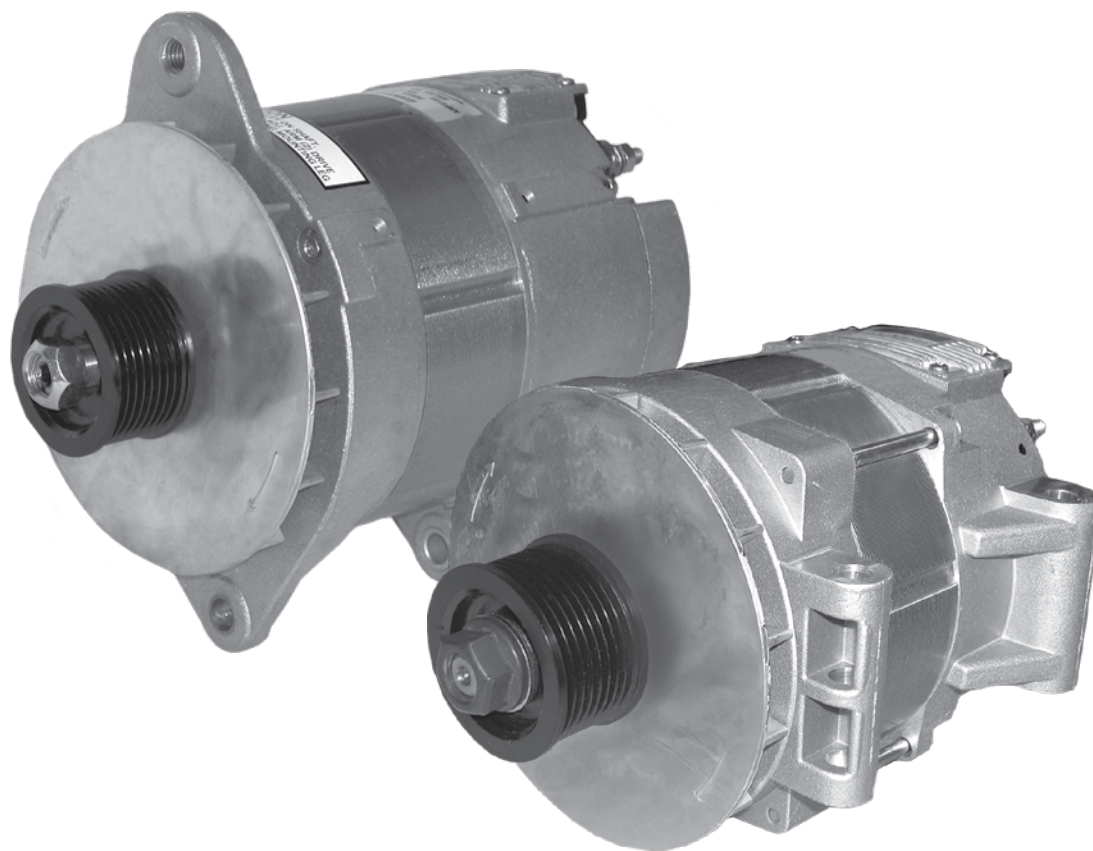




## SERVICE MANUAL FOR THE 12 DIODE 4000 SERIES ALTERNATOR



### TROUBLESHOOTING, DIAGNOSTICS AND REPAIR

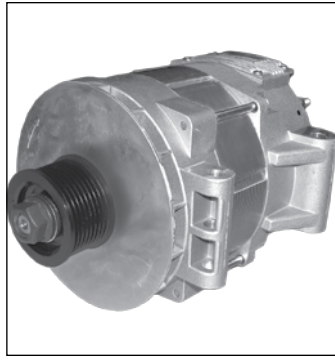
**Prestolite**  
*electric*

**Leece-Neville**  
HEAVY DUTY SYSTEMS

TSM1001 2/09

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### Description:

The 4000 series alternators are air cooled, belt driven units designed for heavy duty diesel engine applications.

These units feature an integral/external voltage regulators, fully enclosed brushes, built-in rectifier assemblies with solid lead frame and extra large heat sinks, a dynamically balanced rotor, and heavy duty stator and bearings. The 4000 series comes in a vast array of features which includes, remote sense, self excite, ignition excite, lamp and Multipower Technology™.

### Mode of operation:

The vehicle battery supplies excitation to the field coil (rotor coil) through the regulator and brushes, to create a magnetic field around the rotor and through the stator.

When the rotor is set in motion, the moving magnetic field induces an alternating current (AC) in the stator windings. This output current increases with the speed of the rotor.

The (AC) produced in the stator is converted to direct current (DC) by the positive and negative rectifier assemblies. The rectifier assemblies are connected to the alternator output terminals to provide (DC) output for charging the batteries and to satisfy the vehicle electrical loads.

The regulator monitors the output voltage through sensing leads which are connected to the positive and negative rectifier assemblies, or on some models this is done externally through a remote sense (S) terminal. When the output voltage deviates from the set voltage, the regulator takes corrective action to maintain the output voltage at the proper level. For more detailed information on how an alternator works please see our training CD PP-1216.

### Causes of Charging System Failure:

Charging system malfunction is identified by the battery

1. OVERCHARGED BATTERIES caused by one or a combination of the following:
  - A. Defective Battery.
  - B. Defective regulator.
  - C. Poor sensing lead contact to regulator or rectifier assembly.
2. UNDERCHARGED BATTERIES caused by one or a combination of the following:
  - A. Loose belts; corroded, broken, loose or dirty terminals; broken wiring; undersize wiring; defective batteries.
  - B. Alternator field circuit malfunction caused by one or a combination of the following:
    - a. Poor contacts between regulator and brushes.
    - b. No residual magnetism in rotor.  
(Refer to TSB-1034 to restore residual magnetism.)
    - c. Defective regulator.
    - d. Damaged or worn brushes.
    - e. Damaged or worn slip rings.
    - f. Poor connection between slip ring assembly and field coil leads.
    - g. Rotor coil shorted, open, or grounded.
  - C. Alternator generating section malfunction caused by one of the following:
    - a. Stator phase(s) shorted, open, or grounded.
    - b. Rectifier assembly grounded.
    - c. Rectifier(s) shorted or open.

### On- Vehicle or Test Stand Troubleshooting:

Detailed information can be found on our web site at [www.prestolite.com](http://www.prestolite.com).

When on our web site, look up the alternator model you have questions on and you will find hyperlinks that will take you to information pertaining to that model. You can also contact our technical support hot line at 1-866-288-9853.

Good information to reference would be our training

# Alternator Disassembly

Step 1: Remove fan and 4 screws that attach the regulator to alternator.  
See Fig 1.

Step 2: Lift regulator from alternator and remove all hardware that attaches regulator to alternator.  
See Fig 2.

Step 3: Remove brushes and regulator from brushbox.  
See Fig 2.

Step 4: Remove through bolts from alternator.  
See Fig 3 Pad mount alternators.  
See Fig 4 J-180 mount alternators.

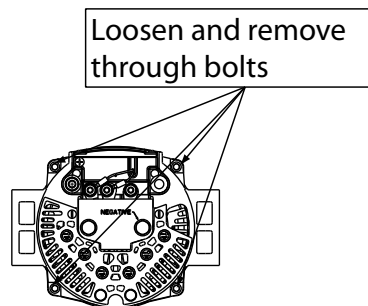


Fig 3

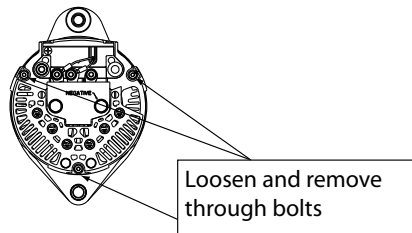


Fig 4

Step 5: Tap front housing with a soft face mallet to separate the front housing/ rotor assembly from the rear housing/ stator assembly.  
See Fig 5.

Step 6: Pull front housing/ rotor assembly from rear housing/ stator assembly.  
See Fig 6.

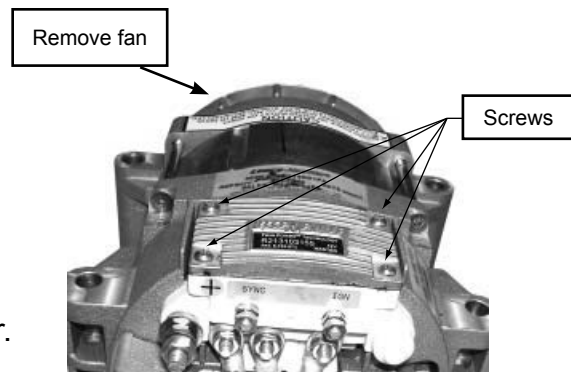


Fig 1

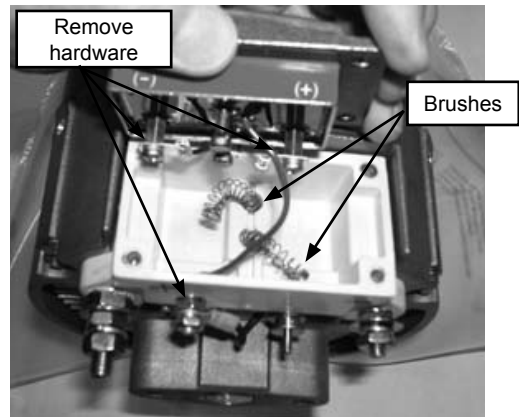


Fig 2

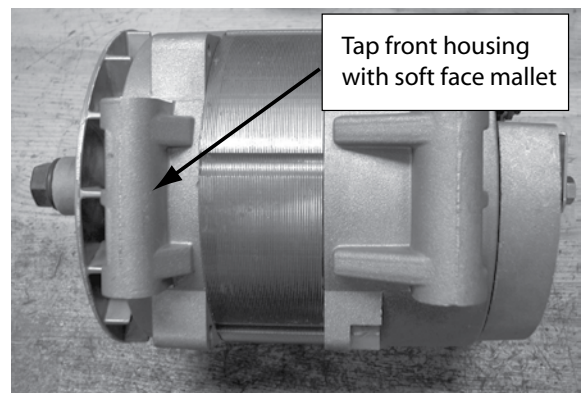


Fig 5

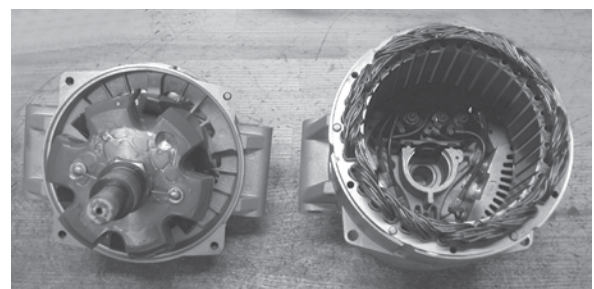


Fig 6

Step 7: Remove three stator nuts holding stator to rear housing and remove stator.  
See Fig 7 and 8.

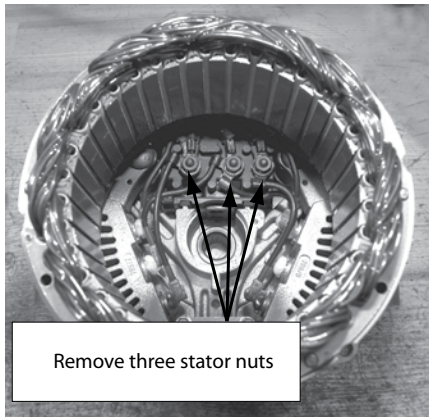


Fig 7

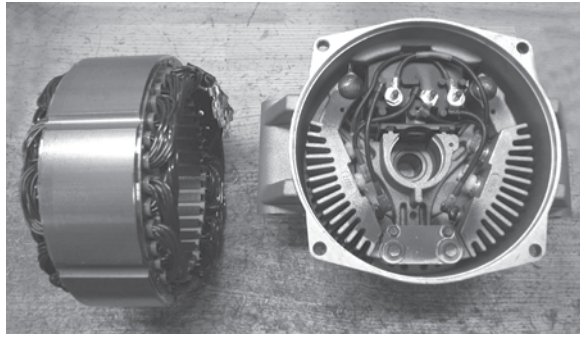


Fig 8

## Negative Rectifier Ring Removal

Step 1: Remove two bolts holding negative cover plate.

Step 2: Remove negative plate.  
See Fig 1.

Step 3: Remove three 1/4" AC tap nuts.  
See Fig 2.

Step 4: Remove two 1/4" bolts.  
See Fig 2.

Step 5: Remove two screws. See Fig 2.

Step 6: Remove negative rectifier ring from alternator.  
See Fig 3.

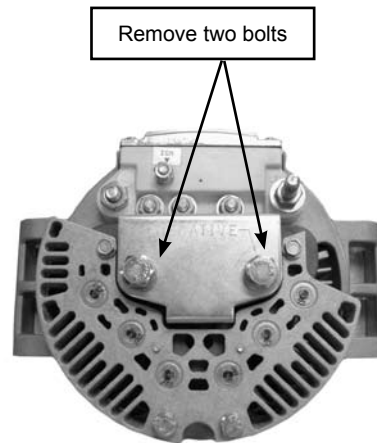


Fig 1

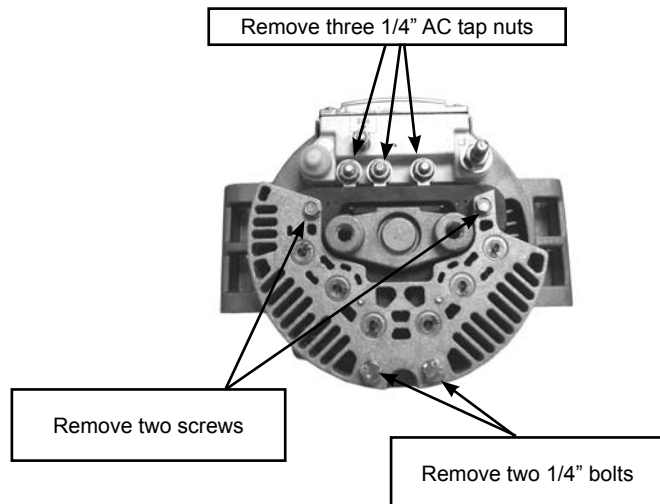


Fig 2

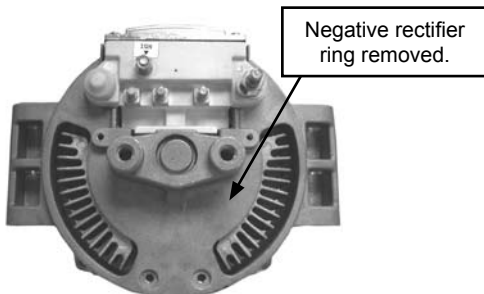


Fig 3



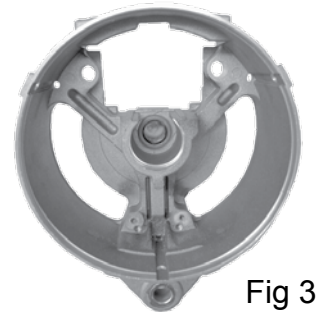
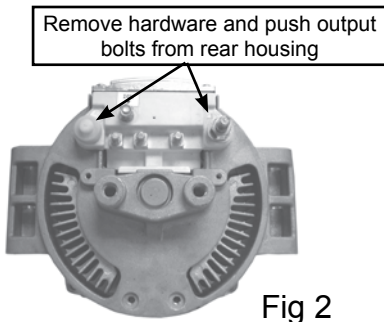
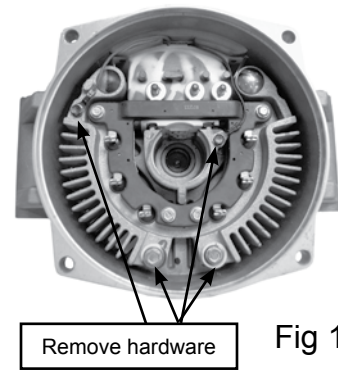
## Positive Rectifier Ring Removal

Step 1: Remove hardware.  
See Fig 1

Step 2: Flip alternator housing and remove hardware. Remove output studs.  
See Fig 2.

Step 3: Remove positive rectifiers from rear housing. See Fig 3.

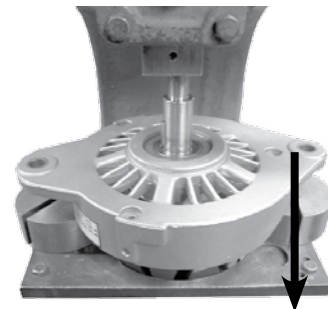
Note: Brush box will come out of rear housing when rectifier is removed.



## Rotor Removal

Step 1: Place front housing/ rotor assembly on a press.

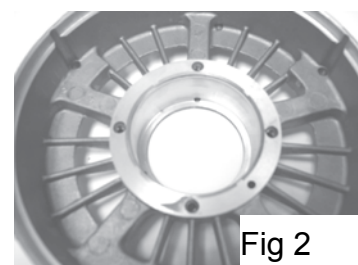
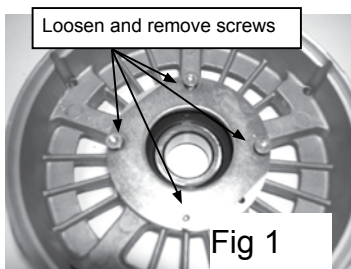
Step 2: Press rotor from front housing.  
See Fig 1 for steps 1 and 2.



## Front Bearing Removal

Step 1: Remove screws that attach the bearing retainer to the front housing. See Fig 1.

Step 2: Press bearing from front housing.  
See Fig 2.



## Rear Bearing Removal

- Step 1: Place rear housing on a press.  
See Fig 1.
- Step 2: Press rear bearing/ seal from rear housing.  
See Fig 2.

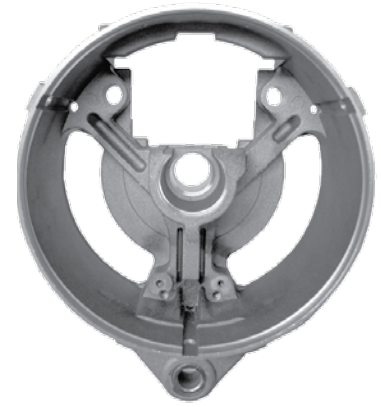
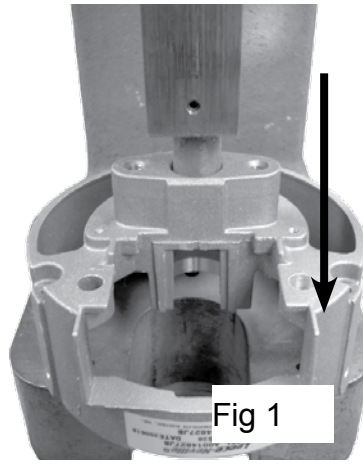


Fig 2

## Alternator Diagnostic/ Component Testing

**All tests are designed to be performed off the vehicle.**

### Positive Rectifier Test

Note: You will need a multimeter to perform the following tests.

#### Test for complete alternator.

- Step 1: Set multimeter to diode check mode (  $\rightarrow \nabla \leftarrow$  ).
- Step 2: Connect positive test lead (+) to alternator AC post (TP-1) and negative test lead (-) to alternator B+ post. Move the positive test lead (+) to (TP-2) and (TP-3). Record readings at all three TP locations. See Fig 1.

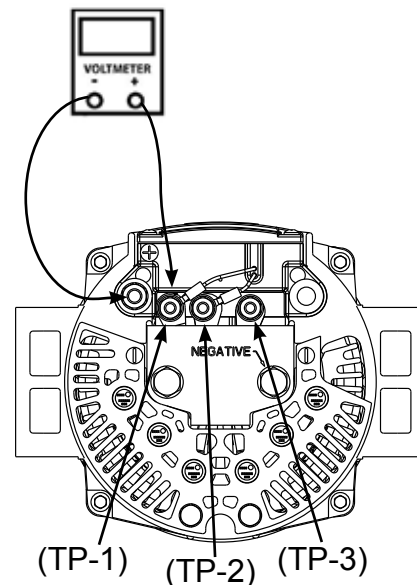


Fig 1

Voltage readings for a good unit: 0.4V-0.5V.  
If voltage does not fall into these parameters then there is a possibility that the rectifier is faulty. Continue to step 3.

- Step 3: Reverse test leads.  
Connect positive test lead (+) to alternator B+ post and negative test lead (-) to alternator AC post (TP-1). Move the Negative test lead (-) to (TP-2) and (TP-3). Record readings at all three TP locations. See Fig 2.

Voltage readings for a good unit: 1V - 2V.  
If voltage does not fall into these parameters then there is a possibility that the rectifier is faulty. Continue to steps 4 and 5.

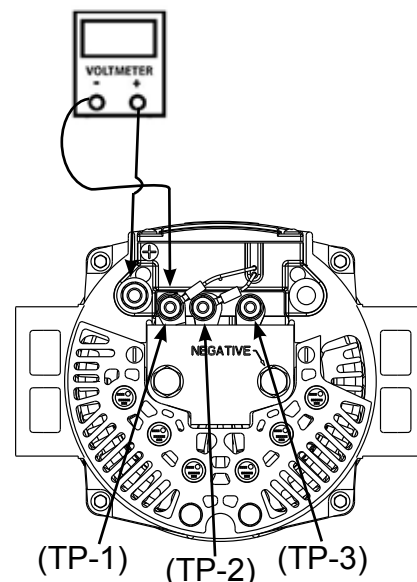


Fig 2

Note: You will need a multimeter to perform the following tests.

**Test for rectifier ring only.**

Step 4: Connect positive test lead (+) to diode post (TP 1) and negative test lead (-) to rectifier heatsink. Move the positive test lead (+) to (TP-2), (TP-3), (TP-4), (TP-5) and (TP-6). Record readings at all six TP locations. See Fig 3.

Voltage readings for a good unit: 0.4V-0.5V.  
If voltage does not fall into these parameters then the rectifier is defective.

Step 5: Reverse test leads.  
Connect positive test lead (+) to rectifier heatsink and negative test lead (-) to diode post (TP-1). Move the Negative test lead (-) to (TP 2), (TP 3), (TP-4), (TP-5) and (TP-6). Record readings at all six TP locations. See Fig 4.

Voltage readings for a good unit: “∞” or “OL”.  
If voltage does not fall into these parameters then the rectifier is defective.

Note: Due to the wiring configuration of the rectifier, the tests above will not identify an open diode.

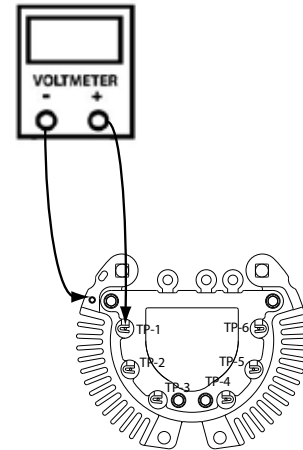


Fig 3

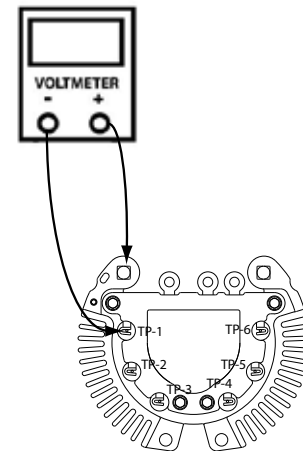


Fig 4



## Negative Rectifier Test

Note: You will need a multimeter to perform the following tests.

### Test for complete alternator.

Step 1: Set multimeter to diode check mode.

Step 2: Connect positive test lead (+) to alternator negative post and negative test lead (-) to alternator AC post (TP-1). Move the negative test lead (-) to (TP 2) and (TP 3). Record readings at all three TP locations. See Fig 1.

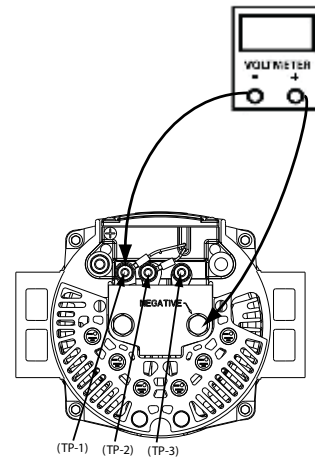


Fig 1

Voltage readings for a good unit: 0.4V-0.5V. If voltage does not fall into these parameters then there is a possibility that the rectifier is faulty. Continue to step 3.

Step 3: Reverse test leads.

Connect positive test lead (+) to alternator AC post (TP-1) and negative test lead (-) to alternator negative post. Move the positive test lead (+) to (TP-2) and (TP-3). Record readings at all three TP locations. See Fig 2.

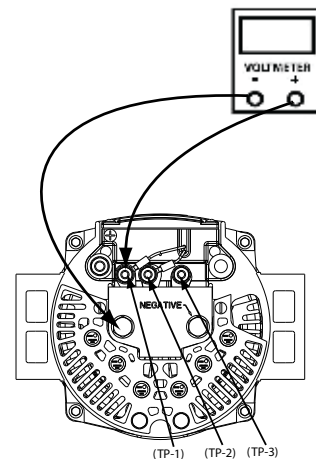


Fig 2

Voltage readings for a good unit: 1V - 2V. If voltage does not fall into these parameters then there is a possibility that the rectifier is faulty. Continue to steps 4 and 5.

### Test for rectifier ring only.

Step 4: Connect positive test lead (+) to rectifier heatsink and negative test lead (-) to diode post (TP-1). Move the negative test lead (-) to (TP-2), (TP-3), (TP-4), (TP-5) and (TP-6). Record readings at all six TP locations. See Fig 3.

Voltage readings for a good unit: 0.4V-0.5V. If voltage does not fall into these parameters then the rectifier is defective.

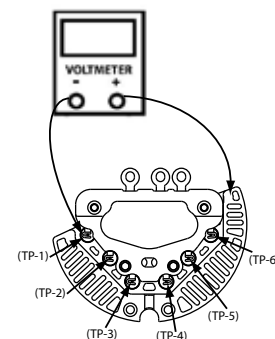


Fig 3

#### Step 5: Reverse test leads.

Connect positive test lead (+) to diode post (TP-1) and negative test lead (-) to rectifier heatsink. Move the positive test lead (+) to (TP-2), (TP-3), (TP-4), (TP-5) and (TP-6).

Record readings at all six TP locations.  
See Fig 4.

Voltage readings for a good unit: “∞” or “OL”.  
If voltage does not fall into these parameters then the rectifier is defective.

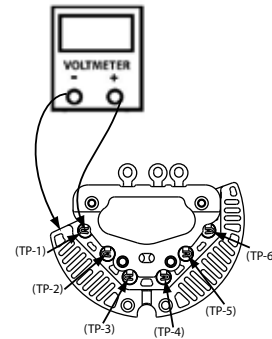


Fig 4

Note: Due to the wiring configuration of the rectifier, the tests above will not identify an open diode.

### Alternator Field Test

The test below will help determine if the alternator field is working properly.

Set multimeter to diode check mode.

Step 1: Insert 1/16" drill bit or mechanics wire into alternators full field access hole. Insert straight into hole until it stops about 1/4" (Do not Force). Hold firmly in place to ensure appropriate contact. See Fig 1.

Step 2: Connect voltmeter where one test lead connects to the wire or drill bit inserted into the full field access hole and the other test lead connects to the alternator B+ terminal. Observe reading on multimeter.

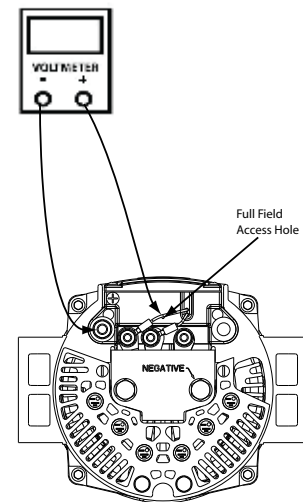


Fig 1

Note: While performing this test, you may need to rotate the rotor to make sure the brushes are making contact to the slip rings.

If a low voltage reading (0V) is observed on the multimeter then the field circuit is good.

If a high voltage reading (∞ or OL) on the multimeter then the field circuit is open.

#### Possible causes for an open field circuit.

- 1) Poor contact between regulator and brushes.
- 2) Poor contact between brushes and slip rings.
- 2) Damaged or worn brushes.
- 3) Rotor coil open.
- 4) Positive regulator sense lead damaged or a loose connection.
- 5) Defective regulator.
- 6) Worn or damaged slip rings.

## Rotor Test

The tests below will help determine if the rotor is within specifications.

Set multimeter to check resistance (R X 1) scale.

Step 1: Connect multimeter test leads per Fig 1. Move test lead to (TP-2). Record readings at both TP locations.

If a high resistance reading is observed then the rotor is good. Continue to step 2.

If a low resistance (Short) is observed then the rotor is defective. Rotor will need to be replaced.

Step 2: Connect multimeter test leads per Fig 2 and record resistance reading.

Note: It may be necessary to clean the carbon coating off the slip rings with a strip of emery cloth.

Determine the voltage and amperage rating of the alternator you are testing and compare your reading to the chart below.

Voltage	Amperage	Rotor Resistance
12V	185 A	1.9 - 2.1 Ohms
12V	200 A	2.6 - 2.8 Ohms
12V	220 A	2.8 - 3.0 Ohms
12V	270 A	2.2 - 2.5 Ohms
12V	320 A	1.9 - 2.0 Ohms
24V	200 A	4.0 - 4.3 Ohms

If the resistance reading measured does not compare then the rotor is defective and will need to be replaced.

Step 3: Check shaft diameter for wear, where it contacts the rear bearing. If the diameter is less than .6688"/ 16.987mm then rotor will need to be replaced.

Step 4: Check slip ring diameter for wear. If the diameter is less than 1.057"/ 26.847mm then the rotor will need to be replaced.

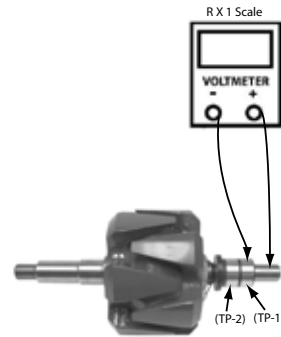


Fig 1

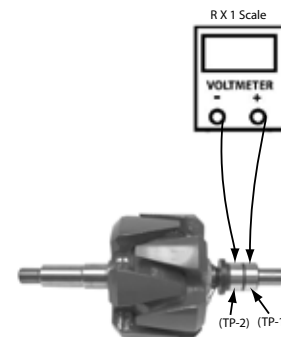


Fig 2

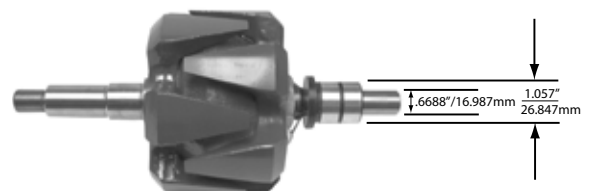


Fig 3

## Brush Inspection

If brushes appear burned, cracked, broken or if they are worn to a length of 3/16" or less, brushes must be replaced. Check shunt lead within the brush spring. If the shunt lead is broken, frayed or damaged install new brushes.

## Stator Test

Tests below will help determine if stator is within specifications.

Set multimeter to check resistance (R X 1) scale.

Step 1: Connect one test lead to a bare metal surface on the stator lamination and the other test lead to (TP-1). Move test lead to (TP-2) and (TP-3). Record reading at all three TP locations. See Fig 1.

If a high resistance reading ( $\infty$ ) is recorded then the stator is good. Continue to step 2.

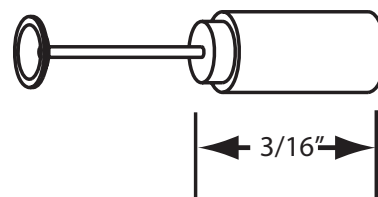
If a low resistance reading (Short) is recorded then the stator will need to be replaced.

Note: It is recommended that a "High Pot" test be performed on a stator for grounds by a qualified electrical shop.

Note: To perform the test below, a digital ohmmeter with 1/1000th of an ohm (m  $\Omega$ ) display capability must be used.

Step 2: Connect test leads to stator terminals (TP-1 & TP-2), (TP-2 & TP-3) and (TP-1 & TP-3). Record measurements at all three locations.

Refer to chart for correct readings. If readings are not within specifications, then stator is defective.



Minimum brush length

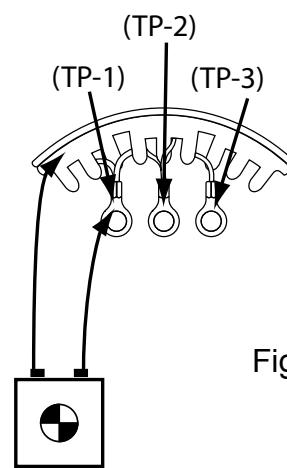
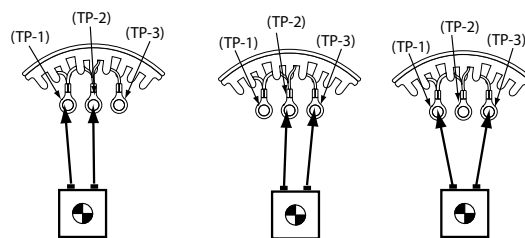


Fig 1



Wheatstone Bridge or  
Ohmmeter with 1/1000 scale

Fig 2

Voltage	Current	Phase to Phase Resistance Ohms
12	185 amps	0.020 - 0.023
12	200 amps	0.012 - 0.016
12	220 / 270 amps	0.008 - 0.010
12	320 amps	0.007 - 0.009
24	200 amps	0.022 - 0.026

## Regulator Test

The tests below will help determine if any faults are in the regulator.

Note: It may be necessary to have the regulator tested on a Transpo regulator tester by a qualified electrical shop. The tests below will diagnose about 80% of regulator failures.

Set multimeter to diode check mode.

Step 1: Connect one test lead to a bare metal surface on the regulator housing and the other test lead to (TP-1).  
Move test lead to (TP-2), (TP-3), (TP-4), (TP-5).and (TP-6).  
If a terminal is not shown or different per Fig 1 make sure all terminals are tested. See Fig 1  
Record readings at all TP locations.

If a high reading (OL) is recorded then the regulator is good.  
Continue to step 2.

If a low reading (0V) is recorded then the regulator is defective and needs to be replaced.

Step 2: Connect negative test lead (-) to regulator positive terminal.  
Connect positive test lead (+) to (TP-1). See Fig 2  
Record measurement.

If a low reading (0V) is recorded then the regulator is good.  
Continue on with Step 2.

If a high voltage reading (OL) is recorded then the regulator is defective and needs to be replaced.

Step 2 (Cont): Move positive test lead (+) to (TP-2).  
Record measurement. See Fig 2.

If a voltage reading of 0.4V to 0.7V is recorded then the regulator is good. Continue to Step 3. If the measurements are not within these values then the regulator is defective and needs to be replaced.

Step 3: Connect test leads per Fig 3 and record the reading.

If a voltage reading of 0.4V to 0.7V is recorded then the regulator is good. If the measurements are not within these values then the regulator is defective and needs to be replaced.

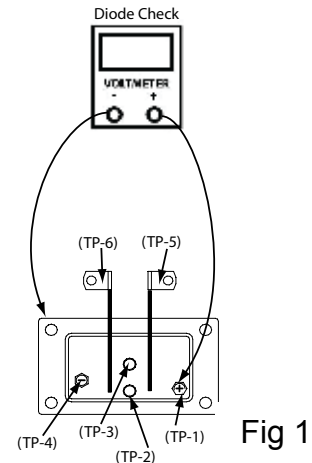


Fig 1

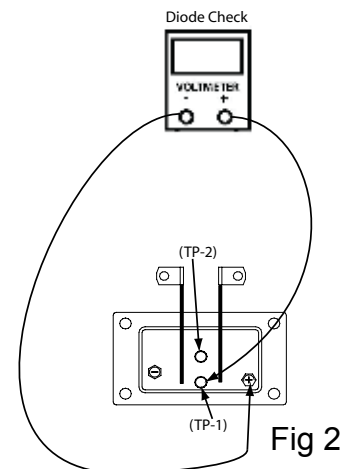


Fig 2

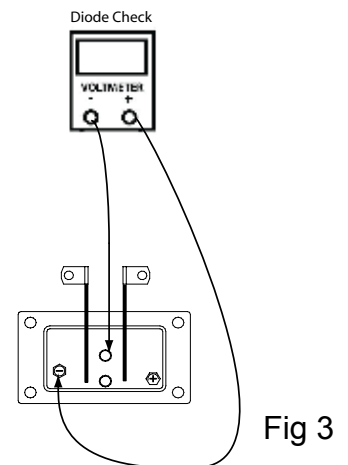


Fig 3



# Alternator Assembly Instructions

## Front bearing installation

Step 1: Place bearing into front housing and press into place.  
See Fig. 1

Note: To prevent damage to the front bearing, press on the bearing's outer race. Use of an appropriate bearing press adaptor, socket or pipe that contacts the entire diameter of the bearing outer race is recommended.

Step 2: Place bearing spacer into front housing. See Fig. 2

Note: On some models, a wider front bearing will be utilized. If your alternator uses this wider bearing then the front bearing spacer used in step 2 will not be needed.

Step 3: Place bearing retainer on front housing and tighten mounting screws to 33-39 in-lbs. See Fig. 3.

Note: Apply "Blue" 242 Locktite® to mounting screws before assembly.

## Rotor installation

Step 1: Measure your existing rotor. See Fig 4.  
If Dim A measures .5" (1/2") continue to step 3.  
Spacer in step 2/ Fig 5 is not needed.

If Dim A measures .25" (1/4") continue to step 2.

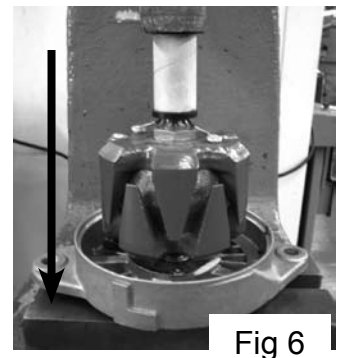
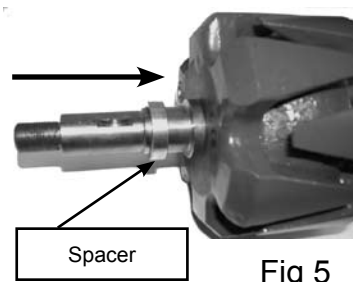
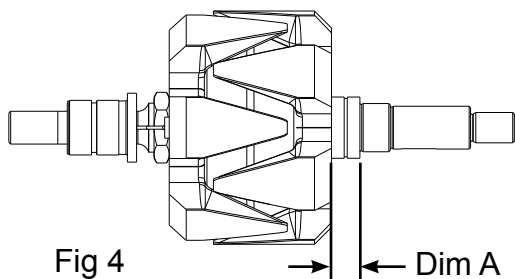
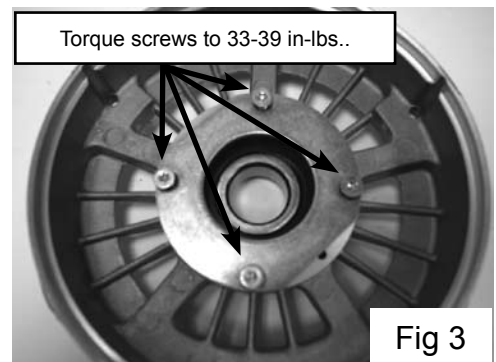
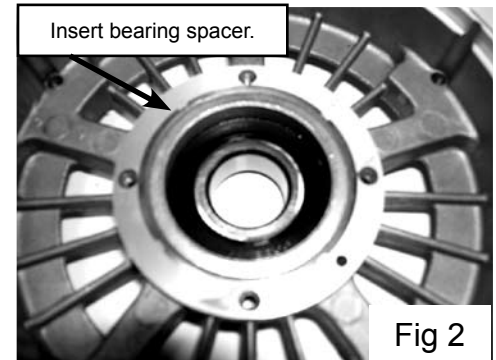
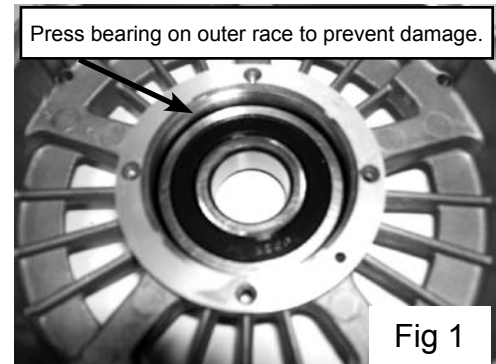
Step 2: Slide spacer onto rotor shaft. See Fig 5.

Note: On some models, a wider front bearing will be utilized. If your alternator uses this wider bearing then the spacer shown in Fig 5 will not be needed.

Step 3: Press rotor into front bearing. See Fig 6.

Note: To prevent damage to the front bearing, press on the bearing's inner race.

Note: Use of a brass or copper block between the press and the rotor shaft will prevent damage to the end of the rotor shaft.  
See Fig.6



## Rear bearing installation

Step 1: Determine the length of bearing you are installing.  
See Fig 1, 1a

Step 2: Place bearing into rear housing and press into place.  
See Fig. 2

Note: Use figure 3 and 3 a to determine correct depth to press bearing.

Note: To prevent damage to the front bearing, press on the bearing's outer diameter. Use of an appropriate bearing press adaptor, socket or pipe that contacts the entire diameter of the bearing outer race is recommended. Use caution not to get debris inside bearing during assembly.

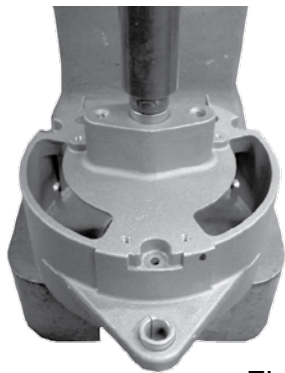
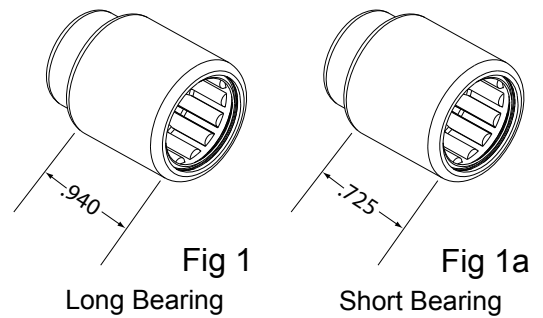


Fig 2

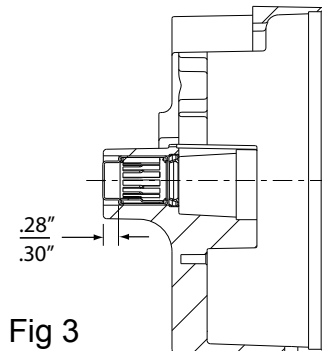


Fig 3

Long Bearing

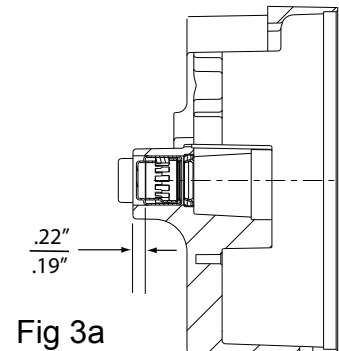


Fig 3a

Short Bearing

## Rear bearing seal installation

Step 1: Place rear bearing seal into rear housing. See Fig 4.

Note correct orientation of seal before pressing into place.

Step 2: Press seal into place.

Note: To prevent damage to the rear bearing seal, press on the seal outer diameter. Use of an appropriate press adaptor, socket or pipe that contacts the entire diameter of the seal outer diameter is recommended.

Use caution not to get debris inside bearing during assembly.

After assembly coat lip of seal with a high quality synthetic bearing grease.

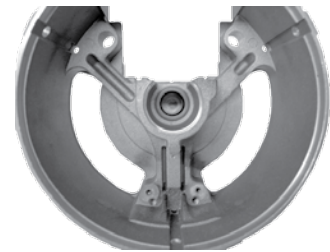
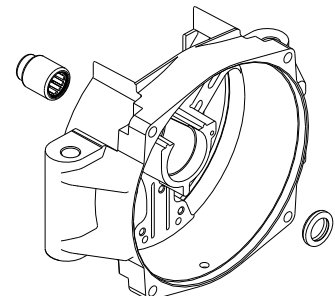


Fig 4



## Regulator/ brushbox assembly instructions.

Step 1: Attach regulator wires to regulator and brush box.

See Fig 1. If your model has a rubber grommet or any additional wires, attach them at this time.

Torque value: #10-32 nuts: 17-23 in-lbs.

Note: Many different regulator models exist with different wiring configurations to the brush box. Please refer to TSB-1134 that will aid in identifying these wires.

Step 2: Place regulator onto brush box. See Fig 2.

Note: Make sure regulator (red) and (black) leads are properly seated into notches before securing regulator.

Step 3: Insert four regulator screws and tighten.

Torque screws to 11-13 in-lbs. See Fig 3

Step 4: Turn over assembly and place brushes into brush box. See Fig 4.

Step 5: With brush placed into holder, compress entire brush into holder and retain brush into opening with a safety pin. Install second brush following the same procedure; slipping retaining pin forward through front opening of brush box to secure both brushes. See Fig 5

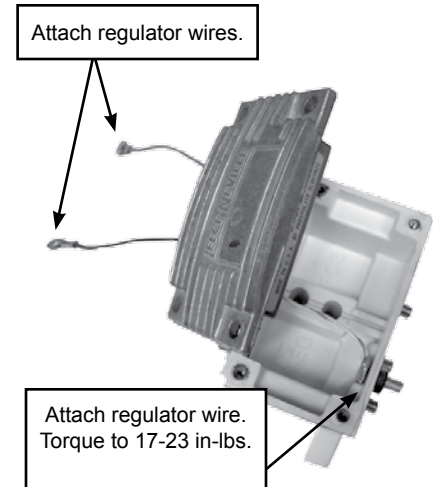


Fig 1



Fig 2

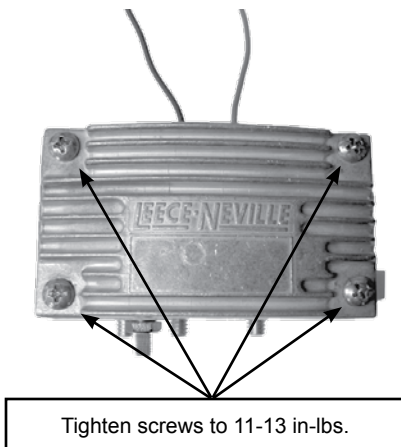


Fig 3

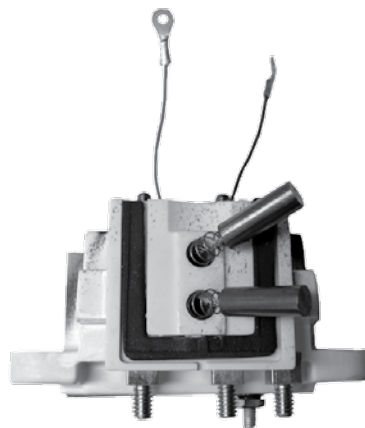


Fig 4



Fig 5

## Positive rectifier installation

Step 1: Place insulators into rear housing. See Fig 1

Step 2: Install positive rectifier ring into rear housing. Make sure insulators are properly seated. Install two bottom bolts do not tighten. See Fig 2

Step 3: For proper orientation of hardware and insulators refer to Fig 3.

Step 4: Install brush box assembly into rear housing. See Fig 4.

Step 5: Insert positive bolt and shorter 5/16" carriage bolt into rectifier ring. Slight downward pressure on the brush box assembly may be needed in order to pass the bolts through the brush box. See Fig 5

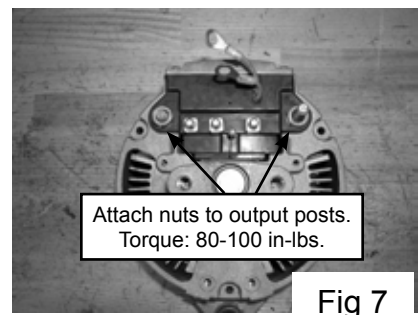
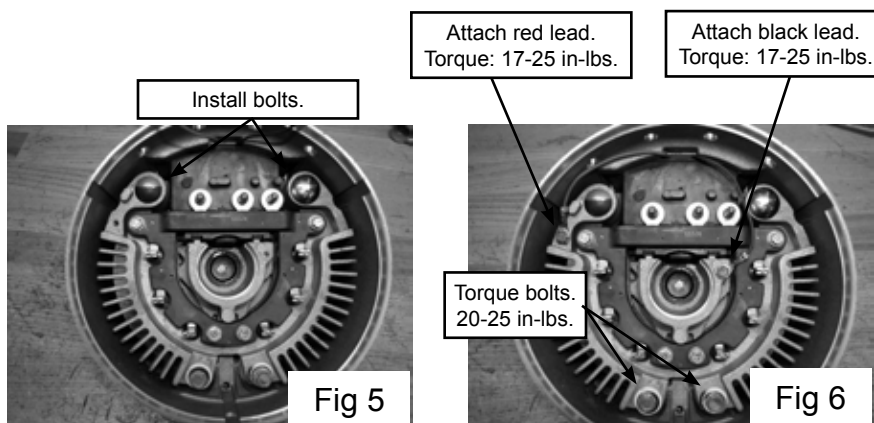
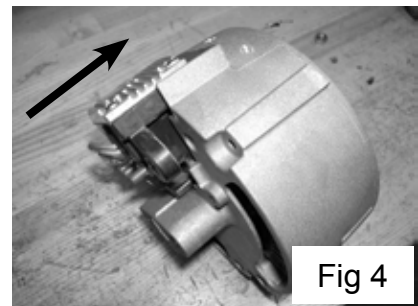
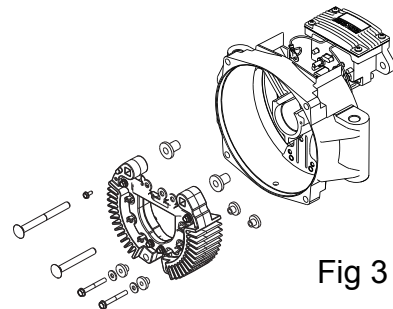
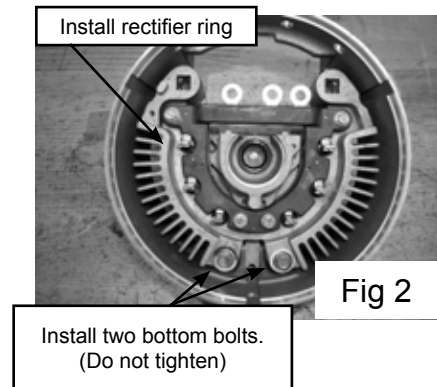
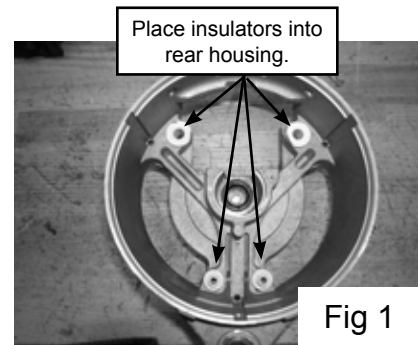
Note: Location of bolts are dependant on application. Review possible clearance issues on application and determine best location for the positive stud.

Step 6: Tighten two lower rectifier mounting bolts and torque to 20-25 in-lbs. See Fig 6

Step 7: Route regulator sense leads per (Fig 6) and attach mounting screws. Torque to 17-25 in-lbs.

Note: On remote regulated models, regulator sense leads will not be present.

Step 8: Turn rear housing over and install hardware to output post and torque to 80-100 in-lbs. See Fig 7



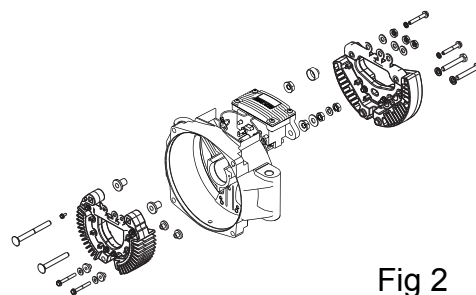
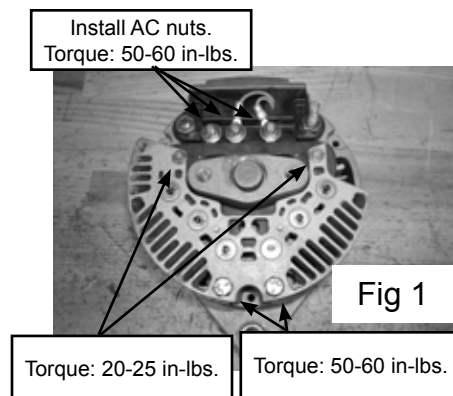
## Negative rectifier installation

Step 1: Place negative rectifier ring onto rear housing and install hardware. Torque hardware per Fig 1

Step 2: Install hardware to alternator AC terminals. See Fig 1

Note: If model applies, connect regulator AC terminals to alternators AC posts.

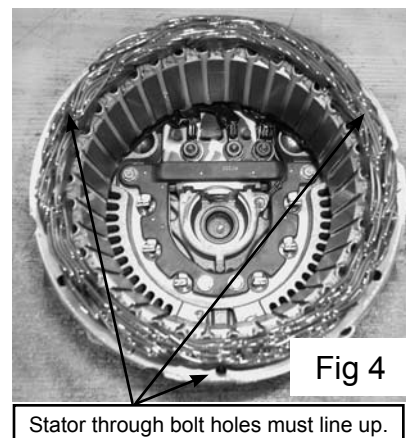
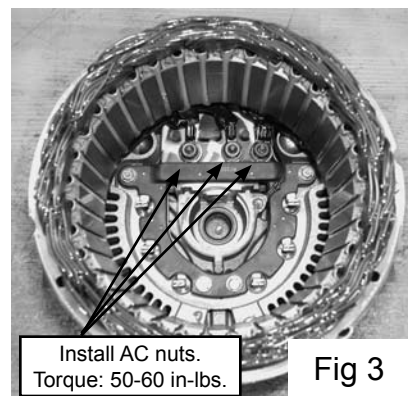
Note: Use Fig 2 for proper orientation of hardware that attaches rectifier rings to rear housing.



## Stator Installation

Step 1: Place stator on rear housing and attach stator terminals to alternator AC studs. Attach nuts and torque to 17-23 in-lbs. See Fig 3

Note: On 4800 J-180 models it is important to line up the stator through bolt holes with the rear housing holes in order to insert the through bolts. See Fig 4





## Alternator final assembly

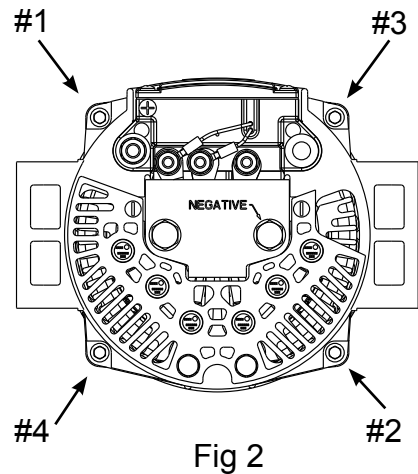
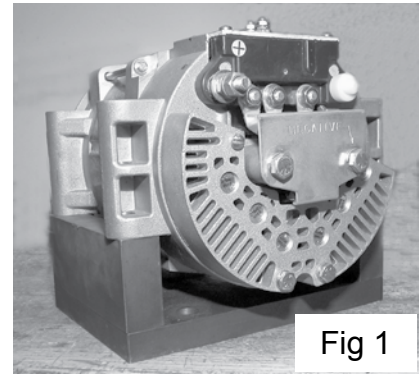
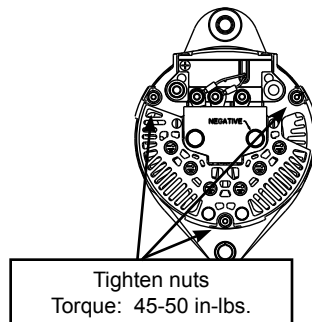
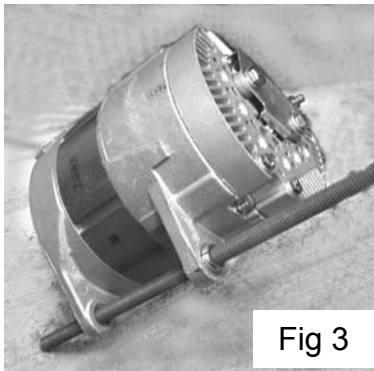
Step 1: Insert front housing/ rotor assembly into rear housing/ stator assembly.

Step 2: On pad mount alternators, place the alternator on a flat surface so the front and rear pads are in line. No rocking should be present between the front and rear pads. See Fig 1

Step 3: Insert through bolts and torque in a cross pattern to 90-110 in-lbs. See Fig 2

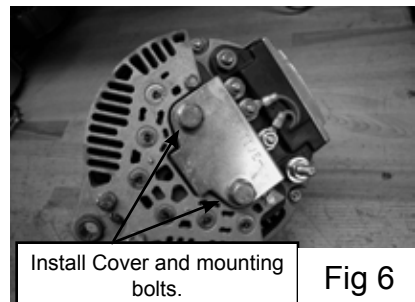
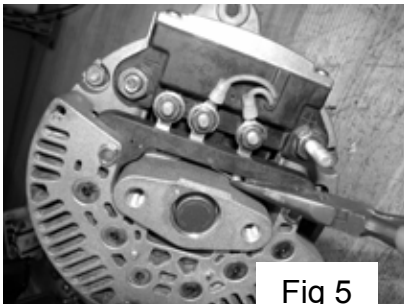
Step 4: On J-180 mount alternators, insert a 1/2" rod through the two mounting holes. This will aid in lining up the through bolts holes. See Fig 3

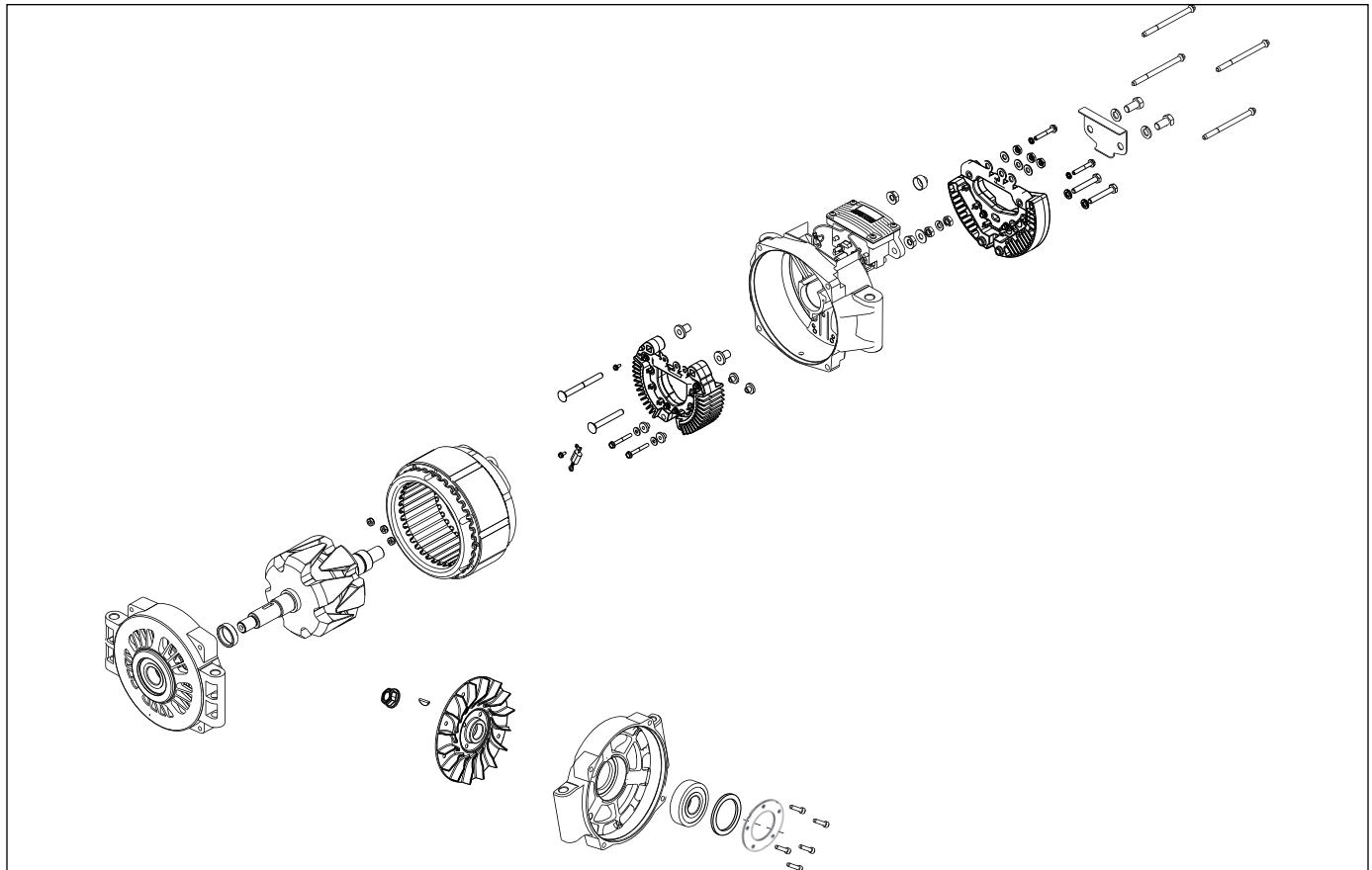
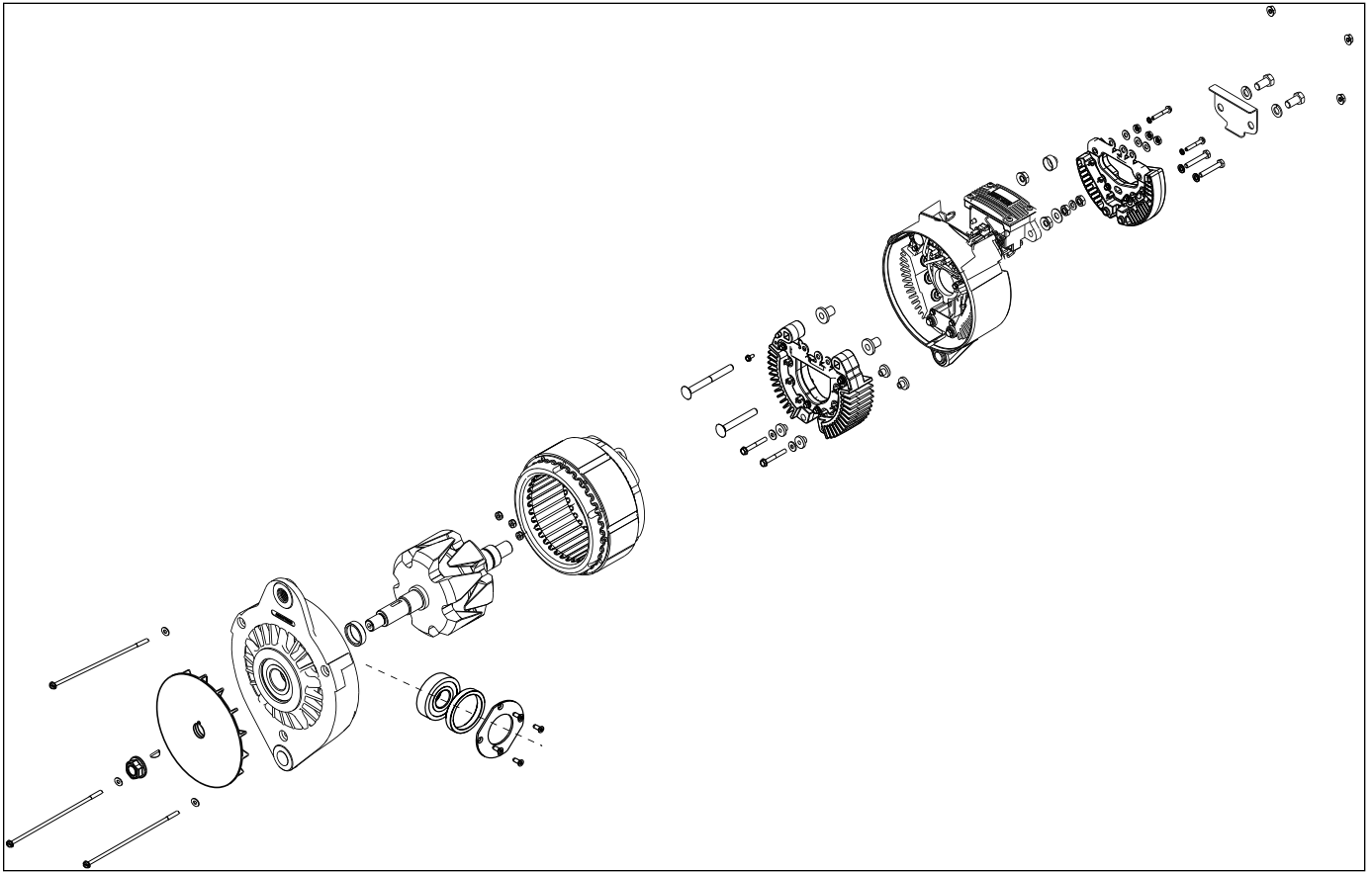
Step 5: Insert through bolts and torque nuts to 45-50 in-lbs. See Fig 4



Step 6: Pull brush retaining pin. See Fig 5

Step 7: Install negative cover plate and tighten mounting bolts. See Fig 6





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