not the case, take appropriate actions to lock out and tag out the electric and pneumatic energy sources connected to the compressor.

**NOTICE** When replacing a pump, all plumbing must be thoroughly cleaned out or replaced. This includes all fittings and hoses on the intake side of the pump up to and including the air filter assembly. It also includes all plumbing and components downstream of the air end (pump), up to and including the nearest check valve. If any debris is left in those areas, the new pump is likely to ingest this debris and fail!

NOTE: Retain all removed parts (other than the pump) for re-installation later in the procedure.

1. Disconnect the inlet filter or inlet fitting from the filter adapter plate.

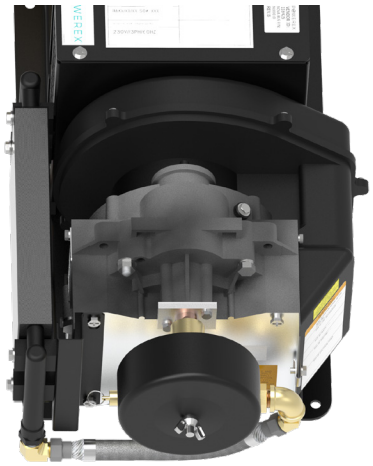

Figure 22

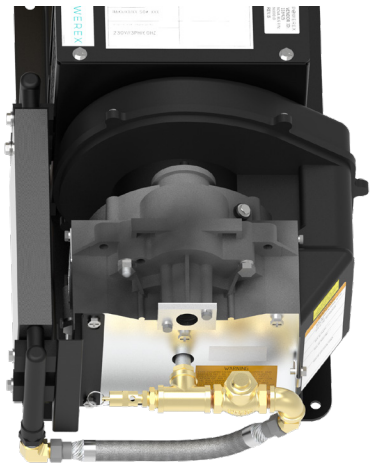

Figure 23: Inlet filter or fitting removed

2. Some models are equipped with an aftercooler, if not equipped with an aftercooler, skip to step 8.

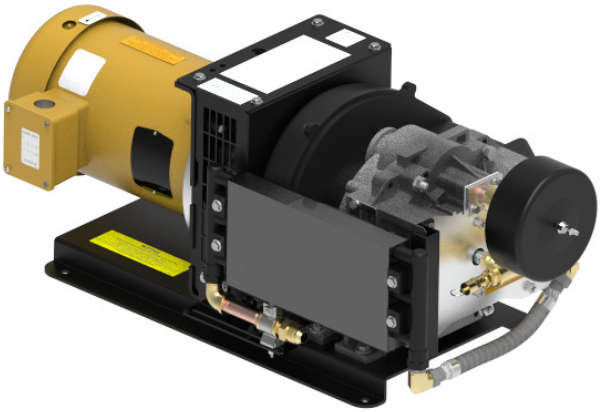

Figure 24: Unit with Aftercooler

Figure 25: Unit without Aftercooler

3. Disconnect the flex hose from the pump discharge plumbing.

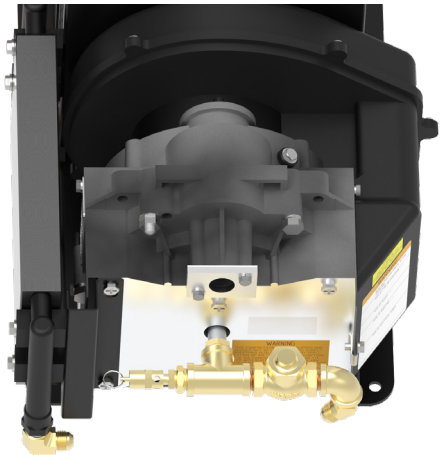

Figure 26: Flexhose removed

4. Loosen the clamp securing the aftercooler plumbing to the coupling guard.

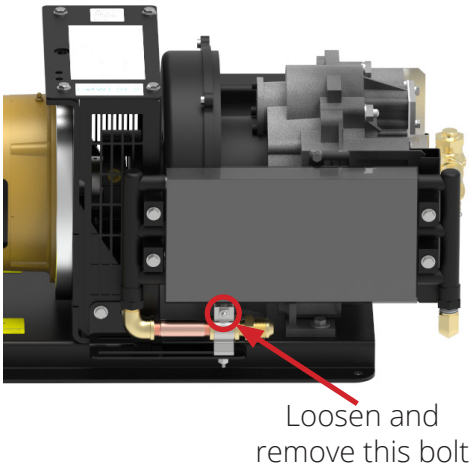


Figure 27

5. Remove the bolts that secure the aftercooler to the coupling guard.

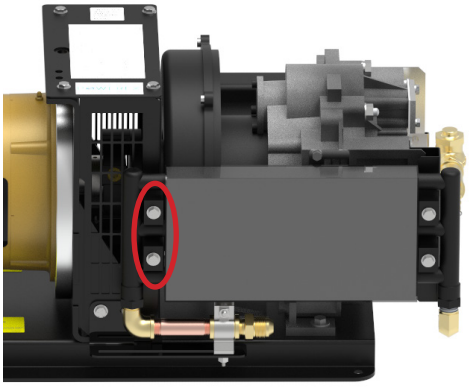

Figure 28

6. Remove the bolts securing the right aftercooler bracket to the pump. Take care to support the assembly so that it does not fall and get damaged.

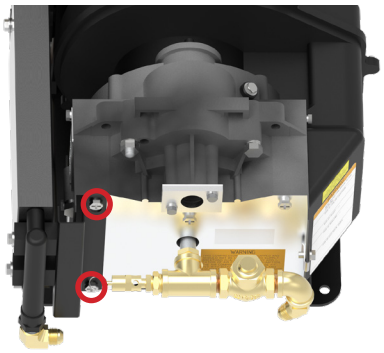

Figure 29


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7. Remove the loosen bolts and the aftercooler.

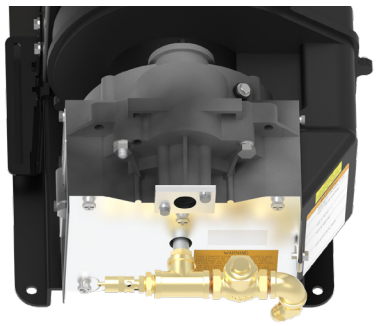

Figure 30: Aftercooler assembly removed

**NOTICE** Be careful not to damage the aftercooler fins.

8. Remove the discharge plumbing assembly from the pump. Use a pipe wrench to support the stainless-steel pump discharge nipple and prevent it from unscrewing from the pump while unscrewing the discharge plumbing.

Figure 31: Discharge plumbing assembly removed

**NOTICE** Components of the discharge plumbing assembly may need to be removed individually to fully remove the assembly from the pump.

9. Loosen the bolts securing the plumbing bracket to the side of the coupling guard. Loosen the bolts on the opposite side, also. Figure 32 highlights the bolts to loosen in this step.

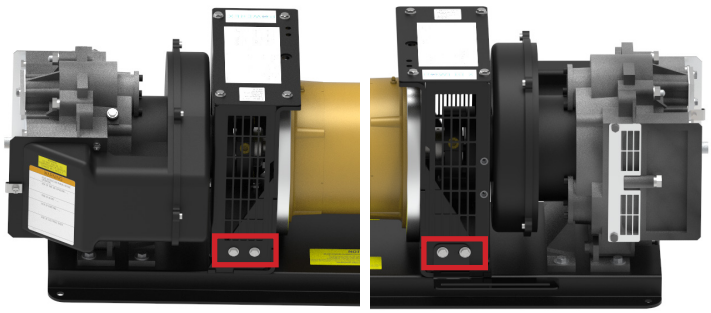

Figure 32

10. Remove the two bolts securing the top of the coupling guard to the motor support and remove the coupling guard.

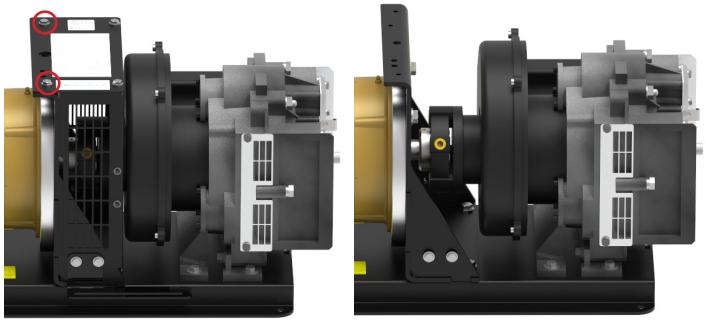

Figure 33

11. Remove the three radial bolts securing the rubber coupling to the metal coupling hub.

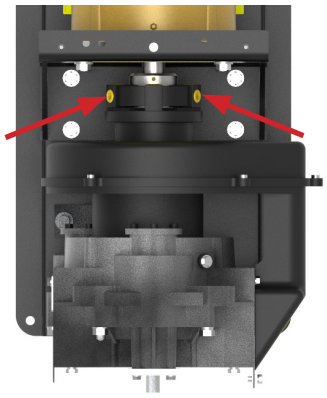

Figure 34: Two of the 3 radial bolts are shown. The 3rd bolt is on the opposite side.

12. Loosen and remove the 4 bolts securing the pump to the baseplate and remove the pump. Be sure to retain the ground strap, if equipped.

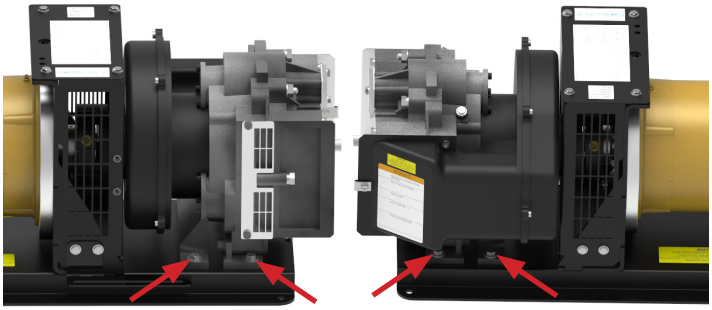

Figure 35

13. At this point, refer to the Field Alignment Tool User Guide (Powerex PN: IN601400AV) which is supplied with the ST300000AJ Tool.

14. Once the pump is installed and alignment process complete, re-install the coupling guard by placing it over the vertical support.

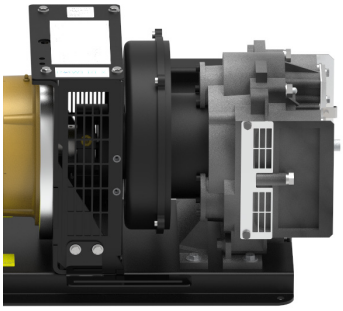

Figure 36

15. Re-install the hardware removed in step 10 into the two outermost holes securing the coupling guard to the top of the vertical support. Tighten to 66 in-lbs.

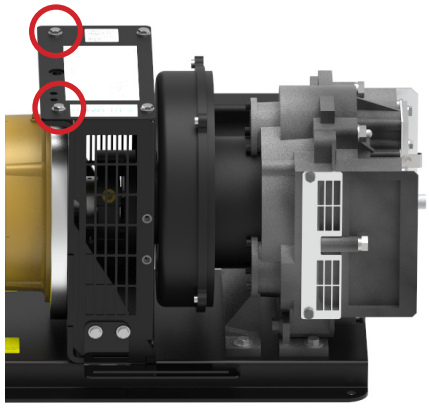

Figure 37

16. Tighten the bolts on both sides of the coupling guard (see Figure 38) to 66 in-lbs.

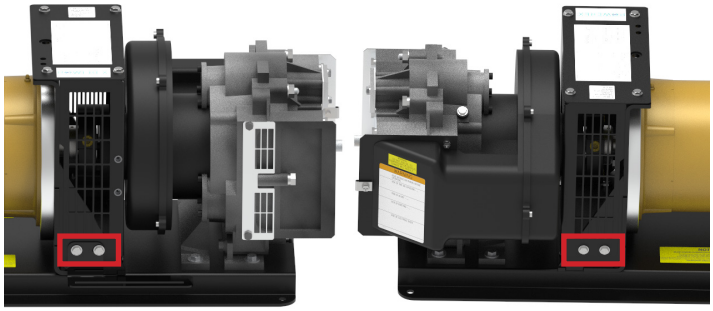

Figure 38

**NOTICE** When replacing a pump, all plumbing must be thoroughly cleaned out or replaced. This includes all fittings and hoses on the intake side of the pump up to and including the air filter assembly. It also includes all plumbing and components downstream of the air end (pump), up to and including the nearest check valve. If any debris is left in those areas, the new pump is likely to ingest this debris and fail!

17. Apply thread sealant to fill the 2nd and 3rd threads on the pump discharge nipple taking care not to get sealant on the end or inside of the tube. Then re-install the original discharge plumbing onto the pump discharge tube. Using a pipe wrench to support the stainless-steel pump discharge nipple and prevent it from turning, tighten the discharge assembly 2 turns past finger tight minimum, 3 turns maximum.

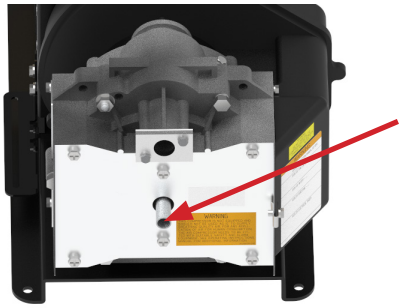

Figure 39: Apply thread to sealant

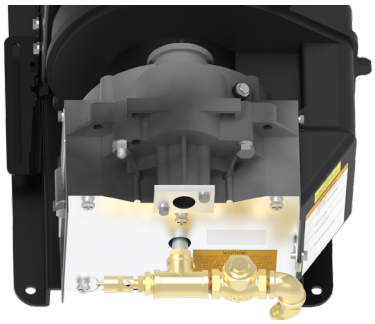

Figure 40: Discharge plumbing re-installed


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18. Next re-install the aftercooler, if equipped. If the unit does not include an aftercooler, skip to step 28.

19. To install the aftercooler, remove the two left bolts (see Figure 41) securing the metal air duct panel to the pump.

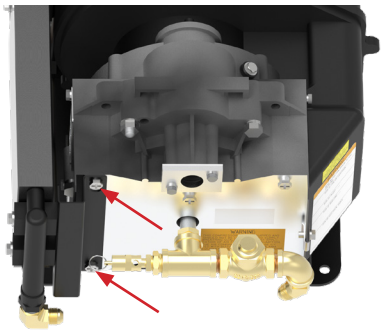

Figure 41

20. Position the aftercooler (with pump end bracket still attached) into place, loosely installing the aftercooler plumbing into the clamp on the plumbing bracket, if equipped.

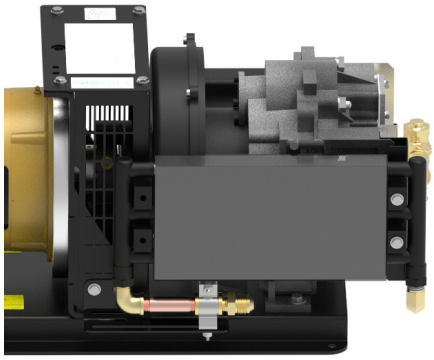

Figure 42

21. Re-install the two bolts removed in step 19 to secure the aftercooler to the pump.

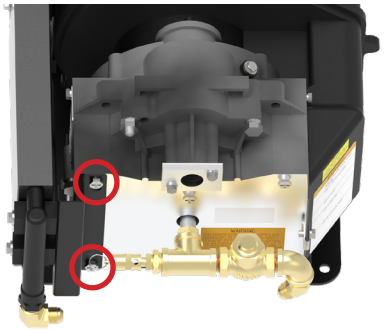

Figure 43

22. Re-install the hardware removed in step 5 to secure the aftercooler to the coupling guard. The fasteners should be tightened until 3 to 4 threads can be seen protruding from the back side of the rivnuts on the coupling guard.

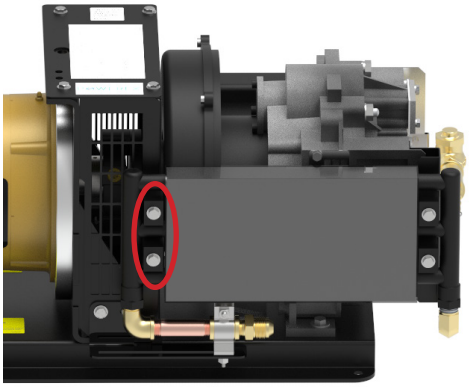

Figure 44

23. Install the flex hose to the aftercooler and the discharge plumbing.

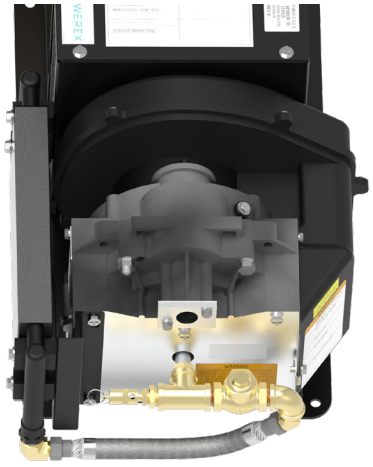

Figure 45

24. Tighten the clamp, if equipped, securing the aftercooler plumbing to the support bracket.

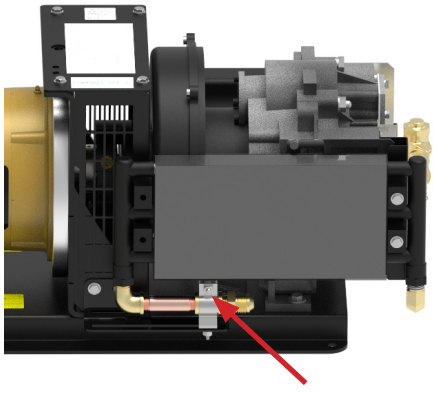

Figure 46

25. Install the inlet filter or inlet fitting into the filter adapter plate.

Figure 47



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### 2.1.2.5 Troubleshooting Guide - SDC with Induction Motor

| Problem | Corrective Action |
|---|---|
| Motor does not run, runs slowly or is excessively noisy | 1. Check wiring—make sure voltage and Hz match motor specification and lead wiring pattern. Correct as needed.<br>2. Check to make sure motor is not overloaded. Remove coupling and determine if no load operation of motor is correct. Check rotation of pump by hand. It should turn smoothly. If not, check for pump damage or obstruction in the pump. |
| Pump is noisy or rough, or puts too much load on the motor | 1. If amp draw and vibration are normal, allow the pump to run for a few minutes and determine if noise diminishes and disappears. If not, contact Powerex at 1-888-769-7979.<br>2. Check for blockages in downstream plumbing. Remove blockages found.<br>3. Check to make sure that the pump is open to intake air. If isolation valves are used on intake and are accidentally closed when the pump is running, pump damage can occur. This is not covered under warranty. Powerex recommends using a three-way valve if isolation is desired so that no matter the valve position, a path to intake air is always open.<br>4. Air end takes approximately 50 hours to break in. During this time, power consumption may be up to 130% of FLA. |
| Current draw (A) is high | 1. Check wiring—make sure voltage and Hz match motor specification and lead wiring pattern. Correct as needed.<br>2. Check to make sure motor is not overloaded. Check rotation of pump by hand. It should turn smoothly. If not, check for pump damage or obstruction in the pump. |
| Excessive vibration | 1. Check for damage. If the motor shaft becomes bent due to shipping, the mass of the coupling will be off-center and generate vibration. Replace the motor.<br>2. If the pump is damaged, the fan may rub and cause noise. It is possible to replace just the fan. Contact Powerex at 1-888-769-7979 for instructions.<br>3. Some variation in the vibration profile is normal.<br>4. Dirty fan blades may contribute to unit vibration. See section 3.5 for information on how to clean the fan.<br>5. Missing coupling bolts or damage to the coupling can cause extreme vibration. Inspect the coupling and re-install bolts or coupling as needed. |
| Pump rotates in reverse for more than a few seconds when power is off. | 1. Check valve is leaking, allowing compressed air to vent through the pump. If allowed to continue, pump damage may occur. Replace check valve.<br>2. Do not use check valve other than Powerex original equipment. |
| Motor runs but no compressed air is produced | 1. Confirm that the motor is rotating in the correct direction. If not, switch any two of the incoming power leads in the junction box to switch motor direction..<br>2. Confirm that the coupling and key are intact between the motor and the air end.<br>3. Check the air filter. If clogged, replace the filter element.<br>4. Inspect the relief valve. If faulty, replace the relief valve. |
| Pressure relief valve activation | 1. Confirm that system pressure is not more than the compressor rating. If the system pressure exceeds compressor rating, review the system controls and correct them, as needed.<br>2. Check downstream plumbing for closed isolation valves, restrictions, or icing. Remove restriction. |

### 2.1.3 SDC with PMAC motor

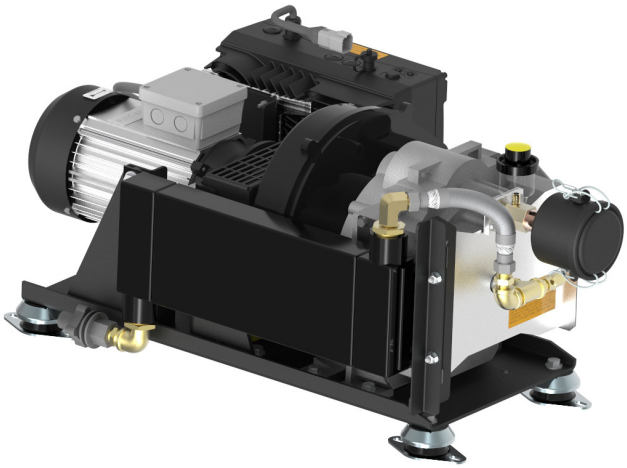

Figure 48

#### 2.1.3.1 Typical System and Major Component Identification Locations


Figure 49

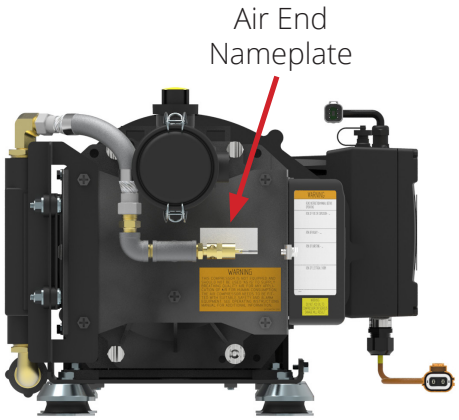


Figure 50

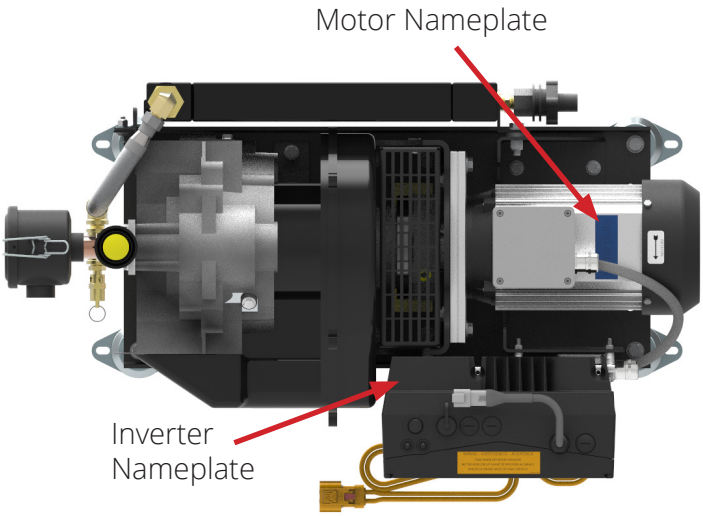


Figure 51


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### 2.1.3.2 Lifting / Handling

To lift the PMAC unit out of the shipping crate, please adhere to the following instructions. This will require the use of a mechanical lift, heavy duty industrial straps, and hooks rated appropriately for the system being lifted.

1. Loop a strap around the motor between the motor's junction box and the motor fan shroud.

2. Place a hook through each eyehole on the top of the air end. Alternatively, you can thread a strap through both holes if no hooks are available.

3. Ensure that the four bolts holding the unit to the shipping pallet are removed and proceed to lift the unit out of the crate with caution.

**NOTICE** Be sure to remove all compressor to pallet fasteners prior to lifting to avoid damaging the compressor.

### 2.1.3.3 Motor Replacement Procedure

To replace the motor on a PMAC unit, please adhere to the following instructions. This will require the use of basic hand tools.

**⚠WARNING** To prevent unexpected compressor operation while performing this procedure, perform the appropriate lock out and tag out procedures to isolate the compressor from electric and pneumatic energy sources.

1. Remove the electric connections from the motor.

2. Remove the coupling guard. Loosen the screws that secure the coupling rubber element radially to the drive hubs.

**NOTICE** Do not loosen the set screw that secures the drive hub to the motor shaft.

3. Loosen the hex head screws that hold motor adapter plate 1 to motor adapter plate 2 (see Figure 53). Support the body of the motor so it can be pulled straight back. The drive coupling hub will come free with the motor.

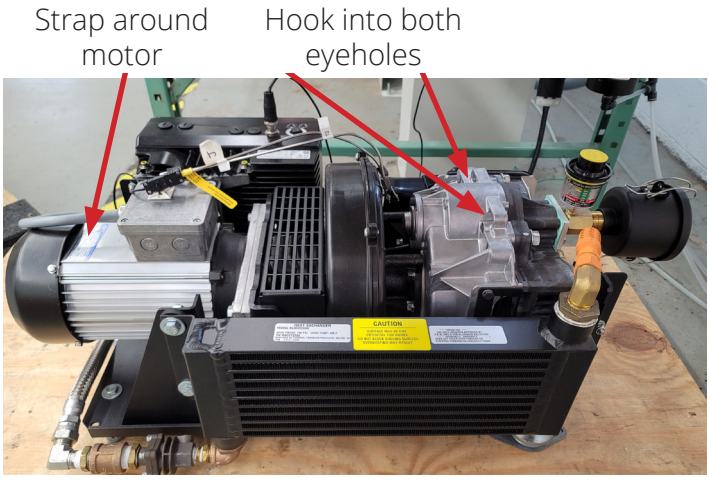


Figure 52

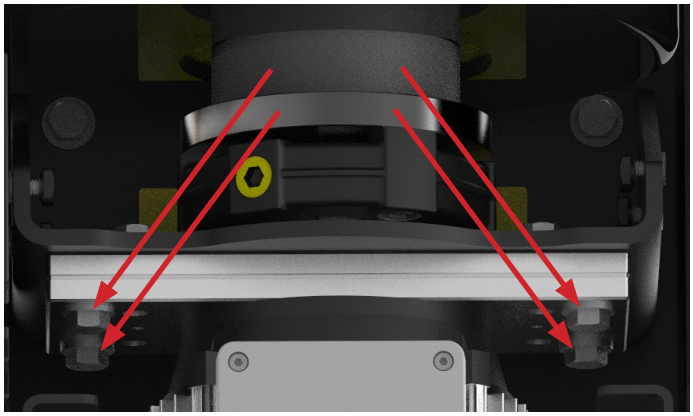

Figure 53

**NOTICE** Do not lose the 4 alignment pins installed in the two motor adapter plates. These pins are required to maintain alignment between the motor and the pump.

**NOTICE** Do not loosen the hex head screws (see Figure 54) that secure motor adapter plate 2 to the motor support bracket.

4. Remove motor adapter plate 1 from the motor by removing the socket head screws that secure the adapter plate to the motor.

5. Measure the position of the drive hub relative to the existing motor shaft. Loosen the setscrew and place the hub on the new motor and position the hub in the same location on the new motor. Make sure the key is in place.

6. Installation is the reverse of removal. Be sure the key is in place on the motor shaft.

7. Install and tighten the screws to secure the rubber element to the motor drive hub. Torque to 37.5 ft-lbs.

8. Reinstall the coupling guard.

9. Reconnect the electric power and verify proper rotation before running the compressor more than a few seconds.

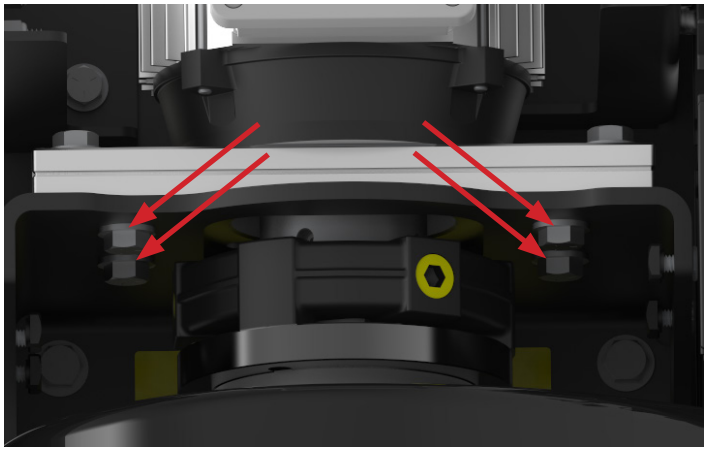

Figure 54


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### 2.1.3.4 Troubleshooting Guide - SDC with PMAC Motor

| Problem | Corrective Action |
|---|---|
| Motor does not run, runs slowly or is excessively noisy | 1. Check wiring—make sure voltage and Hz match motor specification and lead wiring pattern. Correct as needed.<br>2. Check to make sure motor is not overloaded. Remove coupling and determine if no load operation of motor is correct. Check rotation of pump by hand. It should turn smoothly. If not, check for pump damage or obstruction in the pump.<br>3. Check inverter status lights for indication of error/fault |
| Pump is noisy or rough, or puts too much load on the motor | 1. If amp draw and vibration are normal, allow the pump to run for a few minutes and determine if noise diminishes and disappears. If not, contact Powerex at 1-888-769-7979.<br>2. Check for blockages in downstream plumbing. Remove blockages found.<br>3. Check to make sure that the pump is open to intake air. If isolation valves are used on intake and are accidentally closed when the pump is running, pump damage can occur. This is not covered under warranty. Powerex recommends using a three-way valve if isolation is desired so that no matter the valve position, a path to intake air is always open. |
| Current draw (A) is high | 1. Check wiring—make sure voltage and Hz match motor specification. Correct as needed.<br>2. Check to make sure motor is not overloaded. Check rotation of pump by hand. It should turn smoothly. If not, check for pump damage or obstruction in the pump.* |
| Excessive vibration | 1. Check for damage. If the motor shaft becomes bent due to shipping, the mass of the coupling will be off-center and generate vibration. Replace the motor.<br>2. If the pump is damaged, the fan may rub and cause noise. It is possible to replace just the fan. Contact Powerex at 1-888-769-7979 for instructions.<br>3. Some variation in the vibration profile is normal.<br>4. Dirty fan blades may contribute to unit vibration. See section 3.5 for information on how to clean the fan.<br>5. Missing coupling bolts or damage to the coupling can cause extreme vibration. Inspect the coupling and re-install bolts or coupling as needed. |
| Pump rotates in reverse for more than a few seconds when power is off. | 1. Check valve is leaking, allowing compressed air to vent through the pump. If allowed to continue, pump damage may occur. Replace the check valve.<br>2. Do not use check valve other than Powerex original equipment. |
| Motor runs but no compressed air is produced | 1. Confirm that the motor is rotating in the correct direction. If not, switch any two of the power leads in the motor junction box.<br>2. Confirm that the coupling and key are intact between the motor and the air end.<br>3. Check the air filter. If clogged, replace the filter element.<br>4. Inspect the relief valve. If faulty, replace the relief valve. |
| Pressure relief valve activation | 1. Confirm that system pressure is not more than the compressor rating. If the system pressure exceeds compressor rating, review the system controls, and correct them as needed.<br>2. Check downstream plumbing for closed isolation valves, restrictions, or icing. Remove restriction. |

### 2.1.3.5 Inverter Status Lights

| Red LED | Green LED | State |
|---|---|---|
| ☀ | ○ | Boot loader active (flashing in turn) |
| ○ | ☀ | Ready for operation (activate En_HW for operation) |
| ○ | ● | Operation / ready |
| ☀ | ● | Warning |
| ● | ○ | Error |
| ● | ● | Identification of motor data |
| ○ | ☼ | Initialization |
| ☼ | ☼ | Firmware update |
| ☼ | ● | Bus error operation |
| ☼ | ☀ | Bus error ready for operation |

| Legend | | | |
|---|---|---|---|
| ● | LED off | ○ | LED on |
| ☀ | LED flashing | ☼ | LED flashing quickly |


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## 2.2 Scroll Belt Drive Basemount (SBB)

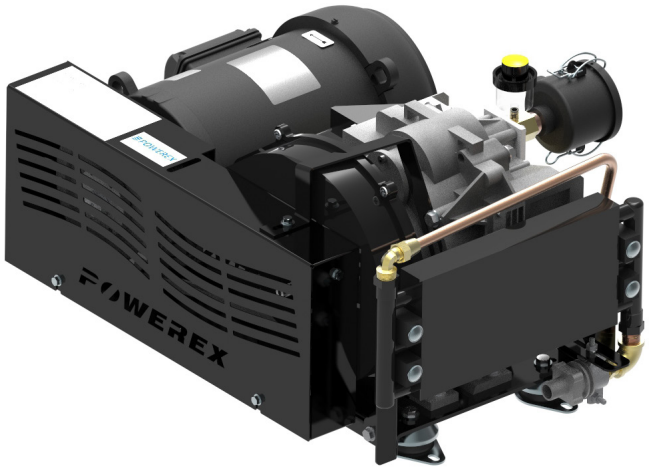


Figure 55

### 2.2.1 Maintenance Schedule

Table 3 and Table 4 indicate the maintenance required based on hours of compressor operation. Please refer to Section 1.3.7 or the vehicle OEM for additional information on how to determine the compressor's operating hours.

Please note that the maintenance intervals vary based on the model of compressor you have. Compare the Powerex Model Number found on the Powerex System Spec Decal (see Figure 11 and Figure 56) to the Powerex Transportation Model Numbering Diagram found in Section 1.3.10. If the Pressure Rating is 145 PSI, follow the intervals in Table 3. If the Pressure Rating is 115 PSI, follow the intervals in Table 4.

Table 3: High Pressure (145 PSI-G) SBB Compressors

| Item | Action Required | Operating Hours | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 2,000 | 4,000 | 6,000 | 8,000 | 10,000 | 12,000 | 14,000 | 16,000 |
| Inlet Air Filter | Replace | Δ | Δ | Δ | Δ | Δ | Δ | Δ | Δ |
| General Inspection | Inspect | Δ | Δ | Δ | Δ | Δ | Δ | Δ | Δ |
| Cooling Fan | Clean | | Δ | | Δ | | Δ | | Δ |
| Fan Duct | Clean | | Δ | | Δ | | Δ | | Δ |
| Scroll Cooling Fins | Clean | | Δ | | Δ | | Δ | | Δ |
| Bearings | Grease | | Δ | | Δ | | Δ | | Δ |
| Tip Seals | Replace | | Δ | | Δ | | Δ | | Δ |
| Check Valve (If equipped) | Replace | | | | Δ | | | | Δ |
| Heat Insulation Pipe | Replace | | Δ | | Δ | | Δ | | Δ |
| V-Belt | Replace | | | | | | | | Δ |

Table 4: Standard Pressure (116 PSI-G) SBB Compressors

| Item | Action Required | Operating Hours | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 2,000 | 4,000 | 6,000 | 8,000 | 10,000 | 12,000 | 14,000 | 16,000 |
| Inlet Air Filter | Replace | Δ | Δ | Δ | Δ | Δ | Δ | Δ | Δ |
| General Inspection | Inspect | Δ | Δ | Δ | Δ | Δ | Δ | Δ | Δ |
| Cooling Fan | Clean | | Δ | | Δ | | Δ | | Δ |
| Fan Duct | Clean | | Δ | | Δ | | Δ | | Δ |
| Scroll Cooling Fins | Clean | | Δ | | Δ | | Δ | | Δ |
| Bearings | Grease | | Δ | | Δ | | Δ | | Δ |
| Tip Seals | Replace | | Δ | | Δ | | Δ | | Δ |
| Check Valve (If equipped) | Replace | | | | Δ | | | | Δ |
| Heat Insulation Pipe | Replace | | Δ | | Δ | | Δ | | Δ |
| V-Belt | Replace | | | | | | | | Δ |

NOTES:

1. This maintenance schedule is a standard schedule for Powerex compressors. Vehicle OEM's may work with Powerex to adjust this to be specific to vehicle design, causing minor differences between Powerex and OEM maintenance intervals and instructions. Consult the vehicle OEM as needed for clarification.

2. If the air end reaches 3 years and has not yet accumulated the minimum run hours specified in the tables above, perform the greasing operation for the bearings, with the amount of grease reduced by 25%.


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### 2.2.2 Typical System and Major Component Identification Locations

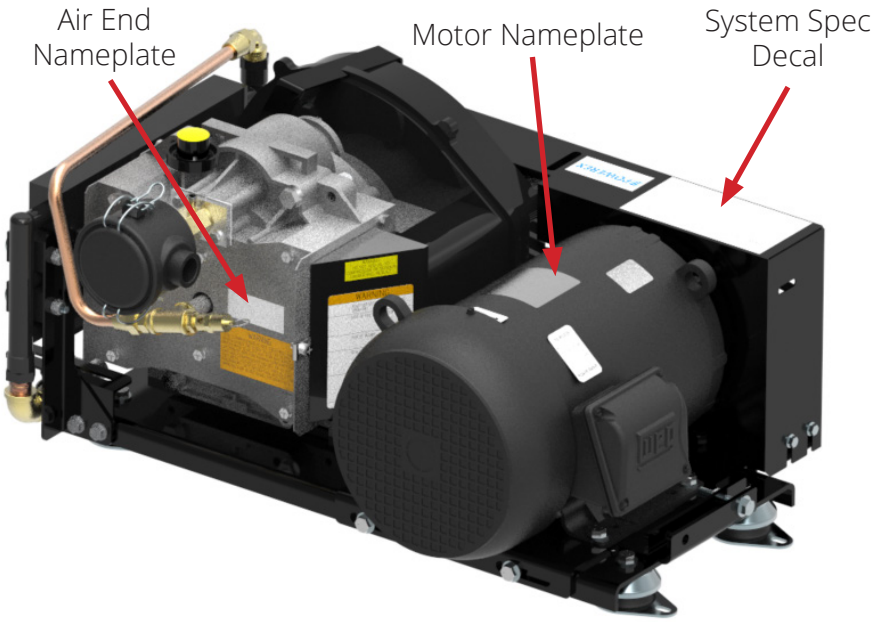


Figure 56: SBB Typical System and Major Component Identification Locations

### 2.2.3 Lifting / Handling

To lift the SBB unit out of the shipping crate, please adhere to the following instructions. This will require the use of a mechanical lift, heavy duty industrial straps, and hooks rated appropriately for the system being lifted.

1. Place a hook through each eyehole on the top of the motor. Alternatively, you can thread a strap through both holes if no hooks are available.

2. Thread a strap around the black iron support as shown in Figure 57.

3. Ensure that the four bolts holding the unit to the shipping pallet are removed and proceed to lift the unit out of the crate with caution.

**NOTICE** Be sure to remove all compressor to pallet fasteners prior to lifting to avoid damaging the compressor.

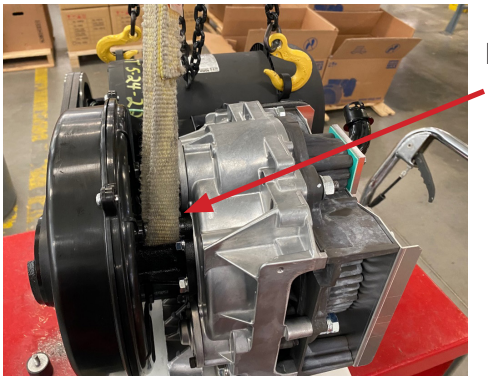


Figure 57

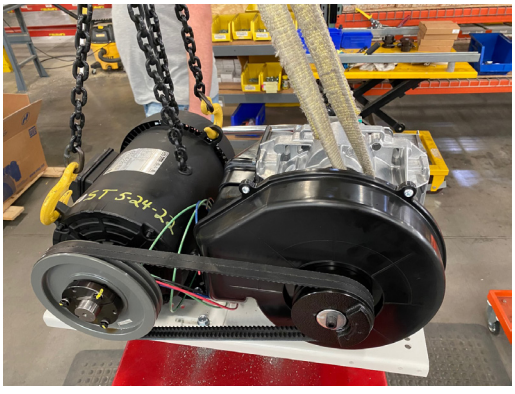

Figure 58

### 2.2.4 Belt Replacement

**⚠WARNING** To prevent unexpected compressor operation while performing this procedure, perform the appropriate lock out and tag out procedures to isolate the compressor from electric and pneumatic energy sources.

1. Remove the belt guard.

2. Loosen the two slide bolts near the motor pulley and the two slide bolts on the front edge of the base. Loosen the bolts just enough to allow the slide base to move. Do not fully remove the slide bolts.

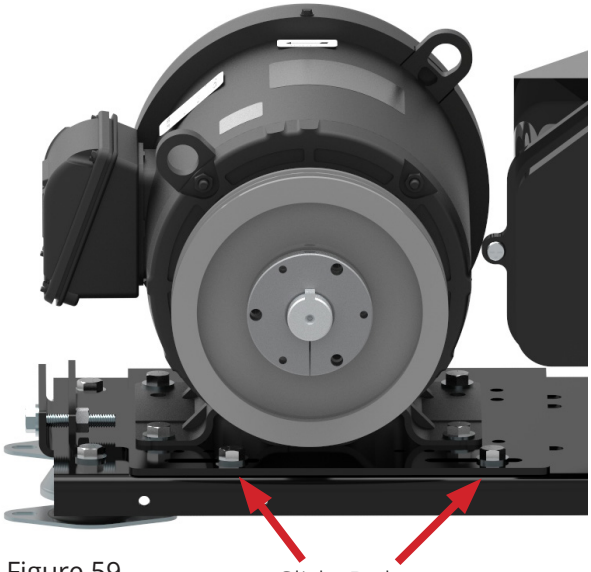


Figure 59

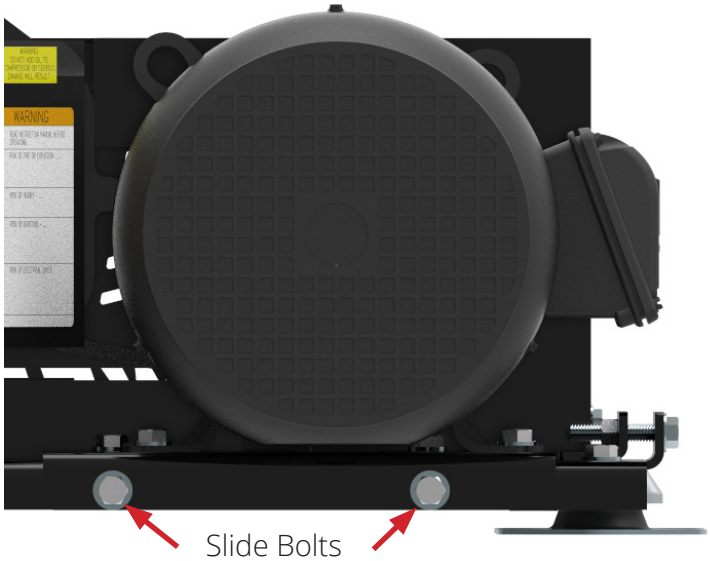


Figure 60

3. Loosen the tensioning bolt until enough slack is available to remove the old belts.

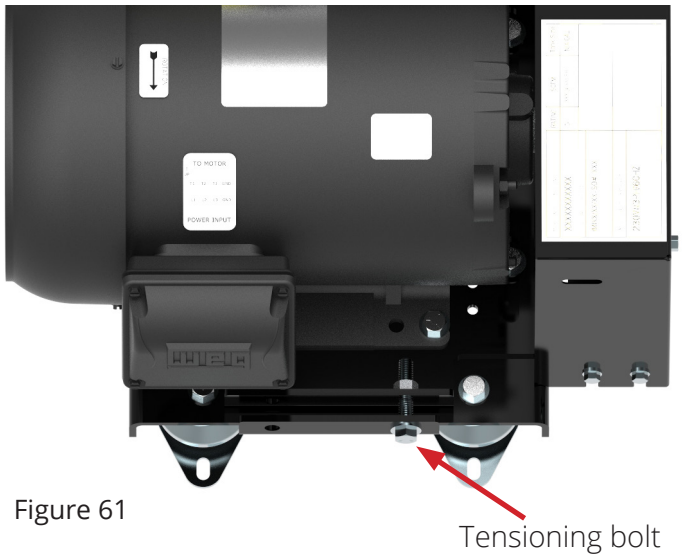


Figure 61

4. Replace the old belts with new ones. Additional loosening of the tensioning bolt may be required to install the new belts.

5. Tighten the tensioning bolt using a torque wrench to 45 inch pounds. This will bring the belts to the proper tension.

6. Tighten the slider bolts, the two on the front edge of the base, then the two slider bolts closest to the motor pulley.

7. Re-install the belt guard.

### 2.2.5 Adjusting Belt Tension

**⚠WARNING** To prevent unexpected compressor operation while performing this procedure, perform the appropriate lock out and tag out procedures to isolate the compressor from electric and pneumatic energy sources.

Any time chirping is heard on startup, check the belt tension. If tension is below 25 pounds on either belt, increase the center distance using the motor slide base so that belt tension is 45 to 50 pounds. Follow the Belt Replacement Procedure above, skipping steps 3 and 4 to make this adjustment.


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### 2.2.6 Motor Replacement

**⚠WARNING** To prevent unexpected compressor operation while performing this procedure, perform the appropriate lock out and tag out procedures to isolate the compressor from electric and pneumatic energy sources.

1. Disconnect the incoming power cable from the motor.

2. Complete steps 1 through 3 listed under section 2.2.4 Belt Replacement.

3. To remove the pulley, remove the set screw over the key from the bushing (see Figure 62). Next, remove the 3 pull-up bolts from the bushing (see Figure 63). Re-install them into the threaded jack-screw holes of the bushing (see Figure 64) and tighten them evenly until the bushing has loosened from the shaft. Slide the pulley and bushing off of the motor shaft. Retain all of these parts for re-use.

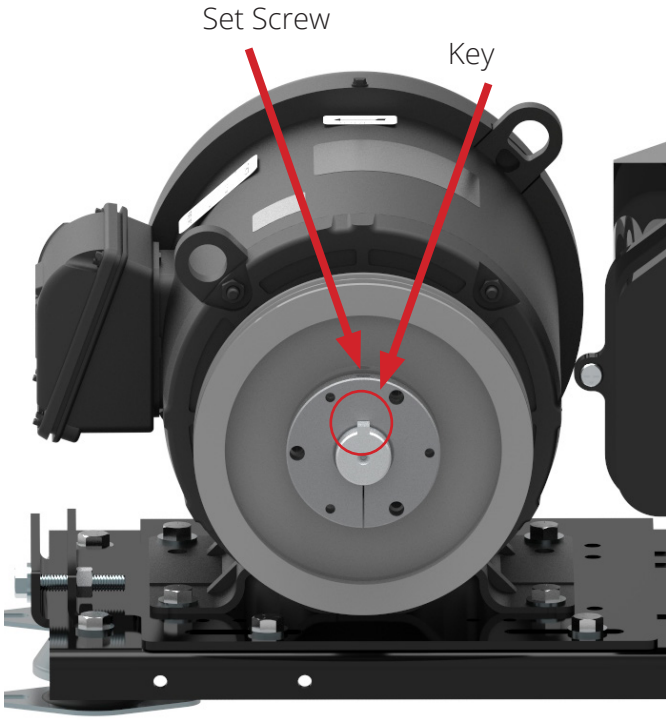


Figure 62

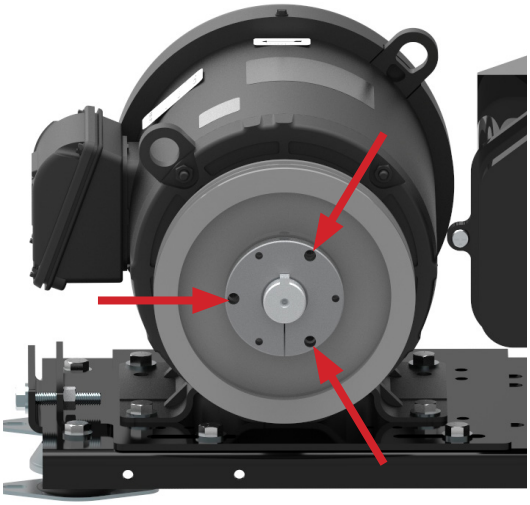

Figure 63: Pull-Up Bolts

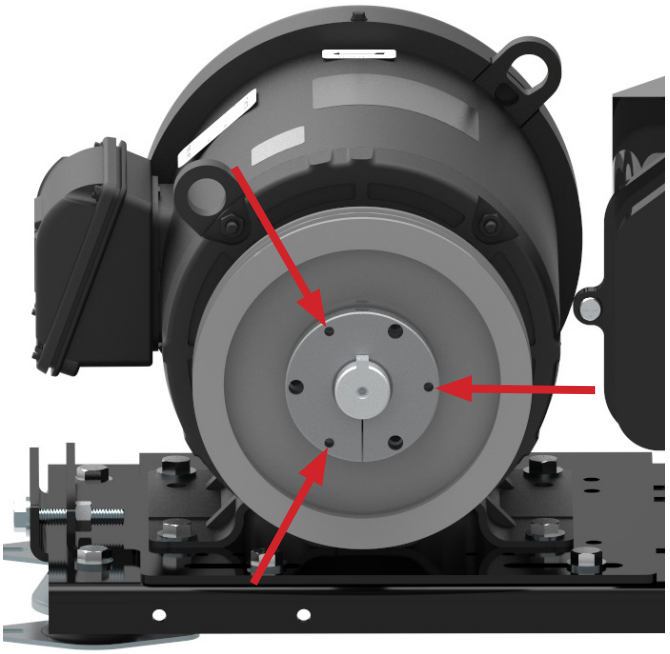

Figure 64: Threaded Jack-Screw Holes

4. Remove the 4 bolts and washers holding the motor to the slide base shown in Figure 65. Retain the bolts for re-use.

5. Remove the motor and position the new motor in the same location.

6. Install the 4 motor bolts and washers retained in step 3 in the locations shown in Figure 65.

7. Slide the pulley and bushing onto the motor shaft. Move the 3 bolts back into the threaded pull-up holes in the pulley. Align the motor pulley with the pump pulley using a straight edge. Make sure the straight edge sits flat against the side of both pulleys.

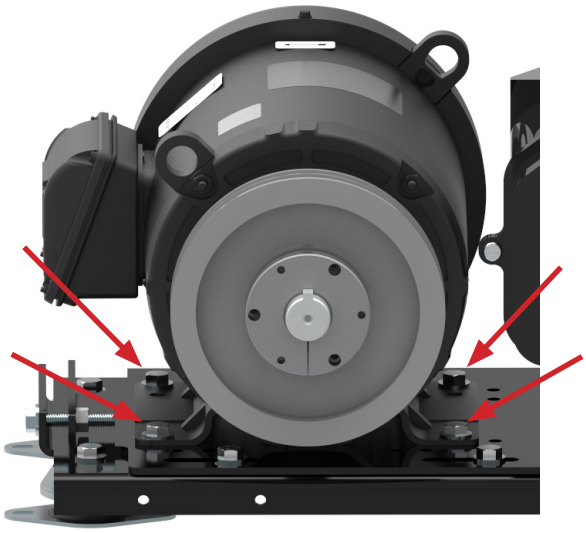

Figure 65

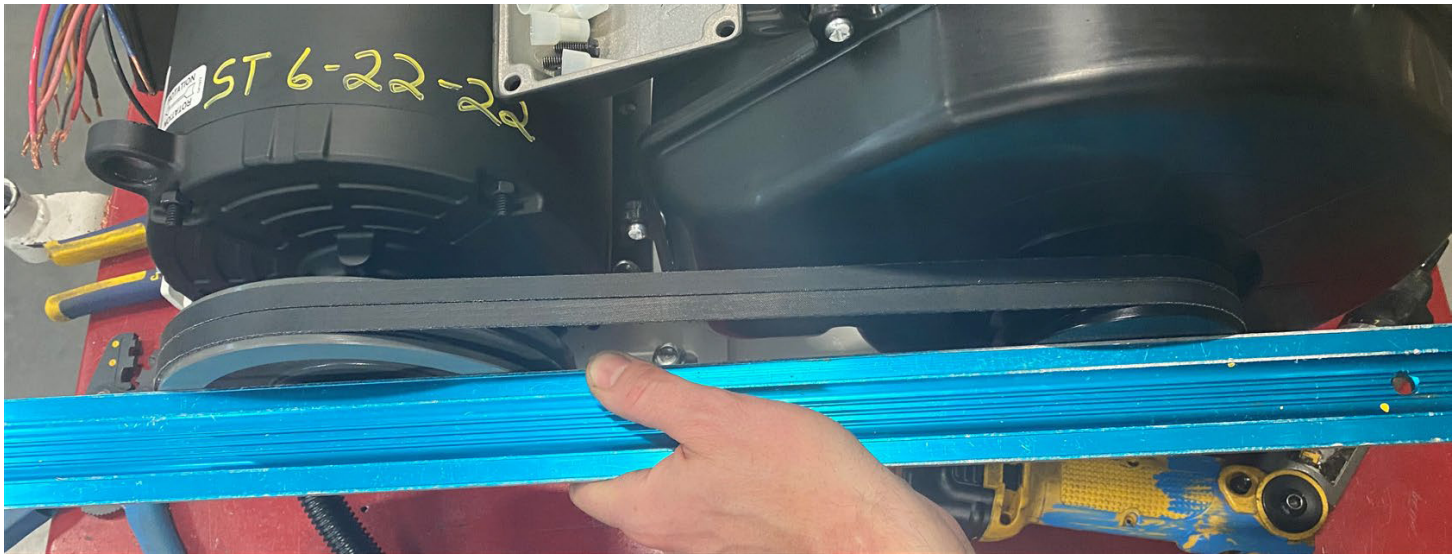


Figure 66: The straight edge must sit flat against the side of both pulleys for proper alignment.

8. Install the set screw to prevent the key from moving while installing the pulley.

9. Tighten the pulley bushing by evenly tightening the pull-up bolts. Final torque should be 9 ft-lbs.

10. After reaching final torque, check all of the bolts again as the bushing will continue to seat as each bolt is tightened which may reduce the load on the previously fully torqued bolts.

11. Complete steps 4 through 7 listed under section 2.2.4 Belt Replacement. Depending on when motor replacement is completed, new belts may not be required as part of this procedure.

12. Reinstall the incoming power cable to the motor.

13. After enabling power, check for correct rotation of the motor. If rotation is correct, the unit is ready to return to service.


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### 2.2.7 Air End (Pump) Replacement

To complete this procedure, please obtain the appropriate Replacement Pump from Powerex or through your vehicle OEM. Two pumps are available depending on the pressure rating of the compressor model. Compare the Powerex Model Number found on the Powerex System Spec Decal (see Figure 11 and Figure 56) to the Powerex Transportation Model Numbering Diagram found in Section 1.3.10. If the Pressure Rating is 145 PSI, order Powerex part number SL016511AV. If the Pressure Rating is 115 PSI, order Powerex part number SL016502AV.

**⚠WARNING** **To prevent unexpected compressor operation while performing this procedure, perform the appropriate lock out and tag out procedures to isolate the compressor from electric and pneumatic energy sources.**

1. Complete steps 1 through 3 listed under section 2.2.4 Belt Replacement.

2. Remove the inlet filter and filter adapter plate by removing the two M6 bolts shown in Figure 67. On some models, a T27 pin-in-torx bit will be required to remove these bolts.

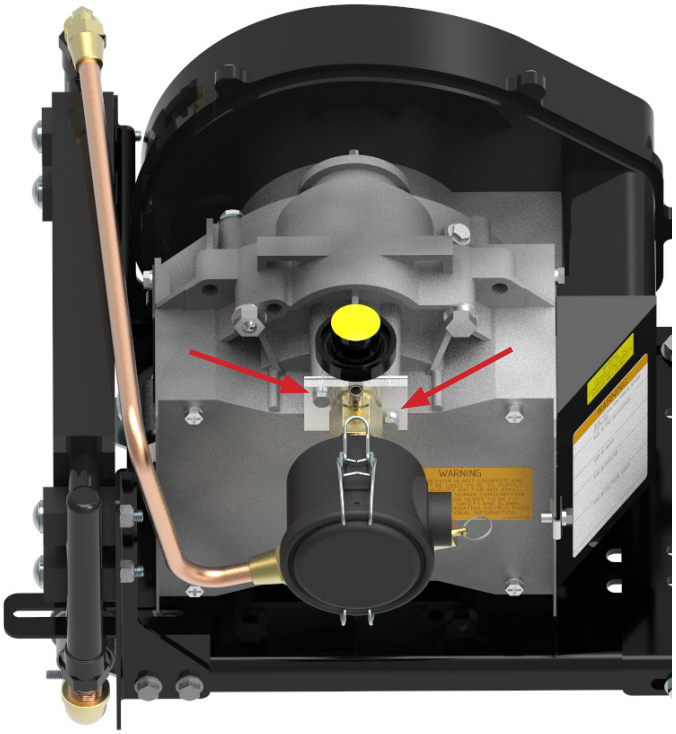

Figure 67

3.Remove the pump discharge to aftercooler tube.

4.Remove the pump discharge fittings. (For some models this will only be an elbow and an adapter, but others will have a tee with a relief valve installed.)

5.Remove the 4 bolts holding the pump to the baseplate.

6.Remove the pump.

7.Remove the finger guard and well nut and re-install them on the new pump.

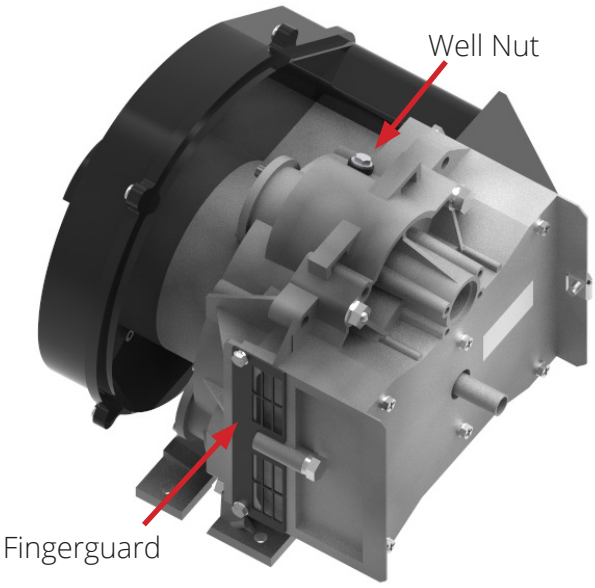


Figure 68

***NOTICE*** **When replacing a pump, all plumbing must be thoroughly cleaned out or replaced. This includes all fittings and hoses on the intake side of the pump up to and including the air filter assembly. It also includes the discharge plumbing up to and including the check valve and aftercooler (if equipped). If any debris is left in those areas, the new pump is likely to ingest this debris and fail!**

8. Place the new pump on the baseplate.

9. Install the 4 bolts to hold the pump to the baseplate.

10. Install the pump discharge fittings.

11. Install the pump discharge to aftercooler tube.

12. Install the inlet filter and filter adapter plate with a new adapter plate gasket. Torque the bolts to 66 in-lbs.

13. Complete steps 4 through 7 listed under section 2.2.4 Belt Replacement.

### 2.2.8 Troubleshooting Guide - SBB

| Problem | Corrective Action |
|---|---|
| Motor does not run, runs slowly or is excessively noisy | 1. Check wiring—make sure voltage and Hz match motor specification and lead wiring pattern. Correct as needed.<br>2. Check to make sure motor is not overloaded. Remove belts and determine if no load operation of motor is correct. Check rotation of pump by hand. It should turn smoothly. If not, check for pump damage or obstruction in the pump. |
| Pump is noisy or rough, or puts too much load on the motor | 1. If amp draw and vibration are normal, allow the pump to run for a few minutes and determine if noise diminishes and disappears. If not, contact Powerex at 1-888-769-7979.<br>2. Check for blockages in downstream plumbing. Remove blockages found.<br>3. Check to make sure that the pump is open to intake air. If isolation valves are used on intake and are accidentally closed when the pump is running, pump damage can occur. This is not covered under warranty. Powerex recommends using a three-way valve if isolation is desired so that no matter the valve position, a path to intake air is always open. |
| Current draw (A) is high | 1. Check wiring—make sure voltage and Hz match motor specification and lead wiring pattern. Correct as needed.<br>2. Check to make sure motor is not overloaded. Remove belts and determine if no-load operation is correct. Check rotation of pump by hand. It should turn smoothly. If not, check for pump damage or obstruction in the pump. |
| Excessive vibration | 1. Check for damage. If the motor shaft becomes bent due to shipping, the mass of the pulley will be off-center and generate vibration. Replace the motor.<br>2. If the pump is damaged, the fan may rub and cause noise. It is possible to replace just the fan. Contact Powerex at 1-888-769-7979 for instructions.<br>3. Some variation in the vibration profile is normal.<br>4. Check for loose or missing pull-up bolts.<br>5. Dirty fan blades may contribute to unit vibration. See section 3.5 for information on how to clean the fan. |
| Pump rotates in reverse for more than a few seconds when power is off. | 1. Check valve is leaking, allowing compressed air to vent through the pump. If allowed to continue, pump damage may occur. Replace check valve.<br>2. Do not use check valve other than Powerex original equipment. |
| Motor runs but no compressed air is produced | 1. Confirm that the motor is rotating in the correct direction. If not, switch any two of the incoming power leads in the junction box to switch motor direction.<br>2. Confirm that the belts are intact and appropriately tensioned between the motor and the air end.<br>3. Check the air filter. If clogged, replace the filter element. |
| Pressure relief valve activation | 1. Confirm that system pressure is not more than the compressor rating. If the system pressure exceeds compressor rating, review the system controls and correct them, as needed.<br>2. Check downstream plumbing for closed isolation valves, restrictions, or icing. Remove restriction. |


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# 3. Scroll Air End Maintenance Procedures

The maintenance procedures in this section are to be performed at the intervals specified in Table 1, 2, 3, or 4 in Section 2 according to the unit architecture and pump type.

## 3.1 Bearing Lubrication

Before getting started, be sure to have the required tools and supplies listed in the table below.

| Required Tools and Supplies | |
|---|---|
| **Part Number** | **Description** |
| IP616100AV | GREASE GUN |
| 92583130 | GREASE GUN NOZZLE |
| IP600000AV | GREASE-POWEREX SCROLL 80gm |


Figure 69: Grease, grease gun, and nozzle required

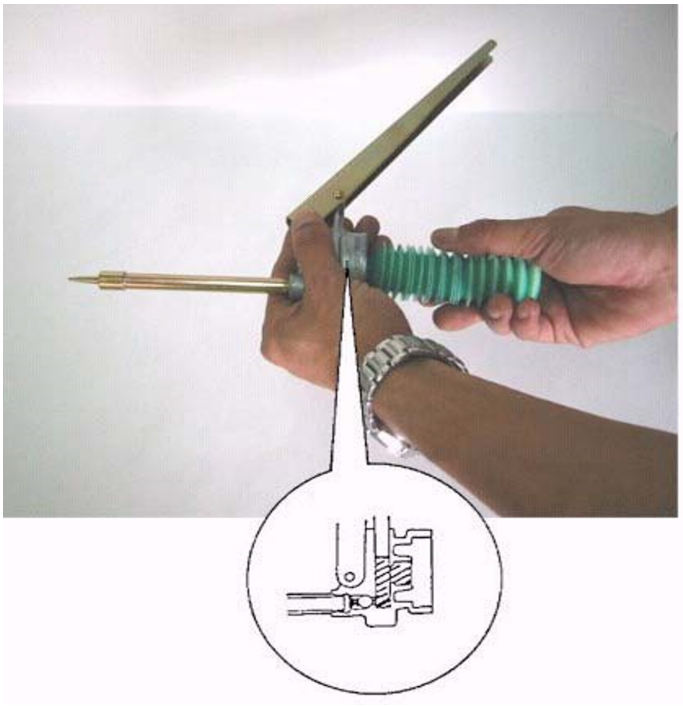

Figure 70: Installing the grease cartridge

NOTE: The Grease Gun Nozzle does not come installed and must be screwed into the gun.

To complete the grease gun assembly:

1. Remove the metal canister from the grease gun.
2. Remove the cap from the grease cartridge.
3. Screw the grease cartridge into the grease gun as shown in Figure 70.
4. Screw the metal canister back onto the gun, covering the grease cartridge.
5. Pump the grease gun to purge the air out of the nozzle.

**NOTICE** Only use Powerex genuine grease.

The Powerex Scroll Air End has 4 greaseable bearings: 1 orbital scroll (OS) bearing and 3 pin crank bearings. Please follow the steps in the sections below to lubricate the bearings at the intervals specified in tables 1 through 4 in Section 2 Architecture Specific Information.

### 3.1.1 OS Bearing Lubrication

**⚠WARNING** To prevent unexpected compressor operation while performing this procedure, perform the appropriate lock out and tag out procedures to isolate the compressor from electric and pneumatic energy sources.

1. Remove the well nut or ribbed plug from the grease access port. Figure 71 shows the standard access port location on all Powerex 5HP scroll air ends. Figure 72 shows the optional second access port. Either may be used to access the OS bearing grease fitting.

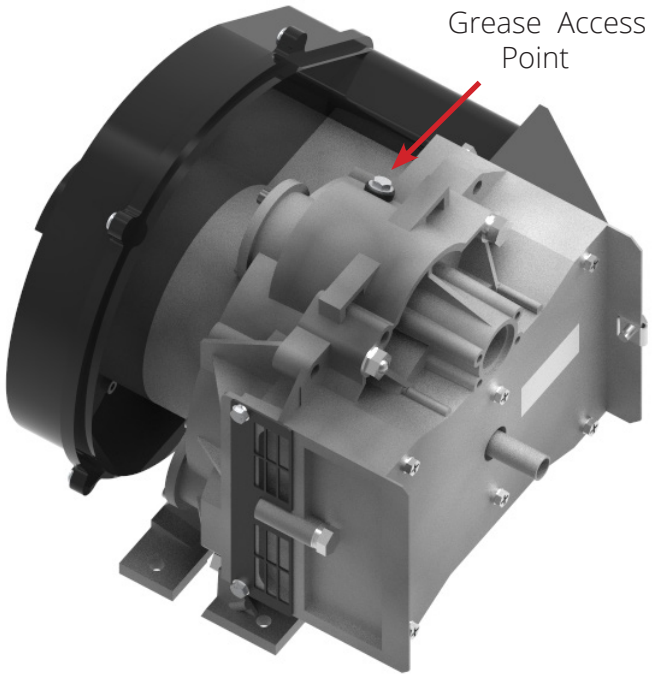


Figure 71

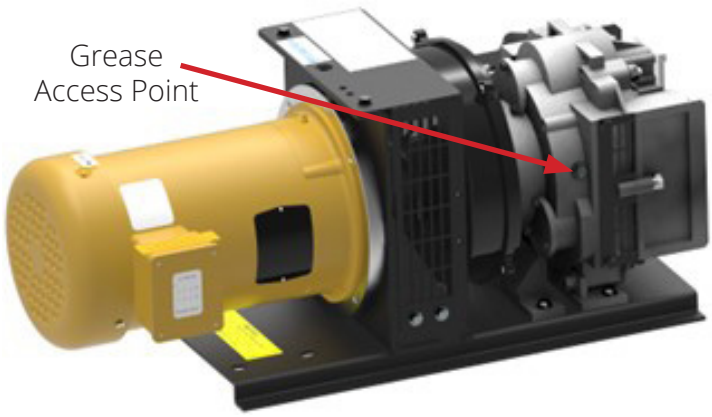


Figure 72: Optional Second Grease Access Point


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2. Rotate the air end shaft by rotating the coupling (if SDC) or the pulley (if SBB) until the grease fitting is visible through the grease access hole. To avoid having to remove the SDC coupling guard, a screwdriver may be used to turn the coupling.

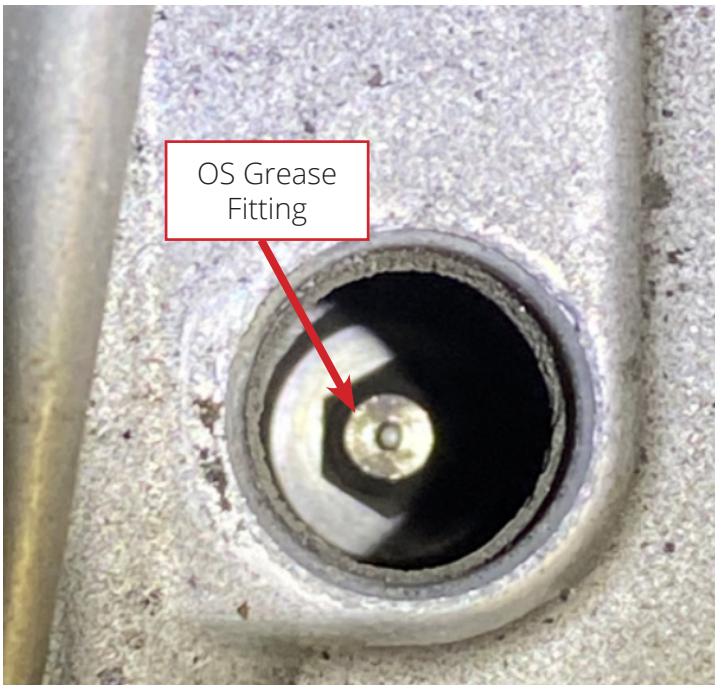


Figure 73: View of the grease fitting through the grease access hole when rotated into the correct position for greasing

Insert Lift Push

Figure 74: For an SDC unit, Insert a screwdriver through the coupling guard to rotate the coupling to align the grease fitting with the access hole

3. Insert the nozzle of the grease gun through the access hole as shown in Figure 75.

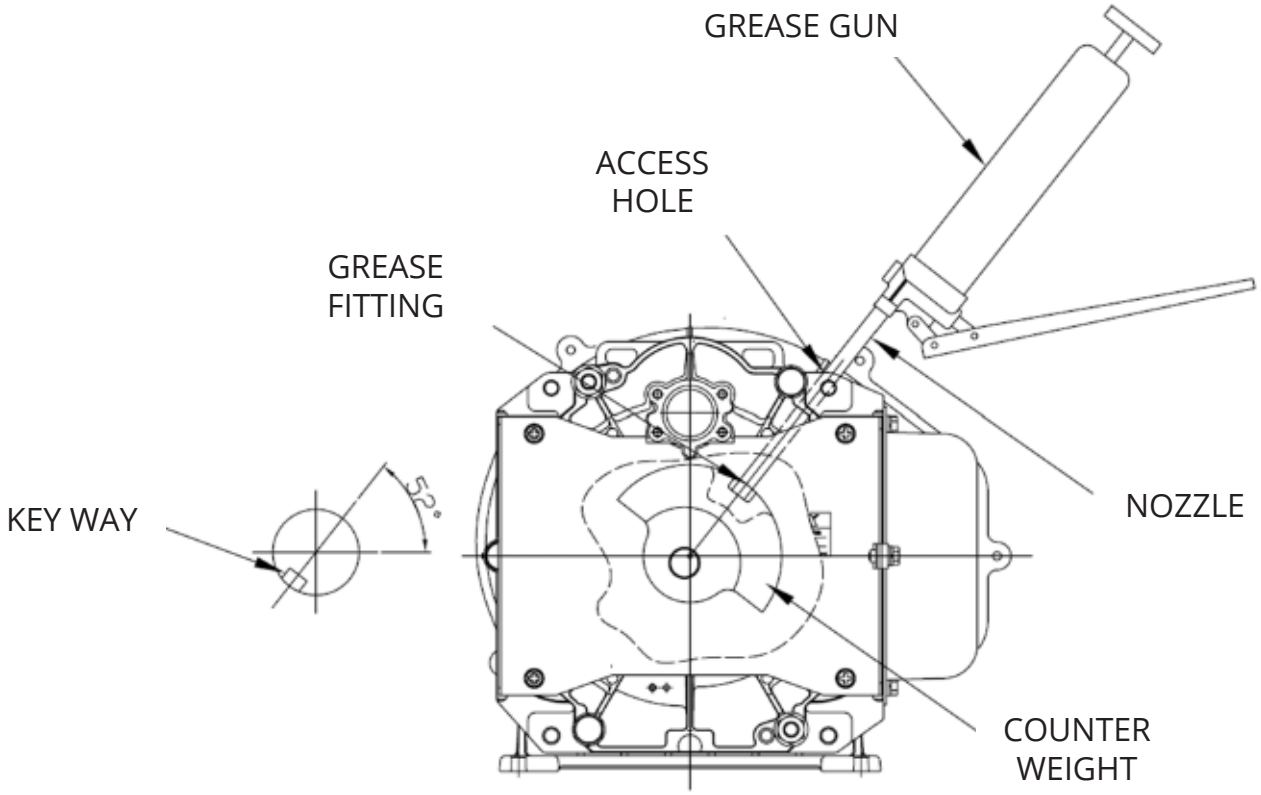


Figure 75: Grease gun insertion for standard access port. For units with the optional second access hole, the grease gun will be inserted the same way but through the second access hole

While holding the nozzle firmly against the grease fitting, pump the grease gun 7 times to deliver the appropriate amount of grease for the standard service interval specified in Tables 1 through 4 found in Section 2 Architecture Specific Information.

**NOTICE** If you are following an increased greasing frequency specified by the vehicle OEM, be sure to only apply the number of pumps of grease specified by their instructions. Overfilling the bearing with grease can damage the seals which hold the grease in the bearing.

**NOTICE** Only use Powerex genuine grease. Make sure to purge the air out of the grease gun and nozzle prior to performing the greasing procedure.

4. Once greasing is complete, remove the grease gun and re-install the well nut or ribbed plug.


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### 3.1.2 Pin Crank Bearing Lubrication

**⚠WARNING** To prevent unexpected compressor operation while performing this procedure, perform the appropriate lock out and tag out procedures to isolate the compressor from electric and pneumatic energy sources.

1. Remove the Fan Duct by removing the fasteners shown in Figure 76.

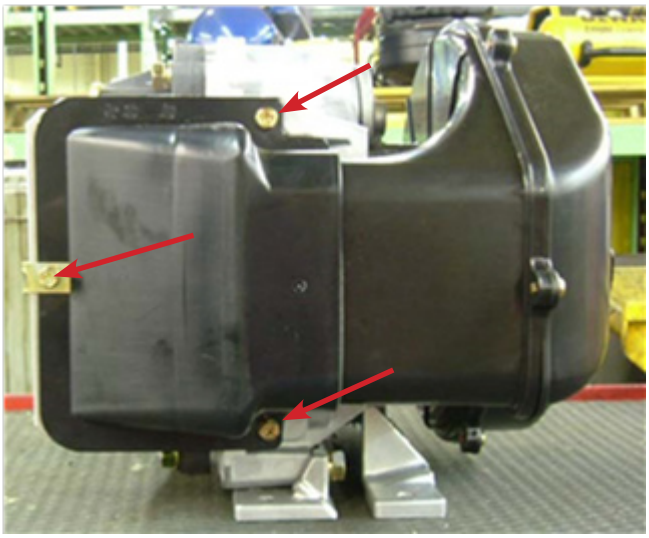

Figure 76


Figure 77: Air end with Fan Duct removed

2. Remove the Fixed Scroll (FS) by removing the fasteners highlighted in Figure 78.

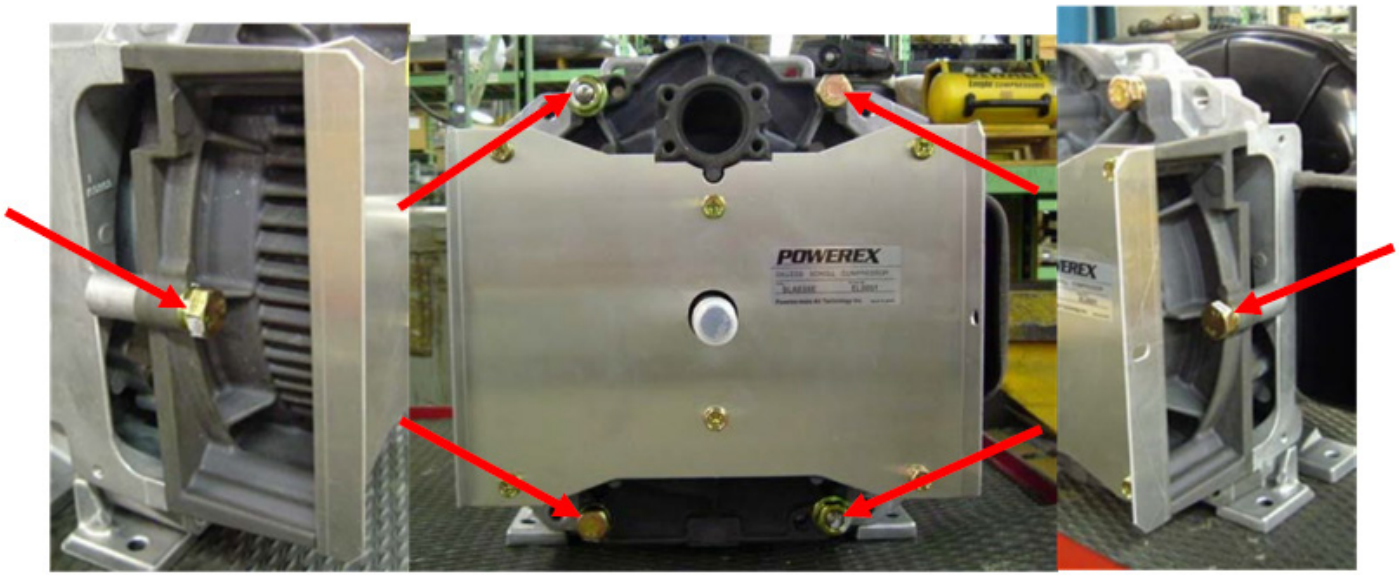


Figure 78: Fixed Scroll Fastener Locations

3. Now that the Orbital Scroll (OS) is exposed, the 3 pin crank grease fittings may be accessed as shown in Figure 79.

**NOTICE** Only use Powerex genuine grease. Make sure to purge the air out of the grease gun and nozzle prior to performing the greasing procedure.

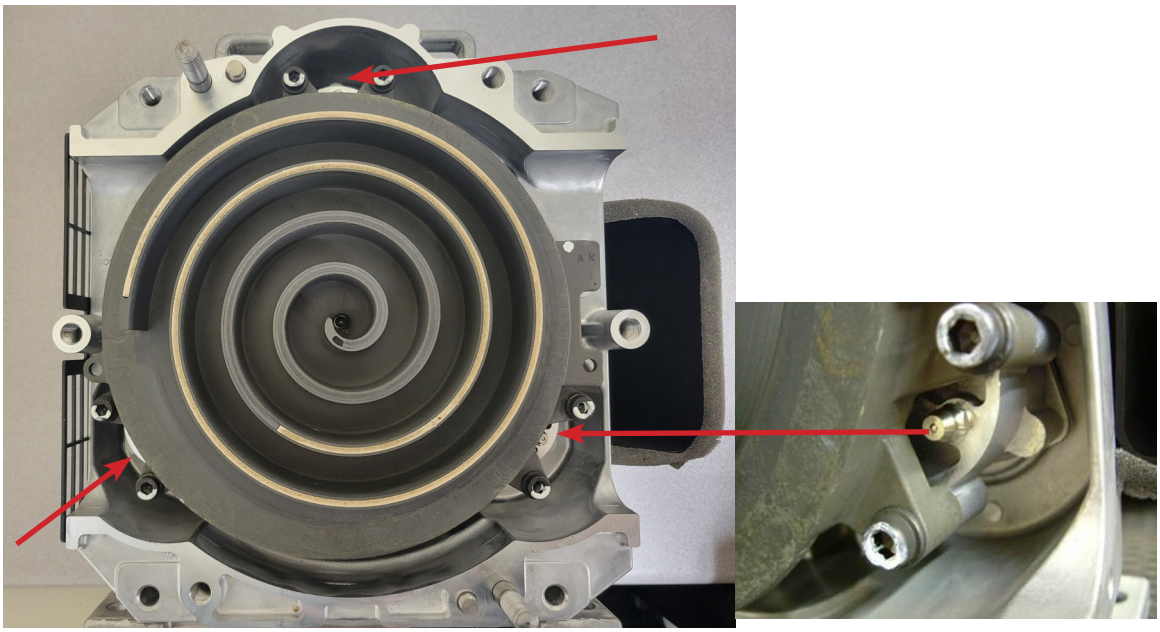

Figure 79: Pin Crank Bearing Grease Fitting

4. Using the grease gun, pump the appropriate amount of grease into each fitting according to Table 5. For an example of the air end nameplate where this part number is to be found, see Figure 12 on page 11.

Table 5

| Pin Crank Bearing Grease | |
|---|---|
| **Air End Part Number** | **Number of Grease Gun Pumps** |
| SL016502AV | 5 |
| SDC016502AV | 5 |
| SL016511AV | 7 |
| SDC016511AV | 7 |
| SDC016520AV | 7 |

5. Re-install the FS. Install the bolts and nuts finger tight and confirm that the crankshaft rotates smoothly by hand.

6. Torque the FS fasteners (see Figure 78) in two stages:

a. 17 in-lb.

b. 265 in-lb.

NOTE: Take care so that the dust seal and tip seal will not drop between the OS and FS during re-assembly as this may damage the seals..

7. Re-install the fan duct with the 3 fasteners shown in Figure 76.

### 3.2 Tip Seal Replacement

To replace the tip seals, the appropriate tip seal set will need to be acquired. Table 6 lists the Air End part number and the corresponding tip seal set part number. For an example of the air end nameplate where this part number is to be found, see Figure 12 on page 11.

Table 6

| Tip Seal Sets | |
|---|---|
| **Air End Part Number** | **Tip Seal Set Part Number** |
| SL016502AV | 92832070 |
| SDC016502AV | 92832070 |
| SL016511AV | 92832080 |
| SDC016511AV | 92832080 |
| SDC016520AV | 92832080 |

Confirm all parts are present in the tip seal set.

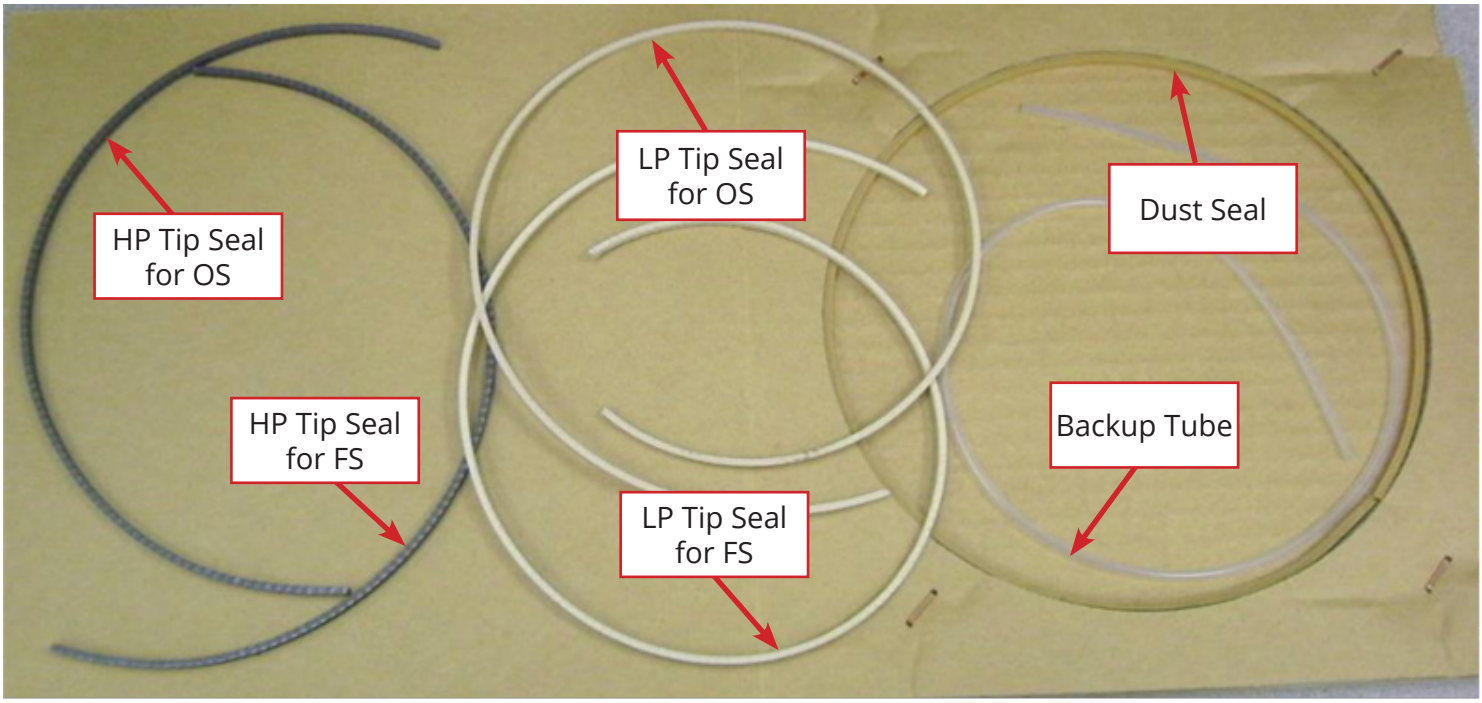


Figure 80: Parts included in Tip Seal Set. HP and LP indicate these seals are for the High Pressure and Low Pressure segments within the scroll, respectively.

**⚠WARNING** To prevent unexpected compressor operation while performing this procedure, perform the appropriate lock out and tag out procedures to isolate the compressor from electric and pneumatic energy sources.

1. To gain access to the tip seals, perform steps 1 and 2 from Section 3.1.2.
2. With the FS removed, use the tip of a ball-point pen to lift the end of the LP Tip Seal out of the FS (see Figure 81).

Continue lifting and pulling until the seal is removed.

Figure 81: LP Tip Seal Removal

3. Repeat for the HP Tip Seal, dust seal, and back-up tube.

Figure 82: HP Tip Seal Removal

Figure 83: Dust Seal Removal

Figure 84: Back-up Tube Removal

4. Repeat this process to remove the LP and HP Tip Seals from the OS.

Figure 85: OS. OS acts as mating surface for the dust seal in the FS. The OS does not contain a dust seal

5. Remove dust from both the OS and FS using a clean cloth or compressed air.

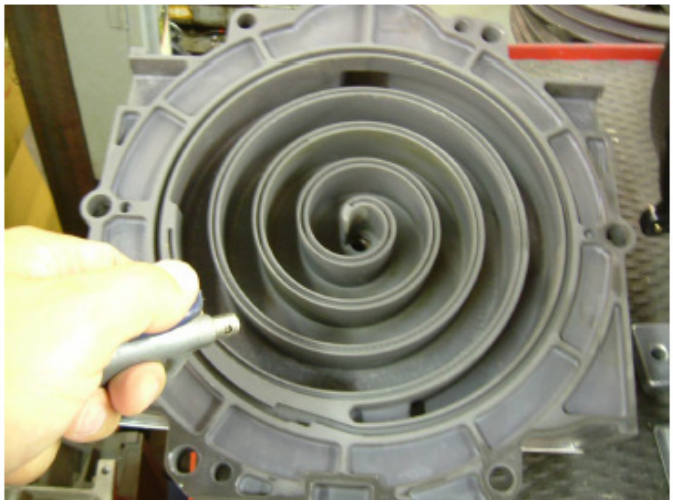

Figure 86: Using an air nozzle to remove dust from FS.


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6. Insert new HP Tip Seal from the center section of OS so that there will be no clearance at the start section.

Figure 87: Begin insertion of the HP Tip Seal at the center of the scroll.

**NOTICE** The Tip Seals have directional lip seals that seal to the groove. Tip Seals for OS and FS have opposing seal cut angles. Insert each Tip Seal so that the lip seal contacting the bottom and inner side of the seal groove points toward the center of the scroll spiral. This must be done on both OS and FS sets, otherwise the scrolls will not seal, and performance will be degraded.

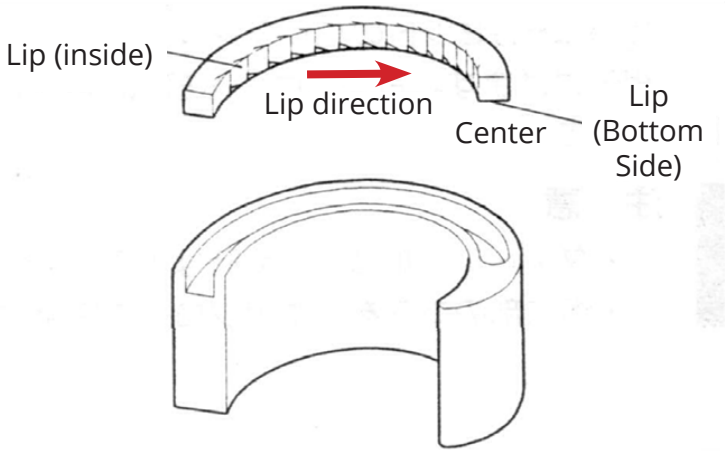


Figure 88: Make sure that the tips of the lips on the Tip Seals point toward the starting point at the center of the scroll

7. Insert the LP Tip Seal with the end butted up against the HP Tip Seal previously installed in the scroll groove.

Figure 89: Butt the LP Tip Seal up against the HP Tip Seal. Be sure the lip seal tips are pointed in the correct direction

8. Insert approximately half of the LP Tip Seal and then remove the Tip Seal to confirm that a notch in the Tip Seal has been created. This will prevent movement during compressor operation. Before reinserting, remove any remaining debris around the notch.

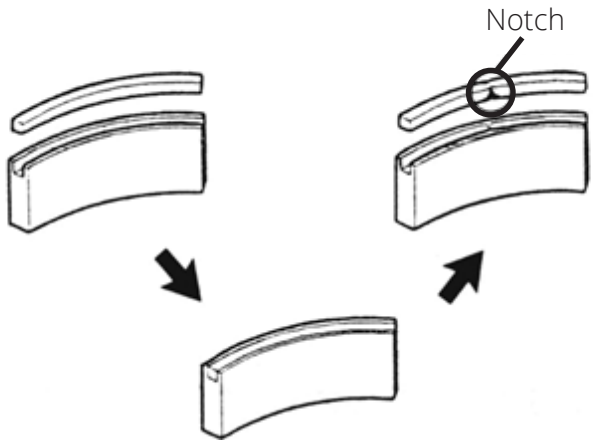


Figure 90: When the LP Tip Seal is installed a notch is created to prevent it from moving in the groove.

11. Continue seating the LP tip seal in the groove. At the end there will be excess. Trim the excess seal off even with the end of the groove and finish seating the seal.


Figure 91

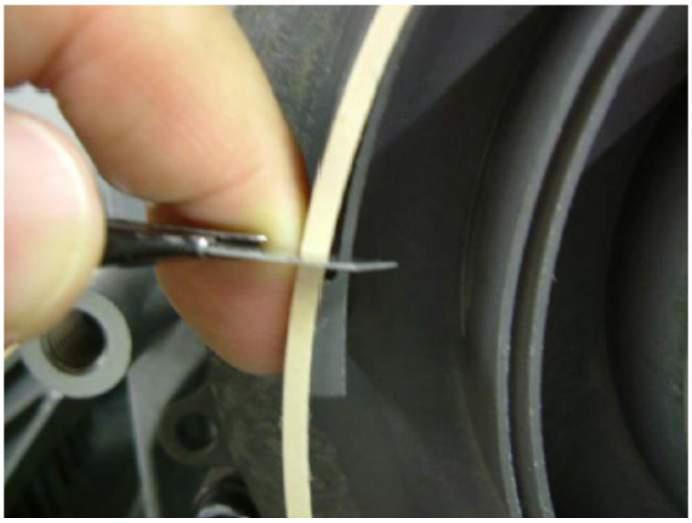

Figure 92: Trim off excess seal even with the end of the groove.

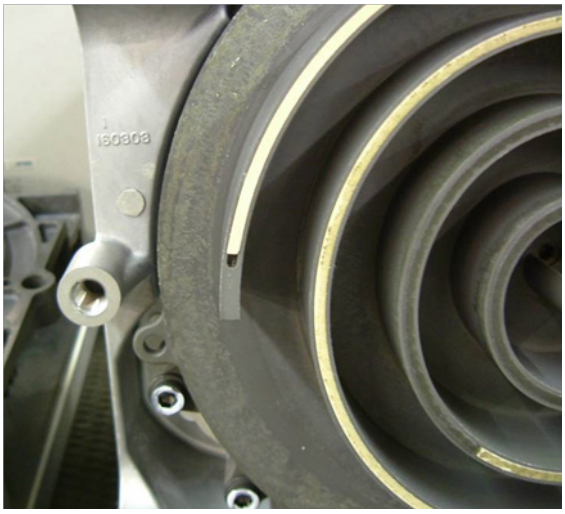

Figure 93: Seat the trimmed seal.


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12. Repeat steps 6 through 11 for the FS Tip Seal set.

13. Insert new Backup Tube in the FS, then insert new Dust Seal on the Backup Tube.

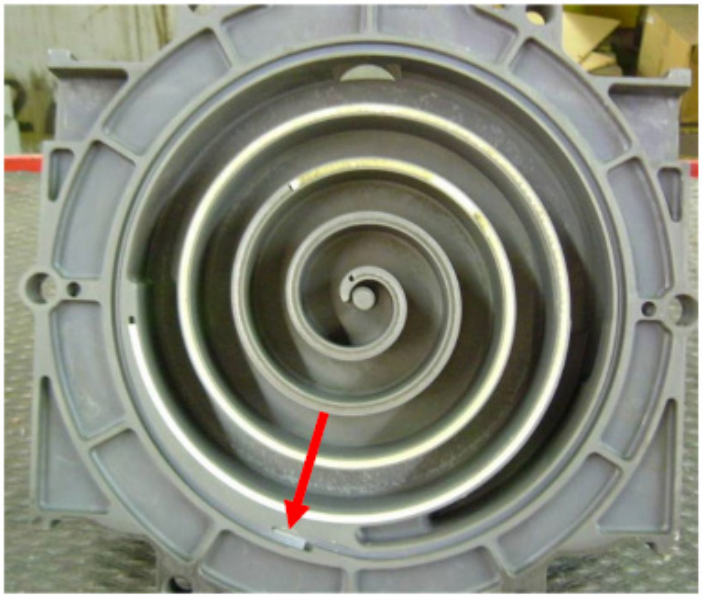

Figure 94: Install back-up tube in outermost groove.

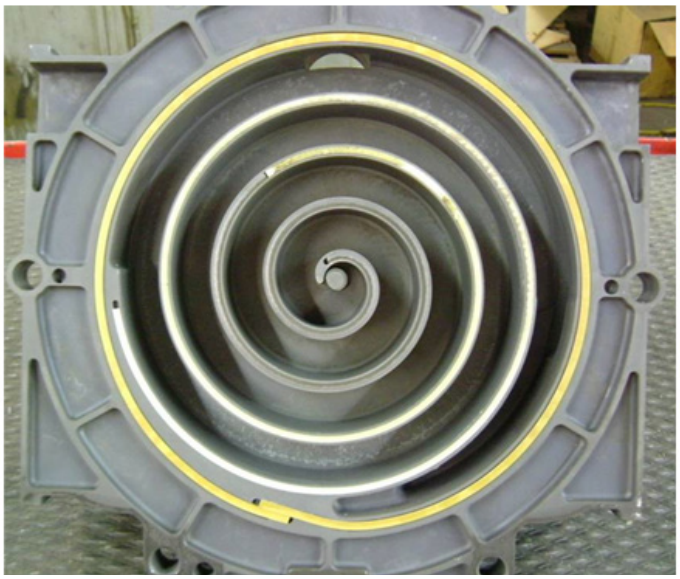

Figure 95: Install dust seal on top of the back-up tube.

14. Re-install the FS. Install the bolts and nuts finger tight and confirm that the crankshaft rotates smoothly by hand.

15. Torque the FS fasteners (see Figure 78) in two stages:

a. 17 in-lb.

b. 265 in-lb.

NOTE: Take care so that dust seal and tip seal will not drop between the OS and FS during re-assembly as this may damage the seals.

16. Re-install the fan duct with the 3 fasteners shown in Figure 41.

### 3.3 Insulation Tube Replacement

Before performing this procedure, obtain a new insulation pipe (Powerex Part Number IP602000AV)

1. Locate the discharge pipe and disconnect any additional plumbing that will prevent removal of the discharge pipe.

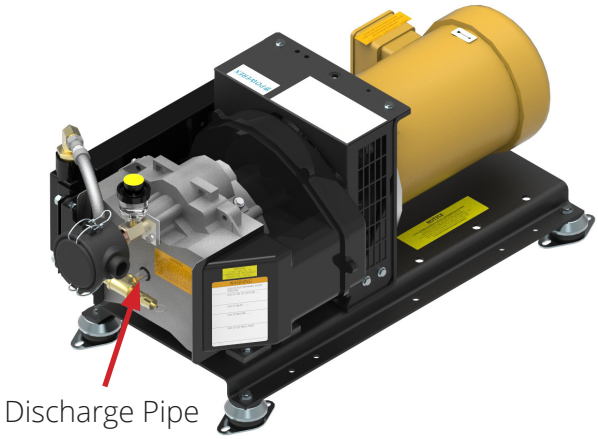


Figure 96

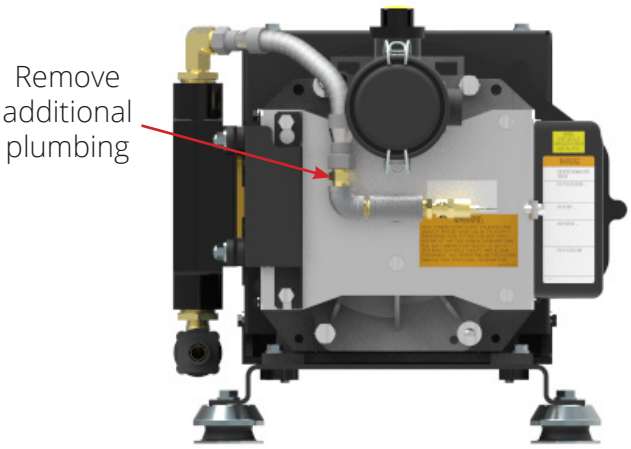


Figure 97

2. Unscrew the discharge pipe.

Figure 98

3. Remove and discard the old insulation tube.

Figure 99: Insulation tube on the left

4. Replace the thread tape on the discharge pipe.

5. Install the new insulation tube.

6. Re-install the discharge pipe. Tighten finger tight plus half a turn. Re-install any additional plumbing that was removed.

**NOTICE** **Over-tightening the discharge tube when reinstalling will damage the pump.**

## 3.4 Fin Cleaning

**⚠WARNING** **To prevent unexpected compressor operation while performing this procedure, perform the appropriate lock out and tag out procedures to isolate the compressor from electric and pneumatic energy sources.**

1. Remove any discharge plumbing that will prevent the removal of the FS cover.

2. Remove the FS cover by removing the 7 fasteners shown in Figure 100.

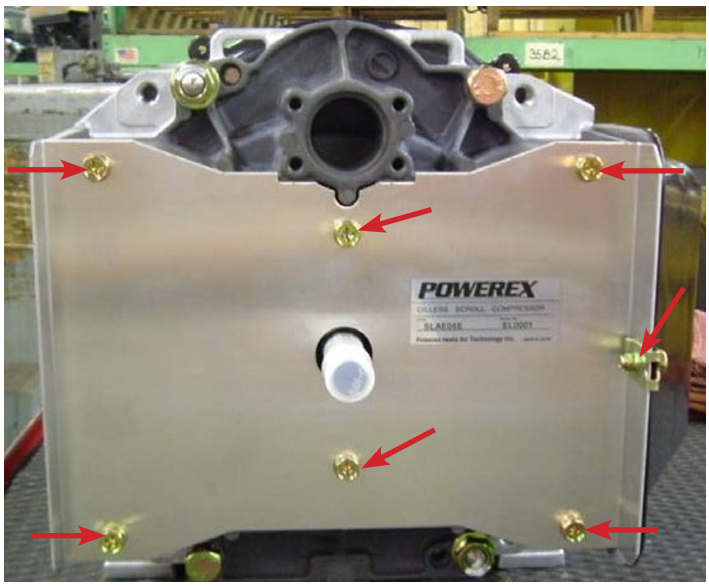


Figure 100: FS cover fasteners

Figure 101: Fixed Scroll with cover removed

3. Cover the discharge tube opening. Using compressed air or a brush, remove all dust and debris from the fins.

NOTE: Failure to properly clean the fins may lead to the air end overheating and premature air end failure.



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Figure 102

4. Reinstall the FS cover and any discharge plumbing that was removed.

## 3.5 Cooling Fan Cleaning

**⚠WARNING** To prevent unexpected compressor operation while performing this procedure, perform the appropriate lock out and tag out procedures to isolate the compressor from electric and pneumatic energy sources.

### 3.5.1 SDC

1. Remove aftercooler, if equipped.
2. Remove the coupling guard.
3. Remove the 5 screws that hold the fan shroud together.

Figure 103: Fan Shroud Screws

4. Slide the fan shroud apart until the fan is visible. Be careful not to damage the shroud.

Figure 104: Fan Shroud opened for cleaning

5. Use compressed air or a brush to remove any dust buildup from the fan blades. Rotate the fan by hand to access all of the blades.

NOTE: Failure to properly clean the fan may lead to excess vibration, air end overheating, and premature air end failure.

Figure 105: Using compressed air to remove dust from the cooling fan.

6. Wipe dust and dirt out of the shroud and duct.
7. Reassemble the shroud.

8. Re-install the coupling guard and aftercooler (if equipped).

### 3.5.2 SBB

1. Remove the belt guard.

2. Remove the 5 screws that hold the fan shroud together.

Figure 106: Fan Shroud Screws

3. Be careful not to damage the shroud.

4. Use compressed air or a brush remove any dust buildup from the fan blades. Rotate the fan by hand to access all of the blades.

Figure 107: Using compressed air to remove dust from the cooling fan

NOTE: Failure to properly clean the fan may lead to excess vibration, air end overheating, and premature air end failure.

5. Wipe dust and dirt out of the shroud and duct.

6. Reassemble the shroud.

7. Re-install the belt guard.

## 3.6 Filter Replacement

The following sections list some typical filter assemblies provided with Powerex transportation compressors and specifies what is needed to service them. When performing any filter service, clean the housing and inspect it for damage or corrosion which might compromise the function of the filter assembly.

Some systems may not include a filter if the vehicle manufacturer integrated the compressor air source into another filtered air system. Powerex recommends 2 micron particulate filters be used if not using a Powerex supplied filter assembly.

### 3.6.1 Filter Assembly VP000501AV

To service this filter assembly, purchase service kit ST951096AJ which includes a replacement element, the lid to housing O-ring, and the two lip seals which seal the element to the housing. All of these items should be replaced when the element is replaced to prevent debris by-passing the filter element.

Figure108: VP000501AV Air Filter Assembly

Figure 109: VP000501AV Air Filter Assembly with top removed


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Figure 110: Seals for VP000501AV

### 3.6.2 Filter Assembly 91907660

To service this filter assembly 91907660, purchase replacement element ST073905AV. The seals are integrated into the element for this assembly, so no additional parts are needed to service this filter assembly.

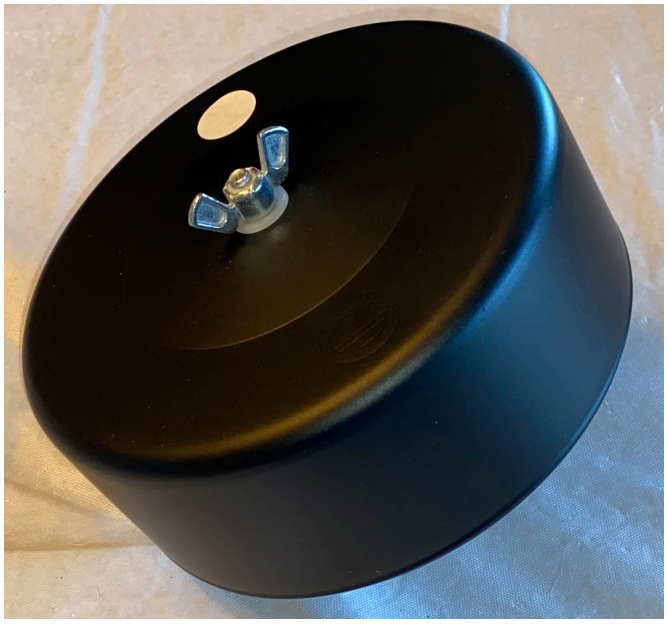

Figure 111: Filter Assembly 91907660

Figure 112: Filter Assembly 91907660 with top removed

### 3.6.3 Filter Assembly ST073924AV or ST073925AV

To service either of these filter assemblies, purchase replacement element ST073921AV. The seals are integrated into the element for this assembly, so no additional parts are needed to service this filter assembly.

Figure 113: Filter Assembly ST073925AV

Figure 114: Filter Assembly ST073925AV with top removed

Figure 115: Filter Assembly ST073924AV

Figure 116: Filter Assembly ST073924AV with top removed

Figure 117: Filter Element ST073921AV



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### 3.6.4. Filter Assembly VP000542AV

To service this filter assembly, purchase service kit VP000558AJ which includes a replacement element, the lid to housing O-ring, and the lip seal which seals the element to the housing. All of these items should be replaced when the element is replaced to prevent debris by-passing the filter element.

Figure 118: Filter Assembly VP000542AV

Figure 119: VP000542AV Air Filter Assembly with top removed


Figure 120: Serviceable parts for VP000542A. The highlighted parts come with the VP000558AJ service kit.

## 3.7 Junction Box Inspection

While not required, the junction box containing the electrical connections to the motor may be inspected. Due to differing motor and incoming power connection configurations, some systems may not match the steps that follow. These steps may be applied for systems with a terminal block. If different and/or additional information is needed, contact Powerex.

1. Locate the motor junction box.

2. Remove the 4 screws and the cover. The screws require either a T15 pin-in-torx driver or a ¼" nut driver. Discard the cover gasket.

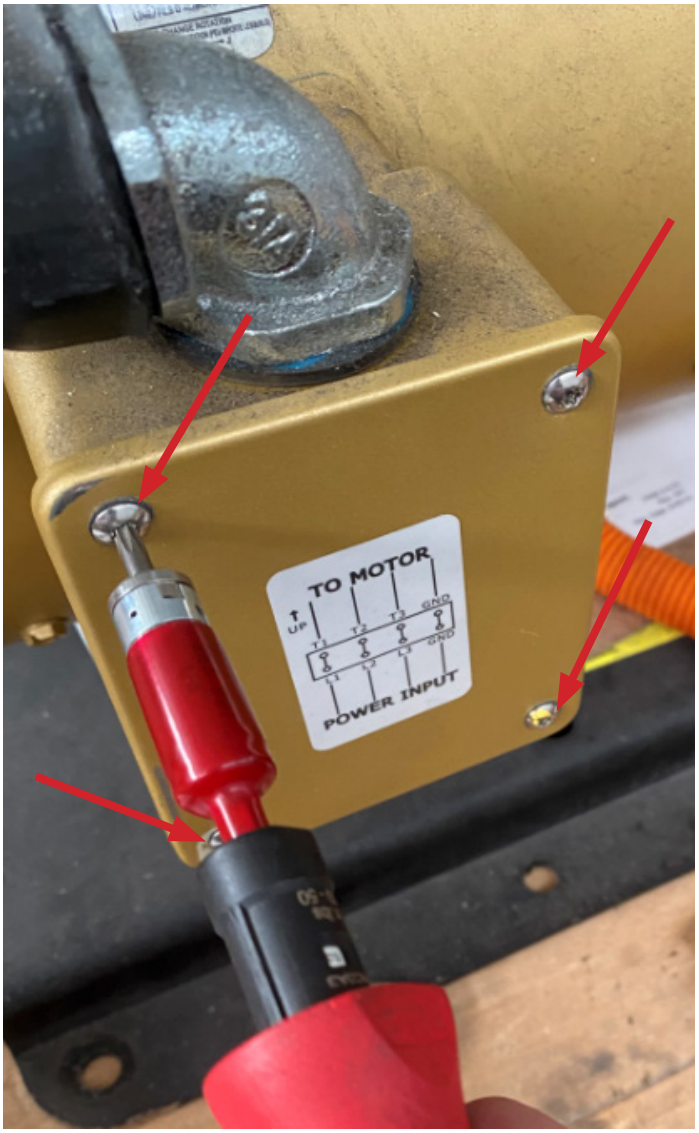


Figure 121: Junction Box Cover Screws

3. Check each wire for any chafing or other damage.

If any insulation damage is found, use an appropriately rated adhesive lined heat shrink to repair.

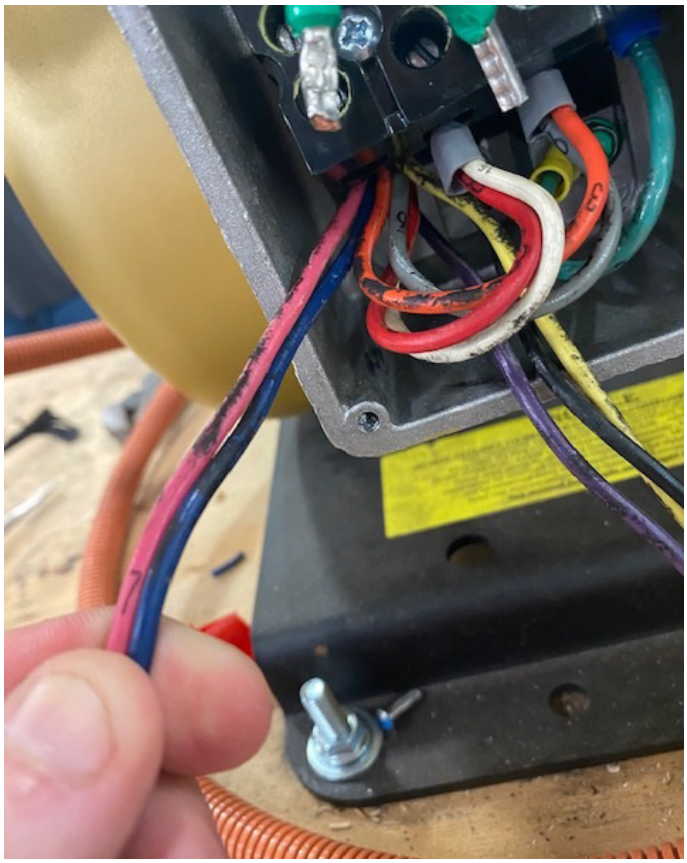

Figure 122: Check each wire for chafing or damage

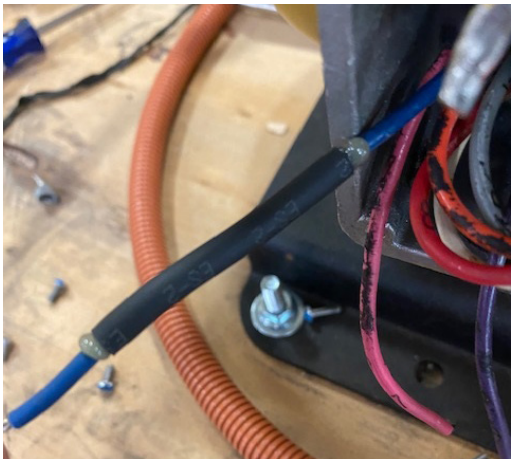

Figure 123: If insulation is damaged, apply heatshrink

4. Firmly tug each wire to confirm each wire is properly secured to the terminal block.


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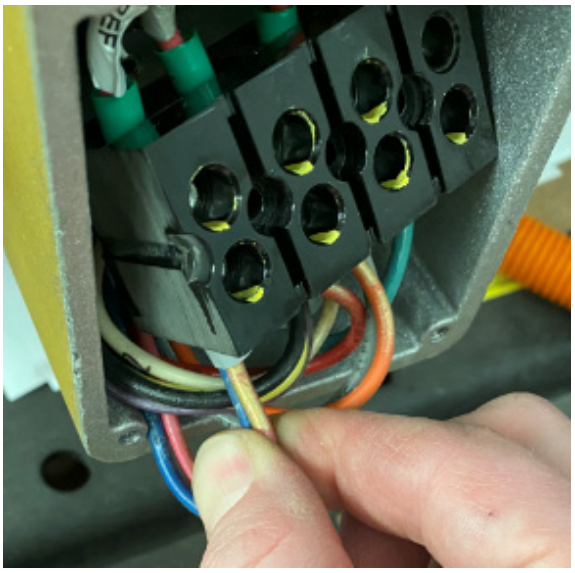

Figure 124: Tug on each wire to confirm it is secure

5. Check the terminal block and bracket for looseness. If loose, tighten the fasteners.

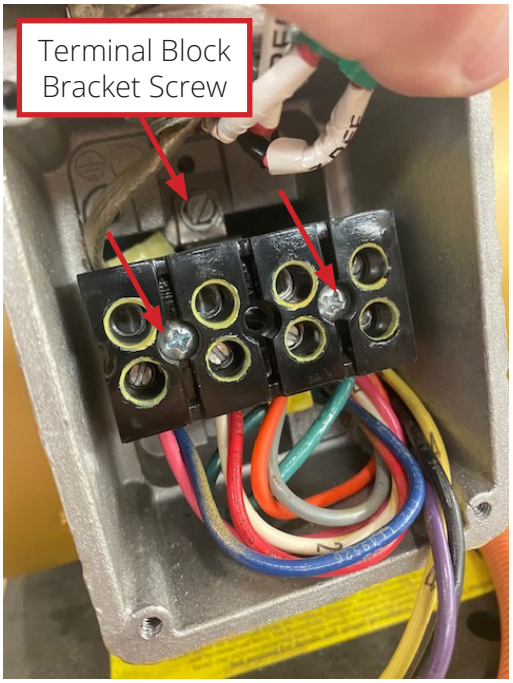


Figure 125: Terminal Block Retaining Screws

6. Once inspection is complete, reinstall the cover with a new gasket.

7. Torque the 4 cover fasteners to 20 in-lbs.

## 3.8. Motor Maintenance

While not required, the following outlines how to perform motor maintenance.

### 3.8.1. Motor Bearing Lubrication – Baldor Reliance Motors Only

Current Powerex Transportation compressors come with a variety of electric motor options and Powerex does not require any maintenance be performed on the motor. Units with Baldor Reliance motors installed have grease fittings. Should you desire to grease these fittings, follow the procedure below.

**NOTICE** Adding too much grease to the motor bearings may damage the bearings.

Bearings should be lubricated while the motor is warm and stopped.

1. Locate and clean the grease fittings on each end of the motor.

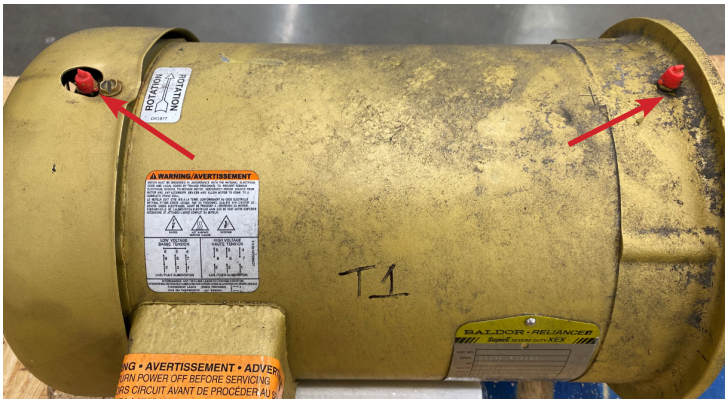


Figure 126: Motor Grease Fittings with Protective Caps in Place

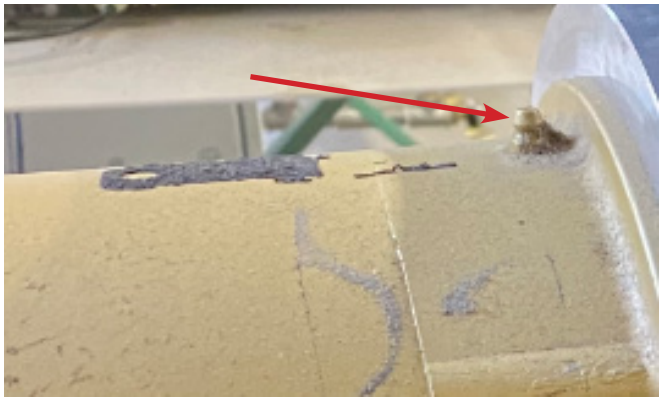

Figure 127: Grease Fitting without Protective Cap

2. Remove protective caps (if equipped).


Figure 128: Use Flathead Screwdriver to remove Protective Caps

Figure 129: Grease Fitting Uncovered

3. Add 5.0 grams of Polyrex EM grease to the shaft end (DE) motor bearing. Add 3.9 grams of Polyrex EM grease to the fan end (ODE) motor bearing.

4. Wipe off any grease residue left on the outside of the grease fittings or motor housing.

5. Replace the grease inlet protective caps (if equipped) and run the motor for 15 minutes.


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## 3.9 General Inspection

When replacing the air filter, the compressor should be inspected for the following:

1. Loose fasteners

Visually check for gaps under bolt heads or washers as well as loose components.

2. Corrosion

Visually check for collection of debris on the unit which may retain moisture and cause corrosion. Use a brush or compressed air to remove the debris. If excessive corrosion is found, replace the corroded component.

3. Damage

Considering these units may be mounted in a variety of locations on a vehicle, potential damage from falling objects or road debris must be considered. Inspect the unit to make sure that no components have been cracked, bent, or broken since the last inspection or installation.

4. Coupling Inspection (SDC units only)

Inspect the motor to air end coupling.

A. Confirm that all setscrews are present and secure in the metal hub attached to the motor shaft.

B. Confirm all 6 bolts attaching the rubber element to the motor hub and the air end hub are still in place and torque markings are still aligned indicating that they remain secure.

C. Inspect the rubber element for cracks and loss of rubber adhesion to the metal inserts inside the element. If a crack deeper than 1.5 mm is found or if the rubber-to-metal connections have come loose, the rubber element should be replaced. Figure 130 below shows typical rubber element wear zones. Pressure folds (creasing) in these zones may be considered normal.

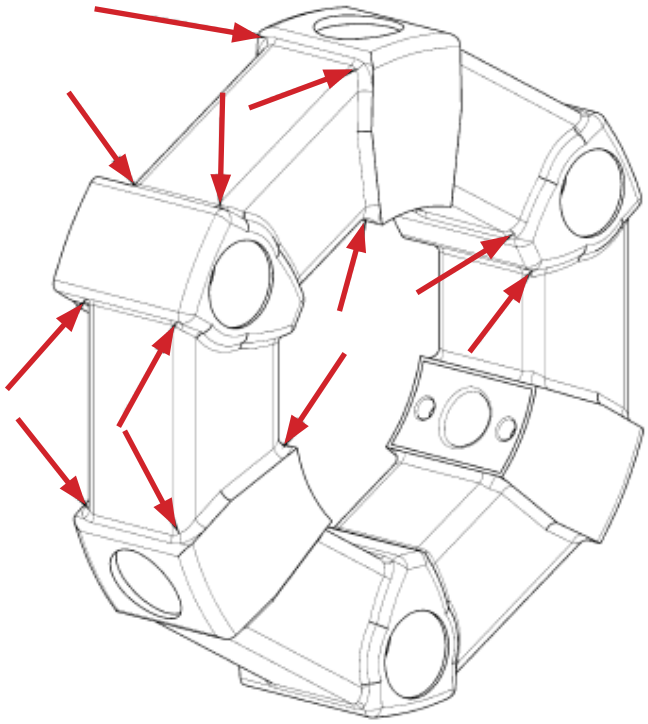

Figure 130: Examples of wear zones on the rubber element indicated by arrows

## 4. Powerex Limited Warranty - Applicable to OEM Customers Only

### Warranty and Remedies.

**(a) General.** Powerex warrants each Compressor System, Vacuum System, Vacuum Pump, Compressor Air-End, or Powerex branded Accessory (collectively "Products", individually each a "Product") to be free from defects in material and workmanship ("Defects") at the date of shipment. This warranty shall apply only to Products that are purchased by Original Equipment Manufacturers (OEMs) and the applications for which are approved in advance in writing by Powerex's Director of Engineering. If the applications for the Products are not approved in advance in writing by Powerex's Director of Engineering then Powerex makes no warranties regarding the Products. EXCEPT AS SET FORTH BELOW, NO OTHER WARRANTY, WHETHER EXPRESS OR IMPLIED, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, SHALL EXIST IN CONNECTION WITH THE SALE OR USE OF SUCH PRODUCTS. TO THE EXTENT PERMITTED BY LAW, ANY AND ALL IMPLIED WARRANTIES ARE EXCLUDED. All warranty claims must be made in writing and delivered to Powerex in accordance with the procedures set forth on its website (www.powerexinc.com), or such claim shall be barred. Upon timely receipt of a warranty claim, Powerex shall inspect the Product claimed to have a Defect, and Powerex shall replace any Product which it determines to have had a Defect; provided, however, that Powerex may elect, upon return of the Product, to refund to buyer any part of the purchase price of such Products paid to Powerex. In no circumstances will Powerex be required or obligated to pay for labor costs to repair any Defect. Freight for returning Products to Powerex for inspection or for shipping warranty parts shall be paid by buyer where permitted by applicable law. Powerex is not responsible for any import fees, taxes, duties, licenses or other fees imposed by any governmental authority upon the production, sale, shipment and/or use of Products covered hereunder. The warranties and remedies herein are the sole and exclusive remedy for any breach of warranty or for any other claim based on any Defect, or non-performance of the Products, whether based upon contract, warranty or negligence.

**(b) (i) Standard Period of Warranty – Parts Only (No Labor)** - The purchase of any system includes Powerex's standard warranty. Powerex warrants and represents all Products shall be free from Defects for the first eighteen (18) months from the date of shipment by Powerex, or twelve (12) months from the documented date of startup, or five thousand (5,000) hours of use, whichever occurs first. During such warranty period, Powerex shall be liable for all Defects in the Products (the "Product Defects"). Supplier's repair or replacement of any Product shall not extend the period of any warranty of any Product. This warranty applies to the exchange of part(s) found to be defective by an Authorized Powerex Service Representative only.

**(ii) Premium Period of Warranty – Parts Only (No Labor).** In order to be eligible for premium warranty coverage, a premium warranty for each system must be purchased when order is placed. Powerex warrants and represents all Products shall be free from Defects for the first thirty (30) months from the date of shipment by Powerex, or twenty-four (24) months from the documented date of startup, or seven thousand five hundred (7,500) hours of use, whichever occurs first. During such warranty period, Powerex shall be liable for all Defects in the Products (the "Product Defects"). Supplier's repair or replacement of any Product shall not extend the period of any warranty of any Product. This warranty applies to the exchange of part(s) found to be defective by an Authorized Powerex Service Representative only.

**(c) Replacement Pumps – Parts Only (No Labor).** For any replacement Air-End or Vacuum Pumps installed on a Powerex manufactured system or unit after any initial warranty period has expired or where another warranty does not apply for any reason, Powerex warrants that the Air-End or Vacuum Pumps shall be free of Defects for a period of twelve (12) months from the date of shipment by Powerex or five thousand (5,000) hours of use, whichever comes first.

**(e) Replacement Motor - Parts Only (No Labor).** For any replacement motor installed on a Powerex manufactured system or unit after any initial warranty period has expired or where another warranty does not apply for any reason, Powerex warrantys that the replacement motor shall be free of Defects for the first twelve (12) months from the date of shipment by Powerex. For any replacement motor installed on a system or unit that was not manufactured by Powerex after any initial warranty period has expired or where another warranty does not


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apply for any reason, Powerex warrants that the replacement motor shall be free of Defects for the first ninety (90) days from the date of shipment by Powerex. Supplier's repair or replacement of any Product shall not extend the period of any warranty of any Product. This warranty applies to the exchange of part(s) found to be defective by an Authorized Powerex Service Representative only.

**(f) Replacement Parts – Parts Only (No Labor).** For other replacement parts besides motors, Air-End or Vacuum Pumps installed on a Powerex manufactured system or unit after any initial warranty period has expired or where another warranty does not apply for any reason, Powerex warrants that such replacement parts will be free from Defects for the first twelve (12) months from the date of shipment by Powerex. For other replacement parts besides motors, Air-End or Vacuum Pumps installed on a system or unit that was not manufactured by Powerex after any initial warranty period has expired or where another warranty does not apply for any reason, Powerex makes no warranties. Supplier's repair or replacement of any Product shall not extend the period of any warranty of any Product. This warranty applies to the exchange of part(s) found to be defective by an Authorized Powerex Service Representative only.

**(g) Coverage.** The warranty provided herein applies to Powerex manufactured units or systems only.

**(h) Exceptions.** Notwithstanding anything to the contrary herein, Powerex shall have no warranty obligations with respect to Products:

**(i)** That have not been installed in accordance with Powerex's written specifications and instructions;

**(ii)** That have not been maintained in accordance with Powerex's written instructions;

**(iii)** That have been materially modified without the prior written approval of Powerex; or

**(iv)** That experience failures resulting from operation, either intentional or otherwise, in excess of rated capacities or in an otherwise improper manner.

**(i)** The warranty provided herein shall not apply to: (i) any defects arising from corrosion, abrasion, use of insoluble lubricants, or negligent attendance to or faulty operation of the Products; (ii) ordinary wear and tear of the Products; or (iii) defects arising from abnormal conditions of temperature, dirt or corrosive matter; (iv) any OEM component which is shipped by Powerex with the original manufacturer's warranty, which shall be the sole applicable warranty for such component.

**Limitation of Liability.** NOT WITHSTANDING ANYTHING TO THE CONTRARY HEREIN, TO THE EXTENT ALLOWABLE UNDER APPLICABLE LAW, UNDER NO CIRCUMSTANCES SHALL POWEREX BE LIABLE FOR ANY INCIDENTAL, CONSEQUENTIAL, PUNITIVE, SPECULATIVE OR INDIRECT LOSSES OR DAMAGES WHATSOEVER ARISING OUT OF OR IN ANY WAY RELATED TO ANY OF THE PRODUCTS OR GOODS SOLD OR AGREED TO BE SOLD BY POWEREX TO BUYER. TO THE EXTENT ALLOWABLE UNDER APPLICABLE LAW, POWEREX'S LIABILITY IN ALL EVENTS IS LIMITED TO, AND SHALL NOT EXCEED, THE PURCHASE PRICE PAID.

**Warranty Disclaimer.** Powerex has made a diligent effort to illustrate and describe the Products in its literature, including its Price Book, accurately; however, such illustrations and descriptions are for the sole purpose of identification, and do not express or imply a warranty that the Products are merchantable, or fit for a particular purpose, or that the Products will necessarily conform to the illustrations or descriptions.

**Product Suitability.** Many jurisdictions have codes and regulations governing sales, construction, installation, and/or use of Products for certain purposes, which may vary from those in neighboring areas. While Powerex attempts to assure that its Products comply with such codes, it cannot guarantee compliance, and cannot be responsible for how the product is installed or used. Before purchase and use of a Product, please review the Product applications, and national and local codes and regulations, and be sure that the Product, installation, and use will comply with them.

**Claims.** Any non-warranty claims pertaining to the Products must be filed with Powerex within 6 months of the invoice date, or they will not be honored. Prices, discounts, and terms are subject to change without notice or as stipulated in specific Product quotations. Powerex shall not be liable for any delay or failure arising out of acts of the public enemy, fire, flood, or any disaster, labor trouble, riot or disorder, delay in the supply of materials or any other cause, whether similar or dissimilar, beyond the control of Company. All shipments are carefully inspected and counted before leaving the factory. Please inspect carefully any receipt of Products noting any discrepancy or damage on the carrier's freight bill at the time of delivery. Discrepancies or damage which obviously occurred in transit are the carrier's responsibility and related claims should be made promptly directly to the carrier. Returned Products will not be accepted without prior written authorization by Powerex and deductions from invoices for shortage or damage claims will not be allowed. **UNLESS OTHERWISE AGREED TO IN WRITING, THE TERMS AND CONDITIONS CONTAINED IN THIS LIMITED WARRANTY WILL CONTROL IN ANY TRANSACTION WITH POWEREX.** Any different or conflicting terms as may appear on any order form now or later submitted by the buyer will not control. All orders are subject to acceptance by Powerex.


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## Notes