INSTALLATION INSTRUCTIONS
700-0078 REV -

INSTALLATION OF 700-0069 SEAL KIT IN LANCAIR 108 HYDRAULIC PUMPS

LOG OF REVISIONS

Revision	Pages	Description	Date
-	ALL	INITIAL RELEASE	02/20/2025

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LIMITS TO LIABILITY AND DISCLAIMER

This manual and 700-0069 seal kit are provided to assist owners and mechanics complete their own repairs to their 108 series hydraulic power pack. This kit is made of industry standard seals, parts, and materials found in the original manufacture's kit, 634412. O'Day Design LLC did not design the original pump, nor size and specify the original seals used in it. As such O'Day Design LLC makes no claim as to the airworthiness of the design or particular pump being serviced. O'Day Design LLC assembles these kits as a convenience for owners who would otherwise need to purchase the original kit at a higher cost and longer lead-time.

700-0069 is tailored to the Lancair application and therefore does not include the extra (unused) seals included in the original kit which was intended to work with many more models of pumps, for various applications. Specifically, these instructions and the kit are intended to be installed in pumps 108AA19-CLB-3VT (320/360), 108AM19-CLB-3VT (320/360/Legacy), or 108AMS32-CZZ-3V-14-08-Y (Legacy). These are the typical pumps found in Lancair 320, 360, and Legacy models. This document and seal kit are not intended to be all encompassing, being used in an experimental aircraft there are many variations of the pumps that have been installed in these aircraft, some may not be ideal for the hydraulic circuit configuration of the aircraft, others may have been modified to be better. It is the installer's responsibility to determine if their pump is proper for the application prior to installing the pump on their aircraft. The intent of this manual is only to provide the information necessary to replace the seals and wear parts in the most common configurations.

By using these instructions, and/or the 700-0069 seal kit, the installer, owner, operator, and their representatives understand and assume all risks involved with completing the reseal and subsequently operating the aircraft with this pump. To the extent permitted by law, they agree to indemnify, defend, and hold harmless O'Day Design LLC from any and all claims, actions, liabilities, suites, injuries, demands, obligations, losses, settlements, judgments, damages, fines, penalties, costs, and expenses, including attorney's fees and other expenses, (collectively a "Claim") arising out of, or relating to, the installation or use of these instructions or the 700-0069 seal kit.

O'Day Design LLC encourages feedback from owners and installers on the content of this kit and these instructions so that they may be improved for other future installations.

INTRODUCTION

This manual contains instructions for resealing the 108 series hydraulic pump used on Lancair 320, 360, and Legacy models using the 700-0069 seal kit. The 700-0069 seal kit is intended to be an alternative to the original manufactures kit P/N 634412 except that it only includes the seals and parts required for most Lancair applications with plastic reservoirs (metal reservoir seals may be added if there is demand). There was never a manual created specifically for repairing Lancair pumps but they are similar to that used in marine tilt-trim pumps, RV pumps, and tractor pumps. Information taken from these manuals has been combined with the specifics of the Lancair configuration to develop this document.

What this manual does not cover is theory of operations for the pumps and what configurations are proper for the airframe in question. Being an experimental aircraft it is the installer's responsibility to determine if their pump is proper for the application, and that the seals are proper for their pump, prior to installing the pump on their aircraft. There are other excellent write-ups available for this information.

PARTS AND TOOLS REQUIRED

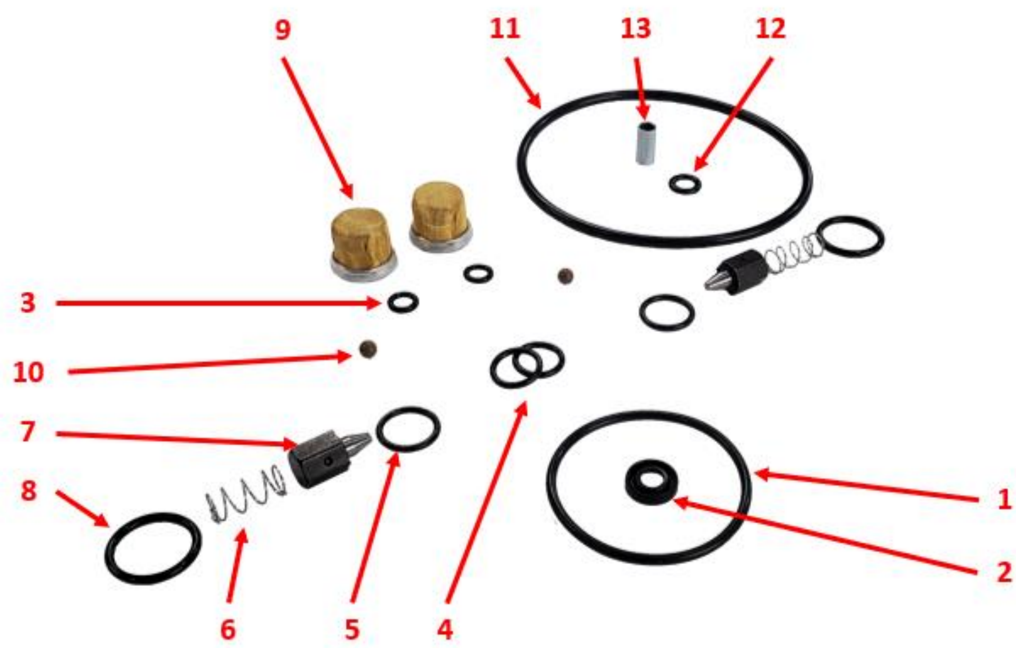
PARTS:

700-0069 108 Pump Seal Kit

Obtained from www.odaydesign.com/product/700-0069

ITEM	DESCRIPTION	QTY USED
1	MOTOR O-RING	1
2	SHAFT SEAL	1
3	PUMP O-RING	2
4	SPOOL O-RING (90A)	1 OR 2
5	POPPET SEAT O-RING (90A)	2
6	POPPET SPRING	2
7	POPPET VALVE	2
8	HEX PLUG O-RING	2
9	FILTER	2
10	PLASTIC TRV (THERMAL RELIEF VALVE) BALL	2
11	LARGE RESERVOIR O-RING	1
12	SMALL RESERVOIR O-RING	1[1]
13	RESERVOIR SPACER	1[1,2]

1. ONLY USED ON ASSEMBLIES WITH CENTER RESERVOIR SCREW
2. KIT INCLUDES 0.5" HIGH SPACER FOR 0.0187 IN3/REV GEAR SECTIONS. 0.0321 IN3/REV PUMPS REQUIRED A .375" HIGH SPACER.



Reservoir (Optional)

You may wish or need to replace the reservoir. This is not part of the seal kit, but the following information may be valuable:

1. First determine if the pump uses four bolts in the housing to hold on the reservoir. If so, move to step 2. If not, you need to use the center screw reservoir below. Some pumps came with the bolt tabs but used the center screw reservoir, the tabs are a better design so if your pump has them it is best to get one of the other reservoirs instead.

ARCO M525

Note: One thing to watch out for on these center screw reservoirs is the spacer. If this spacer is too short it can cause too much preload on the reservoir. Around 0.050" of preload seems appropriate. Typically pumps with 0.0187 cuin/rev gear sections (19 pumps) use a 0.5" tall spacer (included in 700-0069 kit) while pumps with 0.0321 cuin/rev gear sections (32 pumps) use a .375" spacer (Included with M525).

2. If you have the four bolt tabs, then you need to determine which orientation reservoir you have. Note that the screw positions are different on these two, when facing the inlet and outlet ports M532 places the cap on the right side and M533 places the cap on the left side. M532 is the most common.

ARCO M532 (Right)

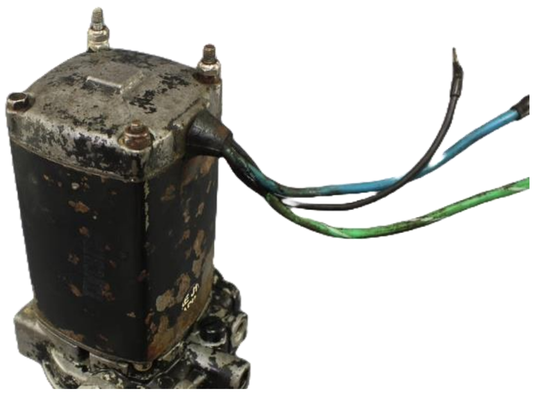
ARCO M533 (Left)

Electric Motor (Optional)

You may wish or need to replace the electric motor. This is not part of the seal kit, but the following information may be valuable:

"AA" motors can be identified by the studs protruding out to the top of the motor like shown below. These are old and are not available anymore.

AA Motor (unavailable)



"AA" motors can be swapped with "AM" motors. To do this the struts in the housing must be removed, screws are used to hold the AM motor onto the housing. The wiring is also slightly different for the AM motor, consult the build manual.

AM Motor

Many aftermarket options for the "AM" motor can be found. Consider quality over price, the Arco motors are more expensive but are better quality then the others made in Asia. Shop around, genuine ARCO motors can be found much cheaper through distributors.

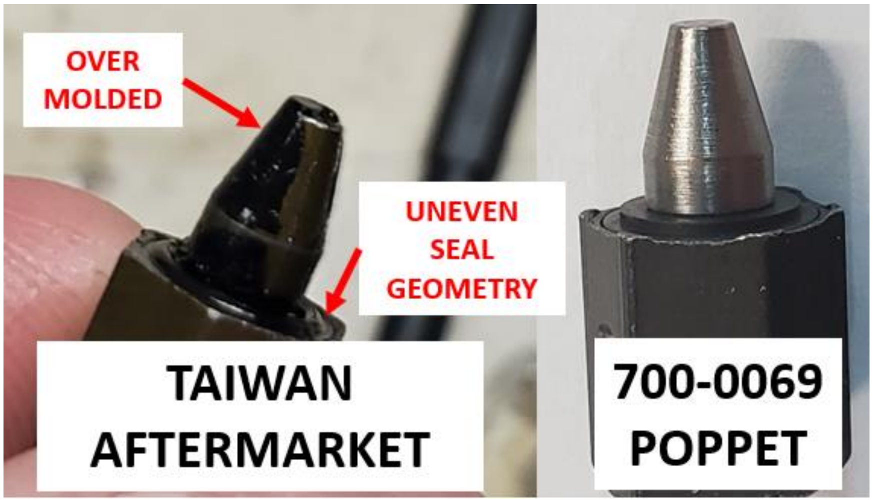
12V - ARCO 6218

24V - ARCO 6219

Appendix B and C contain motor inspection and repair information if desired.

Aftermarket Parts General

You may find that your pump needs additional parts. There are various aftermarket 108 pumps and components available for tilt trim pumps and other similar applications. Most of these come from a handful of manufacturers in Taiwan and China, some of their parts are acceptable and others are poor quality, you must inspect all new and old parts thoroughly. Generally, ARCO's products are made in USA and tend to have the higher quality of the aftermarket parts available with some added cost. Below are a few examples of why it's important to consider and inspect the quality of all the components used in the pump.



TOOLS:

- **Hand Tools**
    - Wrenches
    - Screw Drivers
    - Allen Wrenches
    - Torque Wrench & Hex Sockets
    - Pliers

- **Impact W/ 7/8” Socket**

- **Plastic Seal Picks**

- **Drill Press & Scale**

- **Bore Hone**
    - Fabricated from ½” wood dowl and 600 grit sandpaper.
    - Only if needed for correcting minor scratches in the housing bore for the spool

- **Loctite 565**

- **Grease**

- **O-Ring Lube**
    - Super Lube – 21030 or
    - Parker O-Lube - 884-2 or
    - You can also just use fresh hydraulic fluid
        - MIL-PRF-83282 (Royco 782)
        - MIL-PRF-5606 (Royco 756)

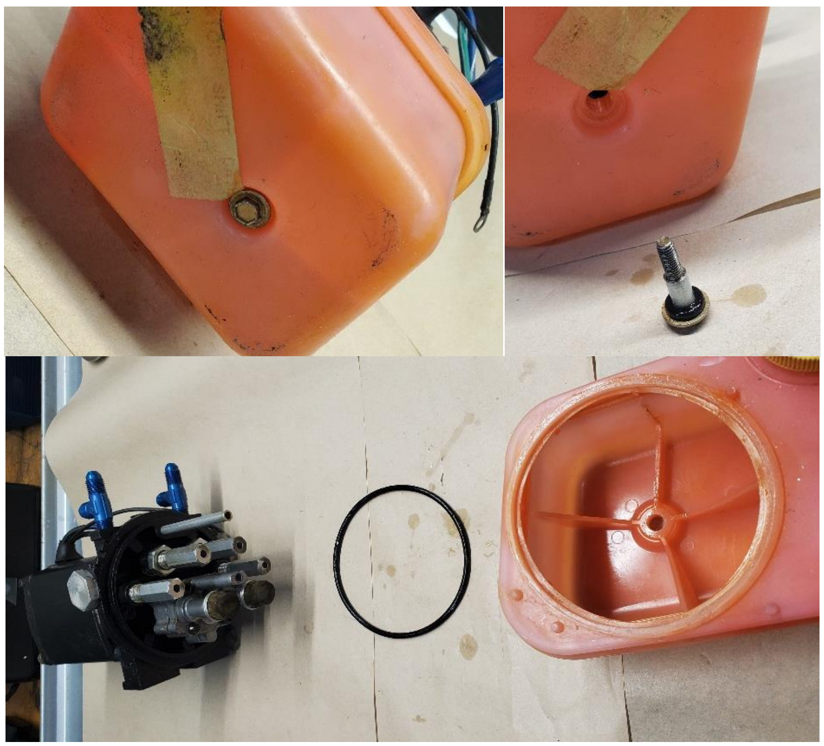
- **Bench Test Equipment**
    - Recommended
    - 1000psi & 2000psi pressure gages
    - 2000psi ball valve

Note: Do not use metal picks for any of this job

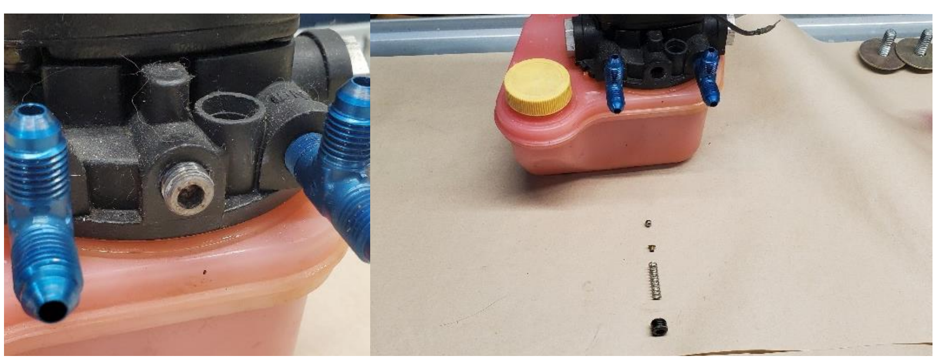
DISASSEMBLY

1. Either jack up the plane or ensure that the over-center springs and gas strut are in good shape to keep the gear from folding while performing this work. At the end of this the plane will need to be put on jacks for a gear swing. Remove the pump from the airframe being sure to label the electrical and hydraulic connections.

2. Remove the reservoir and drain the fluid from it. If the reservoir is the center screw design most of the oil will drain out of the hole when the screw is removed. Discard the o-rings but save the spacer in case the new one in the kit is not correct for the pump.

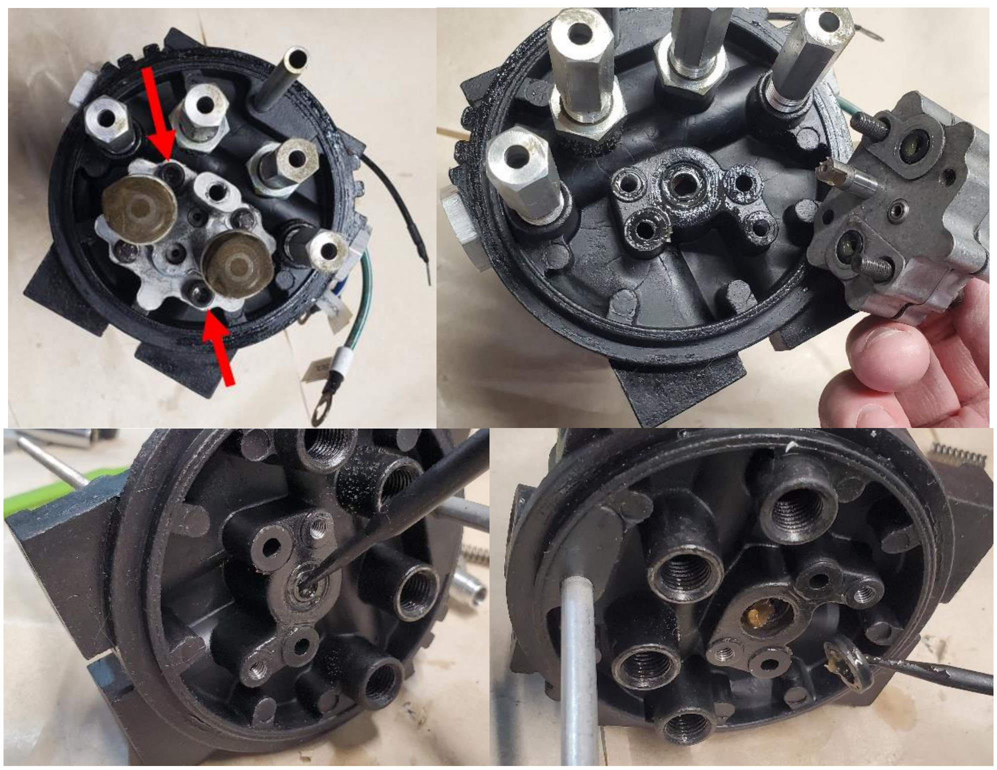


3. Remove the inlet and outlet fittings on the pump as well as the 1/8npt plug (or AN fitting on Legacy) which houses the back pressure valve components. This includes a spring, eyelet, and 3/16 steel ball. Remove these and keep safe for cleaning and reassembly. Legacy models with spool return springs often do not have these back pressure valve components.



4. Using a pair of pliers, remove the two filters from the end of the pump by twisting and pulling. These may be discarded.

5. Remove the pump itself by removing only the two screws shown below. Do not remove the other two screws or the pump will come apart. The pump should not be disassembled as the two halves must be properly realigned. Pull the pump straight out and set it aside for cleaning. The pump shaft seal can be removed from the housing using a plastic pick. Discard this seal as well as the o-rings for the pump.



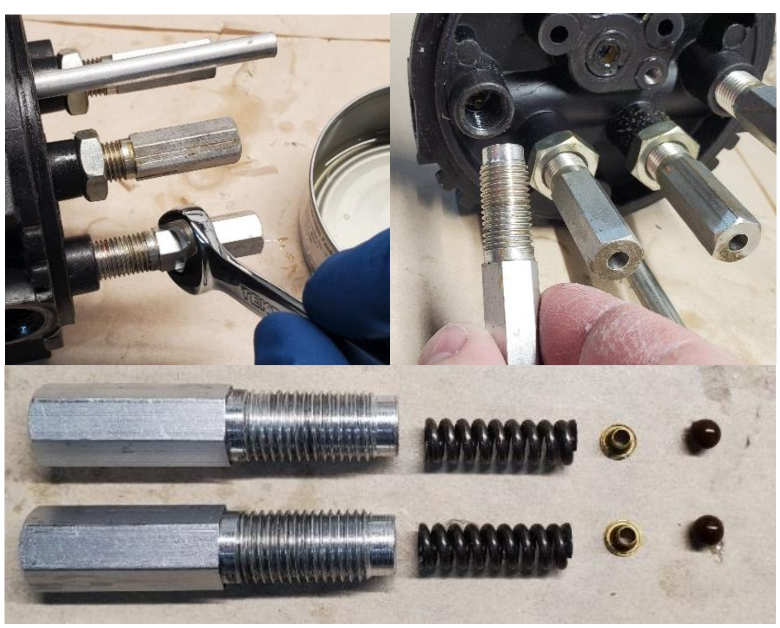
6. The next few steps will remove the pressure relief (PRV) and (TRV) thermal relief valves. These valves use a spring and ball inside the valve housing to set the system pressures. The pressure is adjustable by varying the height of the valve housing. Typically, only the pressure relief valves have the adjusting nuts, the thermal relief valves being simply screwed into the housing without adjustment. Using a pair of calipers, or a depth gage, measure the height of each valve so that it can be replicated during reassembly. You will want to be within 0.005” accuracy to ensure when reset that the setting is close to original. Record this below:

VALVE HEIGHT SETTINGS

PRV (UP) __________ **PRV (DOWN)** __________

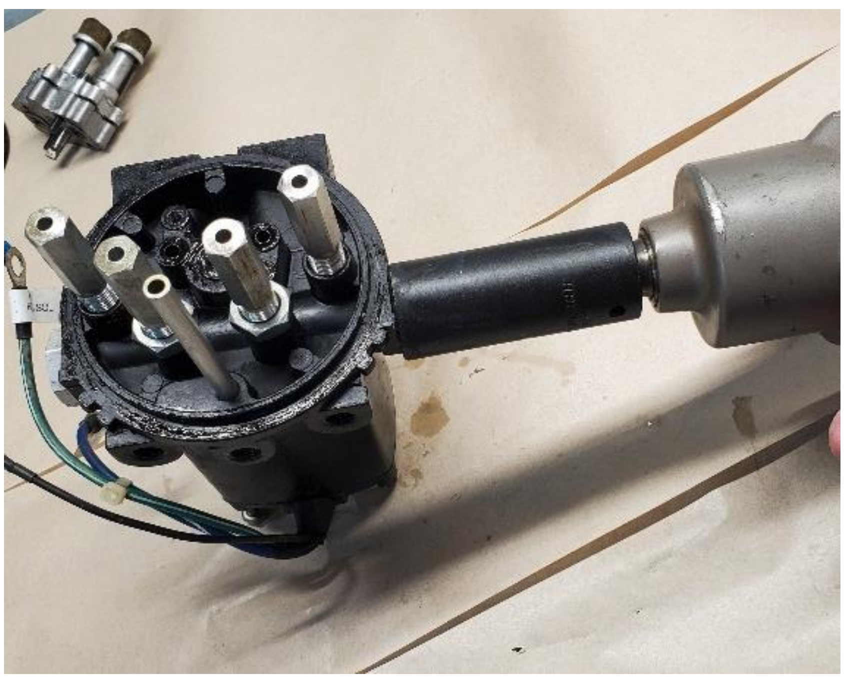
TRV (UP) __________ **TRV (DOWN)** __________

7. Remove the two TRV valves using a wrench or socket. The valve assembly includes the hex housing, a spring, an eyelet, and a plastic 3/16” dia. ball. Bag and label each valve assembly individually so that they may be reassembled in the original position.

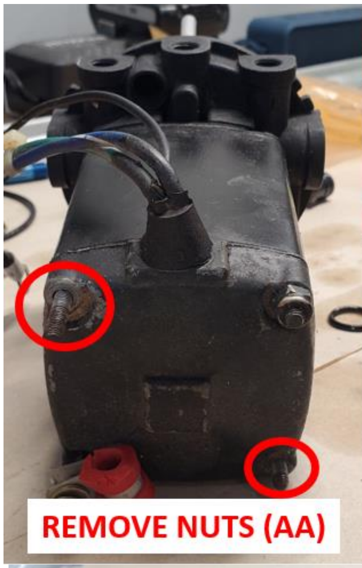


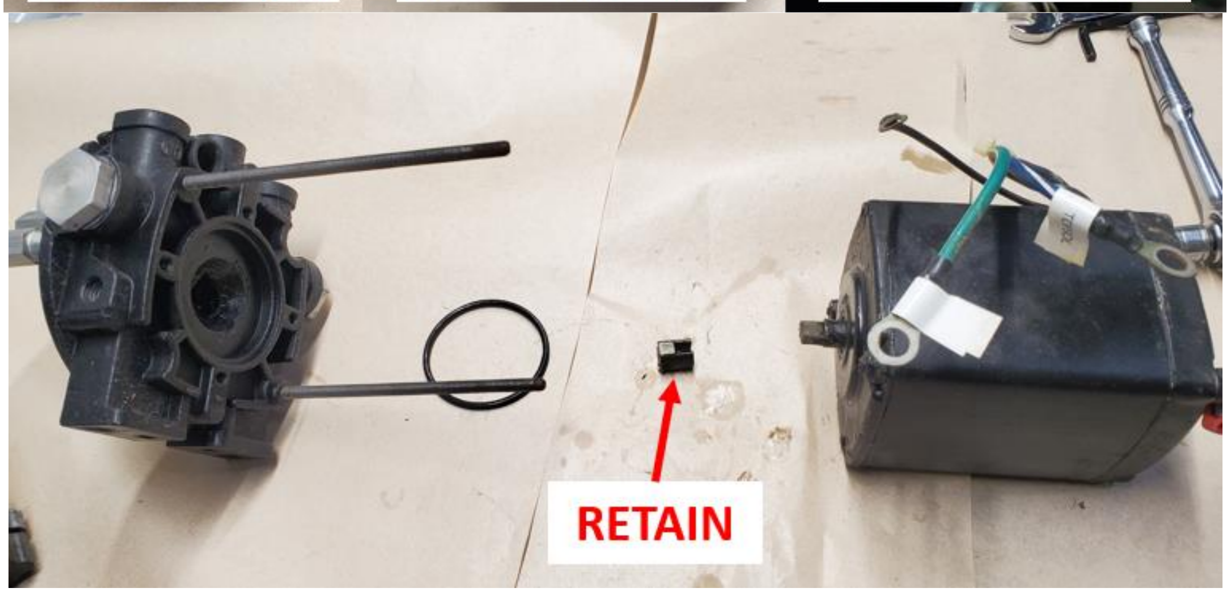
8. Loosen the lock nuts on the two PRV valves using a wrench. Disassemble each valve one at a time. The down (DN) relief valve includes the hex housing, nut, spring, eyelet, and a ¼" ball. The UP relief valve includes the hex housing, nut, spring, eyelet, and a 3/16" ball. Bag and label each valve assembly individually so that they may be reassembled in the original position.

9. Using an impact gun and 6-point 7/8" socket, loosen the hex plugs on either end of the housing while holding the electric motor with the other hand. Never use a wrench or 12-point socket, they will round the soft aluminum plug. Do not remove the Hex plugs yet.



10. Remove the electric motor from the housing. On AA motors this is done by removing two of the nuts on top of the motor. The motor can then be removed from the housing by sliding it off the studs. It is desirable to retain the o-rings on these studs for reuse, but they are not necessary for this application as they are meant to keep water out of the motor. The seal kit does not include them. On AM motors the motor is secured by two hex head screws which must be removed with a wrench. Discard the larger o-ring between the motor and housing. Retain the drive coupling.

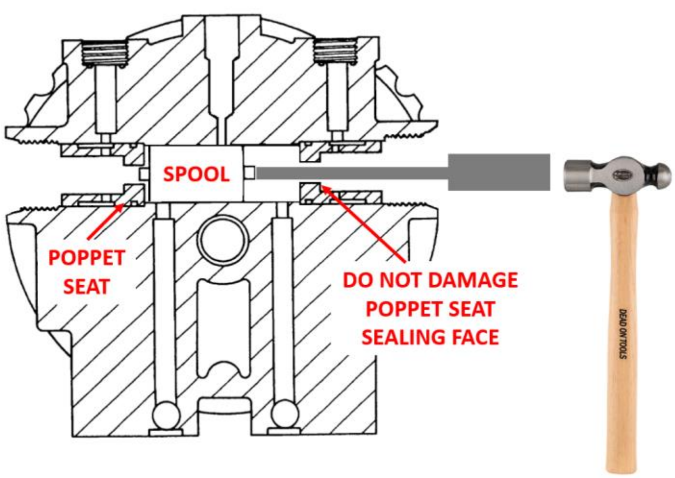




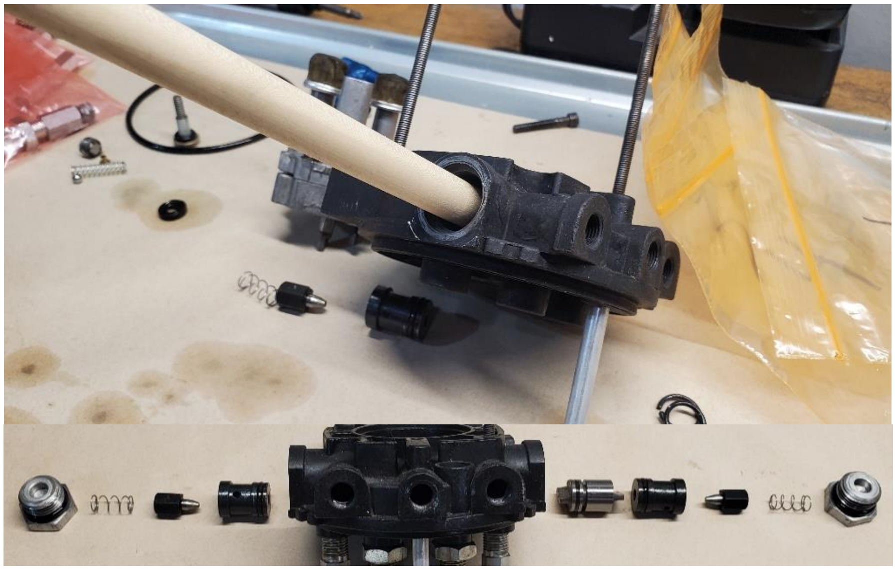
11. Remove the plug, spring, and poppet from each side of the body. Use the plastic pick to remove the o-ring from each plug, discard the o-rings, poppets, and springs but retain the plugs.

12. Next the poppet seats and spool need to be removed. This needs to be done delicately to ensure that the poppet seats are not damaged. These seats are installed into the bore from either end with the spool in the center and have o-rings between them and the housing bore, this can make them difficult to move, particularly if the o-rings are old. The below diagram shows how these are laid out. Using an 1/8" punch (wood, plastic, or brass ideal) carefully pass it through one of the poppet seats so that it contacts the spool. **Softly** tap on the punch using a small hammer. The spool will push on the other poppet seat and will slowly drive it out. Continue to drive the spool out as well.

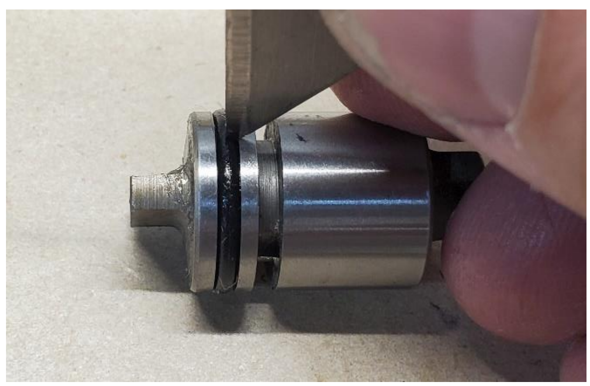
    Note: If the pump is for a Legacy you may find two additional springs, one on either side of the spool. These are used to center the spool and should be retained for reinstallation if not adding a back pressure valve. Contact O'Day Design LLC if you have a 235/320/360 with these springs.



13. Using a larger wood dowel and a hammer drive the second poppet seat out carefully.



14. Remove and discard the o-rings from the poppet seats and the spool. This can be difficult as they are 90A durometer (hard). A plastic pick can be used. **Only if absolutely necessary**, an x-acto knife can be used to **carefully** slit the rubber, making it easier to remove. However, **if the blade scratches the surface of the o-ring groove the entire part will need to be replaced so it is advisable not to try and cut fully through it.**

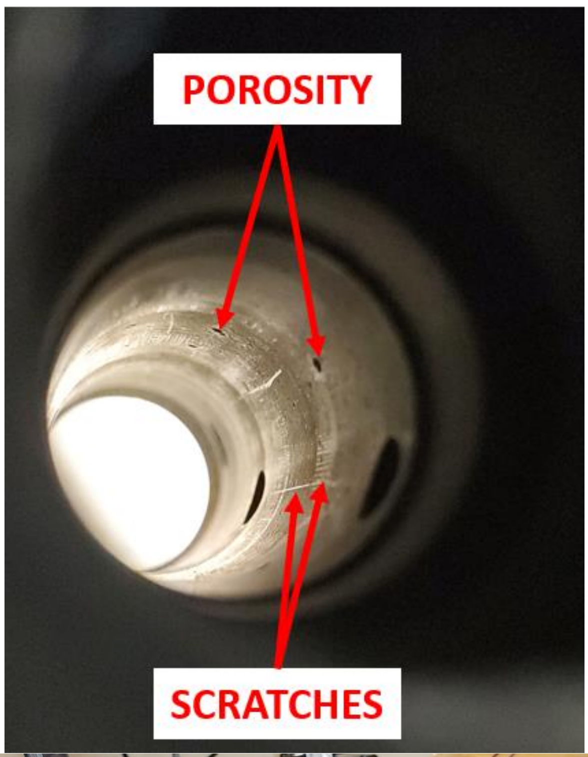


INSPECTION

Clean all the components using brake clean and/or an ultrasonic cleaner. Completely clean all passageways with brake clean and plastic pipe brushes (do not use metal). Be careful not to scratch any sealing or interfacing surfaces. A tooth brush is helpful when cleaning the housing and other components.

The following items should be inspected in addition to a general look over the components for wear, scratches, dents, or other damage.

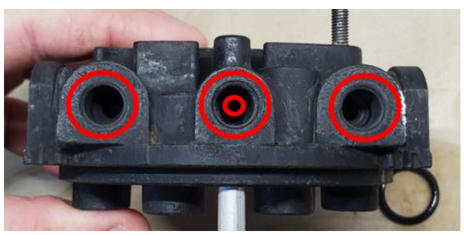
- **Pump Housing**
  - Inspect the 0.6” inside bore for any soring, damage, or burrs. Thought not ideal, it is normal to see some porosity from the original casting. If there are minor scratches it may be removed using a hone made from a dowel rod and a piece of 600grit sandpaper as shown below. However, if too much material is removed the spool o-ring friction (tested further below) will be insufficient to hold position, also excessive oil could leak past the spool which can affect gear transit time, this is particularly true on Legacy models with symmetrical spools.



- Inspect the hex plug sealing surface for dents, scratches, and burrs.

- Inspect all of the ball seat sealing surfaces, the pump mounting flanges, and shaft seal bore for scratches or indentations.

- Inspect if the 1/8NPT threads are free from sealant and in good condition. Inspect the back pressure valve seat deep inside the center hole for dents or scratches.



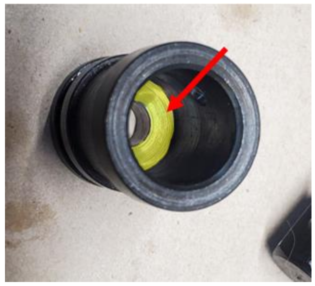
- **Spool**
  - Check the spool over for dents and scratches.

  - Check the o-ring grooves for dents and scratches
  - Check that the groove/s and hole/s are clear.

- This test will check the spool friction to ensure it is sufficient, it is actually a test of the bore condition in the housing rather than the spool itself. Put some of the hydraulic fluid on the spool and in the bore of the housing. Using one or two (depending on spool design) of the new 90A durometer spool o-rings (Item 4) install them onto the spool. Carefully install the spool in the housing, making sure it is fully inside the bore, not jammed, and that the o-rings are not cut. Setup a small scale on a drill press with a socket extension, wood dowel, or something similar in the chuck. Place the housing on the scale and tare the scale reading. Slowly push the spool and read the force on the scale. Flip the housing and repeat this in the opposite direction, do this 2-3 times. The motion and force should be smooth and fairly consistent. The force to move the spool should be above 30oz, the higher the better. (For reference it takes at least 15oz of force to hold the poppet valve cracked open). Remove the spool and inspect that the o-rings are undamaged.

- **Poppet Seats**
  - Inspect the o-ring groove for scratches, dents, or burrs.

- Inspect the poppet sealing face for any scratches or dents where it interfaces with the poppet seal.



- **Hex Plugs**
  - Inspect the sealing area for scratches or burrs.

- **TRV & PRV Relief Valves**
  - Do not mix up the valve components.
  - Inspect the steel balls for corrosion, dents of scratches. These do not normally need to be replaced. The TRV uses plastic balls, they can become indented and worn over time so new ones are included in the kit.
  - Inspect the springs and eyelets for condition.

- **Pump**
  - Do not disassemble the pump, disassembly requires proper realignment.
  - Inspect the input shaft for wear and cracking.
  - Check that the input shaft drives the idler shaft by looking for rotation of both shafts.
  - Look inside the ports for any FOD. Spray out the pump with brake cleaner and then put some fresh hydraulic oil inside the ports and turn the pump to both lubricate it and check for exiting debris.
  - Check that the sealing ports are free of debris, scratches, dents, and burrs.

- **Motor Drive Coupling**
  - Inspect for signs of wear or cracking. Replace if necessary.

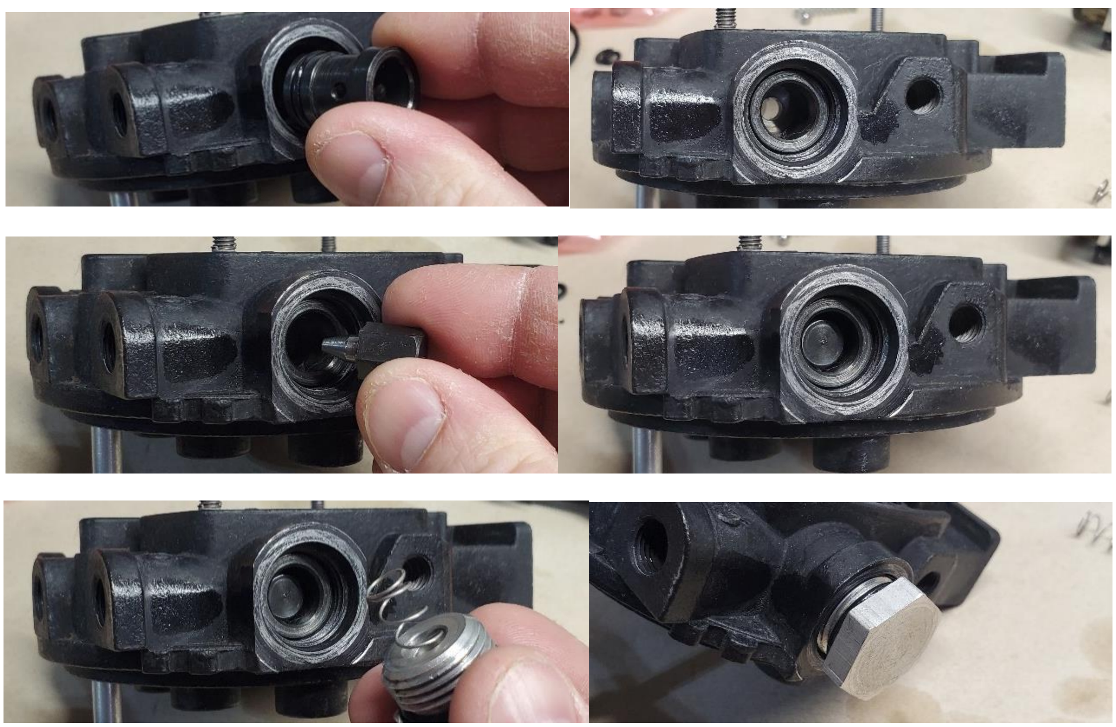
- **Reservoir**
  - Inspect for cracks, warping, or degradation of the plastic. Cracks are most likely to develop around the fastener/s.
  - It is best to just replace the reservoir if there is any question about its condition.

- **Electric Motor**
  - If the motor is an AA type it is best to just replace it with an AM type since the AA motors age is over 30 years old, they can however be rebuilt. Refer to Appendix B.
  - AM motors can be disassembled by removing the four screws. Use Appendix C to inspect and repair these motors as necessary. Often it is easier to simply replace them.
  - Inspect the output shaft for wear and cracking.

ASSEMBLY

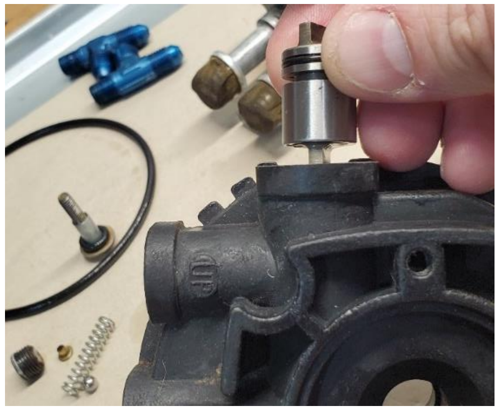
1. Lubricate the poppet seat grooves with o-ring lube or hydraulic fluid. Install the poppet seat o-rings (Item 5). Do the same with the hex plugs using the (Item 8) o-rings. Lubricate the entire housing bore.

2. Take one of the poppet seats and install it into the DN (down) side of the housing being sure to keep it straight so as not to damage the housing or the o-ring. It's orientation rotation wise is unimportant. The poppet seal will only go in a little by hand, the hex plug will be used to fully seat it. Install a new poppet valve (Item 7) into the seat and then place a new poppet spring (Item 6) into the pocket of the hex plug. O-ring lube can be used to help keep the spring in the pocket. Screw the hex plug on only slightly until it contacts the poppet seat.



3. In order to press the poppet seat in straight it is best to slowly and carefully tighten the hex plug ¼ turn in and then 1/8 turn out, repeat this until it is seated against the housing, but do not fully tighten. The hex plug will be fully tightened after the motor is installed as the motor provides more to hold on to.

4. The spool must now be installed into the UP side of the housing. If the spool is non-symmetrical (235, 320, 360) it must be installed with the o-ring end facing the UP side as shown below. Carefully push the spool in using a socket being careful not to cut the o-rings.

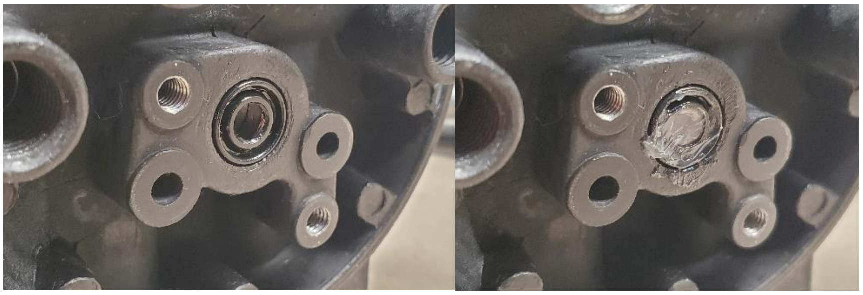


Note: The spool may have been previously installed incorrectly by the factory, the default commercial direction is opposite of the Lancair application, ensure it is installed as described and always test gear function with pressure gages.

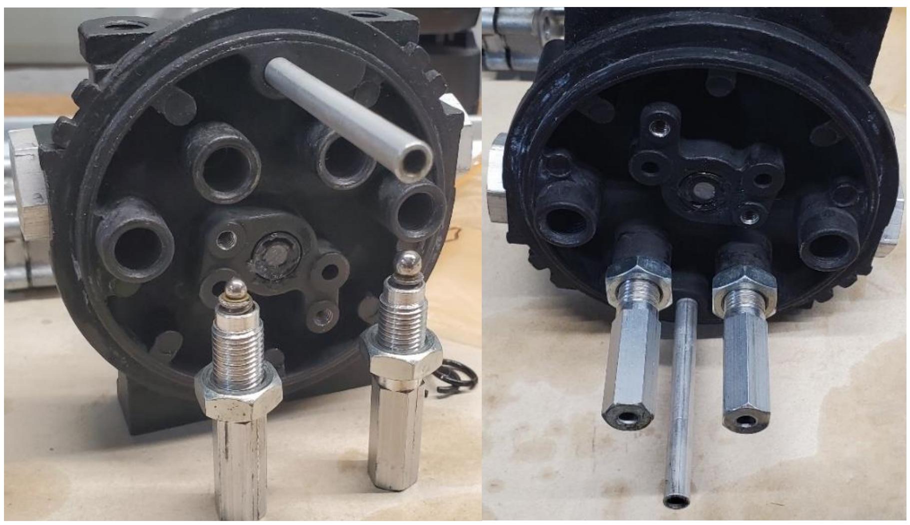
5. Repeat Steps 2 and 3 to install the UP side poppet seat, poppet valve, poppet spring, and hex plug. The hex plug will be fully tightened after the motor is installed.

6. If equipped, install the back pressure ball, eyelet, and spring into the center port. O-ring lube can be helpful in holding these components together during assembly, it is important that the eyelet does not fall out of position in the spring. Install the NPT plug (or NPT-AN fitting on Legacy) along with the UP and DN NPT fittings using Loctite 565 sealant.

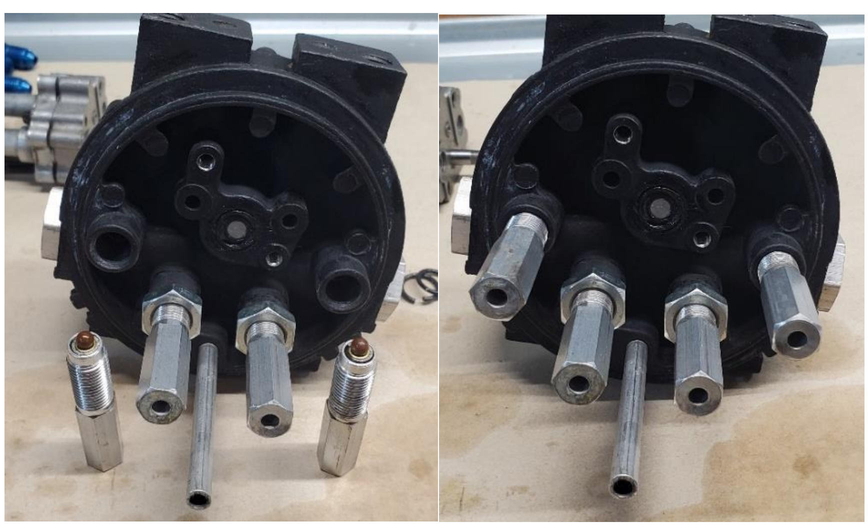

7. Install the (Item 2) shaft seal into the housing as shown. The lip of the seal should be facing the pump side (away from the motor). The seal can be installed with hand pressure and something flat to ensure it is flush with the face of the housing. Lubricate the seal with a slight amount of grease.



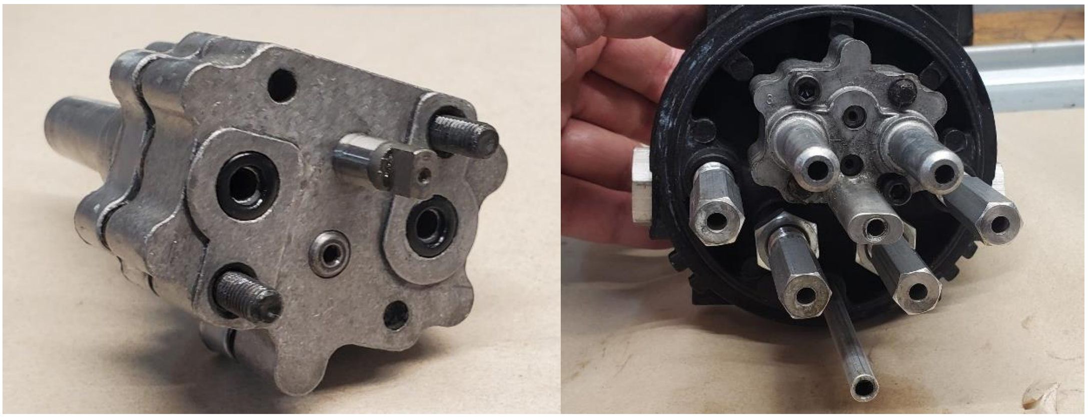
8. Reinstall the pressure relief valves (PRV) into the housing, set their height to the exact values recorded when disassembled. Tighten the jam nuts to approximately 70in-lb. The valves use different diameter balls and should not be swapped or mixed up (DN side uses larger ball).



9. Reinstall the thermal relief valves (TRV) into the housing using new (Item 10) plastic balls. If they are the typical non-adjustable type simply tighten them to 70in-lb.



10. Lubricate the two (Item 3) pump o-rings and place them into the pump manifold. Reinstall the pump into the housing and tighten the two fasteners to 70 in-lb.



11. Install the new filters (Item 9) using a 5/8 socket by lightly tapping with a hammer. Be sure it is secure but not set too deep, the pickup should not be touching the screen.

12. Using some lubricant, install the reservoir to housing o-ring (Item 11) and then the plastic reservoir. Be sure that the reservoir is completely seated as shown, the o-ring should not be visible when looking from the side. This is simple and self-explanatory with the four-screw design. Single screw plastic reservoirs use a screw, spacer and o-ring (Item 12) to secure the reservoir. With this design it is important that the correct spacer is installed, the screw must tighten down on the spacer, setting the compression (preload) of the reservoir. It is important that the reservoir is not over or under compressed so this spacer has to be the right height. The spacer included in the kit (Item 13) is ½" tall and only for 0.0187 in^3/rev gear sections (108AA19 & 108AM19). The 0.0321 in^3/rev gear section pumps (180AMS32) are uncommon to see with the single screw, these use a different, or cut down, 3/8" tall spacer. Refer to the parts section on reservoirs for more information. The center screw is torqued to approximately 12in-lb, but be sure it is bottomed out on the spacer too.

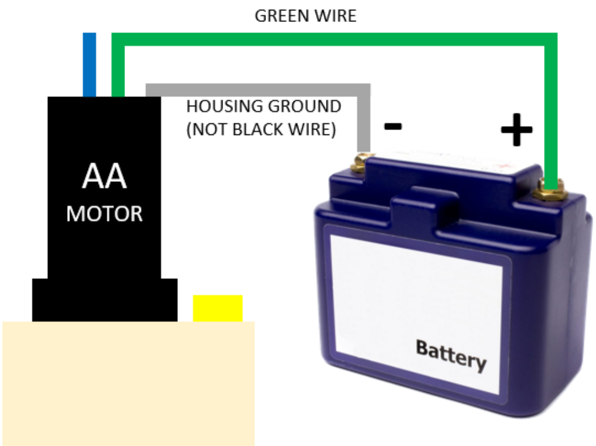
13. Lubricate the new motor o-ring (Item 1) with grease and install in the housing. Push some grease into the cavity where the motor shaft is sticking out. Put grease on the drive coupling and install it onto the pump shaft (small slot). On AA type motors only, reinstall the original small o-rings on the studs before installing the motor. Reinstall the motor being sure to orient the drive coupling and motor flats so that they mesh. Torque the motor screws or nuts to 25in-lb.

14. Finaly, torque the hex plugs on either side of the pump housing to 45in-lb.

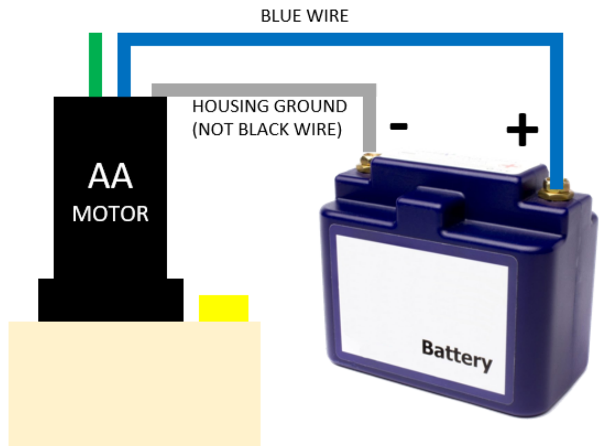
FUNCTIONAL TEST

Assuming that the pressure relief valves were installed at the same height as they were removed, the pressure settings will be un-changed and the pump may be installed in the aircraft. Ideally, however, the pump should be bench tested to ensure that the pressure and thermal relief valves are still set correctly and that they and the poppets do not leak down once the pump shuts down. This isolates the pump from any other issues with the hydraulics such as internally leaking cylinders which is quite common. The test rig is simply constructed by creating the loop below with two gages (1000psi & 2000psi or similar) and a ball valve (rated for 2000psi) in the center. The ball valve allows a simple way to bleed air from the pump and also isolate each port, alternatively, plugs or a hydraulic cylinder may be used instead of the ball valve as-is on the gear system. It is advisable not to do this in the aircraft in case the valve settings are far off as excessive pressure could cause damage. For this bench test do not use the pressure switches.

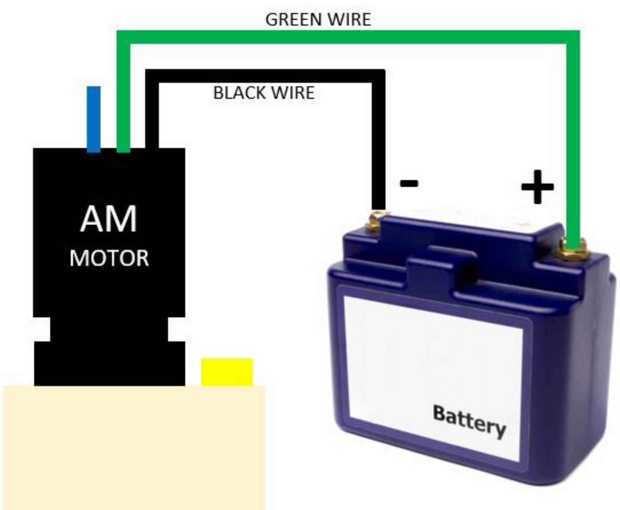
The motor will need to be wired to an appropriate voltage, size, and condition battery in order to drive it, you can use the solenoids or jumper it directly, regardless the polarity needed to drive each direction is shown below.



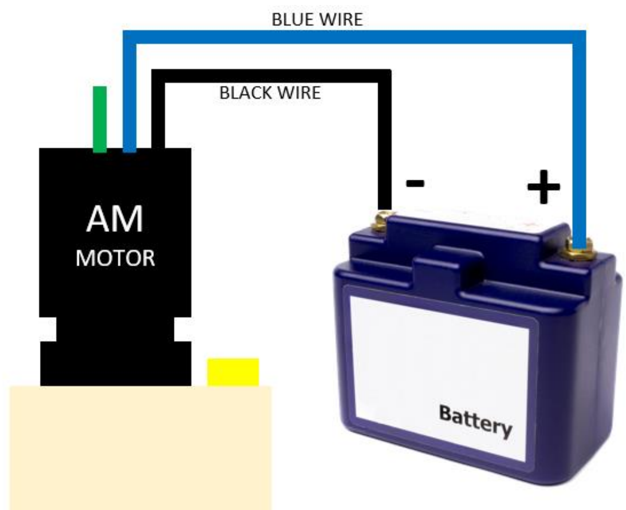
GEAR DOWN POLARITY
AA MOTOR
(NEG TERM TO THE MOTOR HOUSING NOT THE BLACK WIRE THAT COMES OUT OF THE MOTOR)



GEAR UP POLARITY
AA MOTOR
(NEG TERM TO THE MOTOR HOUSING NOT THE BLACK WIRE THAT COMES OUT OF THE MOTOR)



GEAR DOWN POLARITY
AM MOTOR



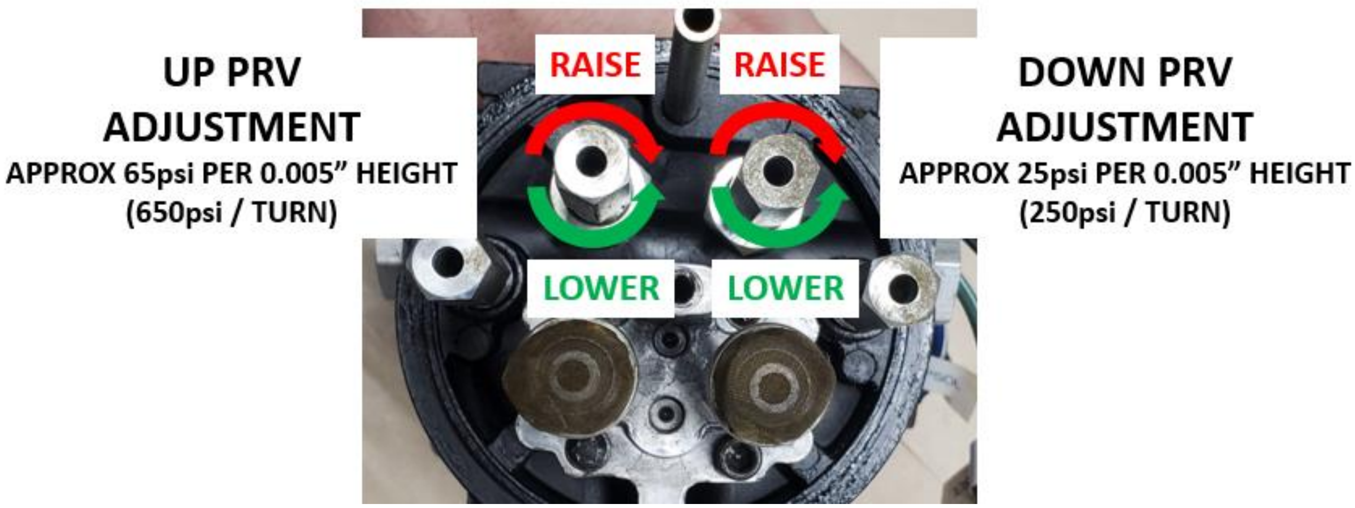
GEAR UP POLARITY
AM MOTOR

Fill the pump with hydraulic fluid, then drive the pump with the ball valve open to bleed air from the system. Close the valve and drive the pump in the gear UP direction until the pressure stabilizes (Do not continue to run the pump if the pressure rises above 2000psi, the PRV's are set wrong). Once the pressure stabilizes (this will happen quickly), shut off electricity to the pump and watch the gage. This value is the approximate up PRV setting. Some initial reduction in pressure is normal (Typ. <10%, but varies with set equipment), it should stabilize and hold after a period of time. If this leaks down it means likely there is a leak in either the TRV, the Poppet Valve, or the poppet valve o-ring (or more likely the test equipment!). Repeat in the down direction to get the down PRV setting. Do not run the motor for longer then 20 seconds doing this and give it adequate time to cool between activations.

The intent is that the pressure relief valves (PRV) never open as long as the pressure switches are functioning normally. The PRVs are a safety feature to limit the pressures on the system and should each be set slightly higher than the set point for the electric pressure switches used in the aircraft. Generally, 200psi higher as this covers the hysteresis's of the system once the pump shuts down. Too low of a relief valve setting will result in pump cycling once the pressure switches are installed. System pressures may vary by builder but generally the 320, 360, and Legacy use the below values:

Pressure Switch	PRV
1200psi UP 550psi DN	1400psi UP 800psi DN

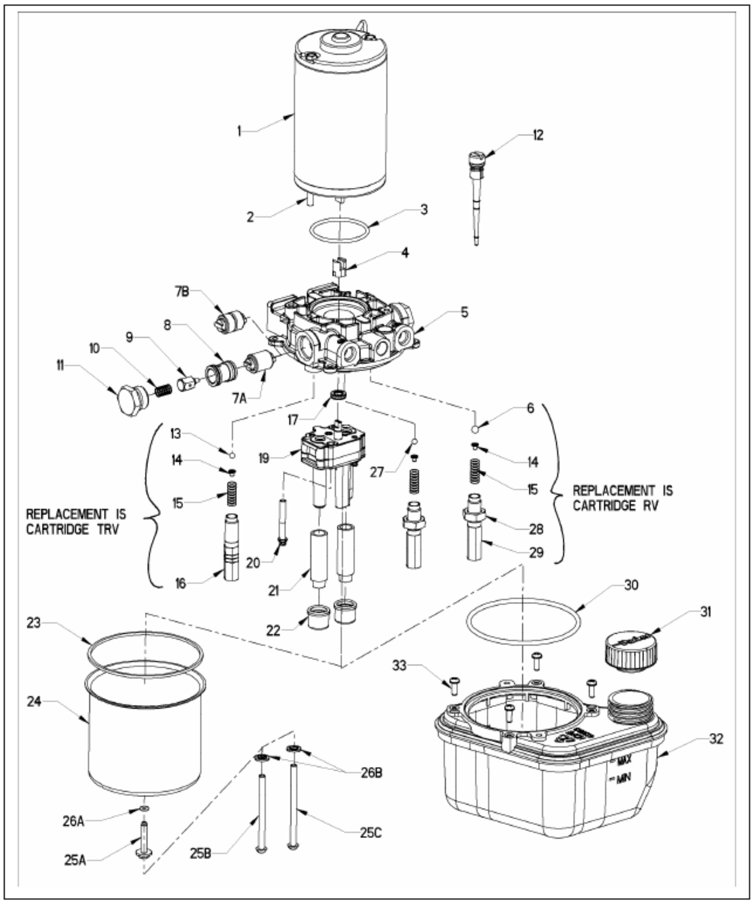
If required, the PRV settings can be adjusted by removing the reservoir. Loosen the lock nut of the appropriate valve, then the pressure can be increased by turning the valve clockwise, and decreased by turning it counterclockwise. Be sure to retighten the lock nut to 70in-lb. The approximate changes this will make are shown below, but be sure to verify by testing pressures after any adjustment of these valves.



Once the pump performs adequately on the bench it should be installed in the aircraft with the pressure switches, and the system bled. Perform gear swings, check that the switches are set to the proper pressures to work with the chosen PRV settings. If the switches are set too high the pump will quickly cycle on and off or it will run continuously. Check for internal cylinder leakage by observing for excessive pump cycling. If any of the cylinders require repair, cylinder seal kits are available from O'Day Design LLC.

APPENDIX A – GENERIC PARTS CATALOG

OILDYNE Division / Parker Hannifin
5520 North Highway 169
Minneapolis, MN 55428
Phone: 763 - 533 - 1600
Fax: 763 - 535 - 6483

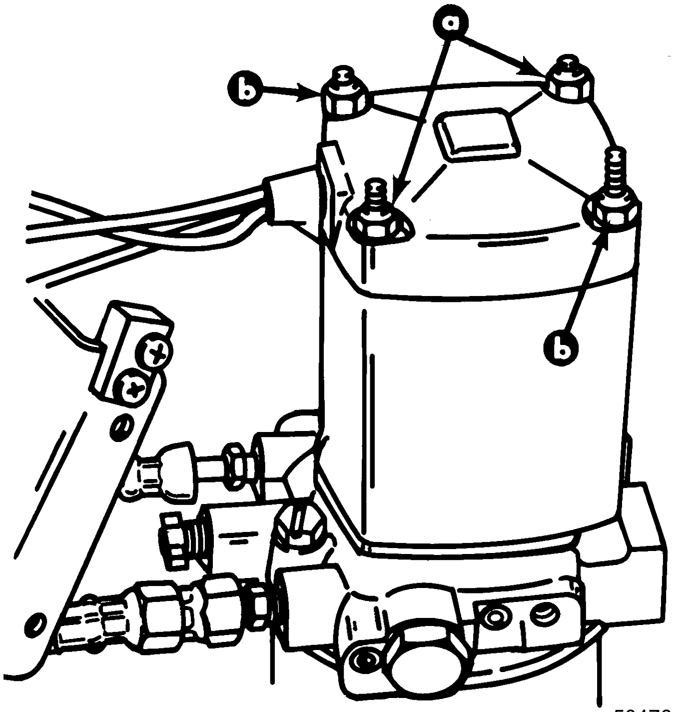


108 Series Power Unit
Generic Exploded View Drawing
4/07

Reversible Locking, Vertical Mount Shown at left			
Item #	**Part #**	**Description**	**Qty**
1	*	Motor	1
2	*	Motor mount screws	2
3	405673	O-ring (132-70)	1
4	413528	Coupling	1
5	*	Adapter	1
6	401065	Steel ball ¼"	1 – 2
7A	*	Spool	1
7B	*	Spool with o-ring	1
8	773763	Check seat	2
9	773776	Check poppet	0 – 2
10	410462	Spring	0 – 2
11	773764	Hex plug retainer	2
12	773762	Dipstick 'A' & 'B' **tanks only**	0 – 1
13	411167	Resin ball (TRV)	0 – 2
14	411173	Eyelet	1 – 4
15	* & **	TRV spring	0 – 2
16	* & **	TRV adjusting screw	0 – 2
17	410512	Shaft Seal	1
18	N/A	N/A	0
19	*	Pump assembly	1
20	*	Pump mount screw	2
21	*	Suction extension	0 – 2
22	410521	Suction filter	1 – 2
23	410578	Reservoir seal – 'A' & 'B' **tanks only**	1
24	411477 410541	Reservoir 'A' Reservoir 'B'	0 – 1 0 – 1
25A	411355	'A' Reservoir mount screw	0 – 1
25B	409715	'B' Reservoir mount screw - .327 pump	0 – 1
25C	411796	'B' Reservoir mount screw - .100, .190 & .250 pumps	0 – 1
26A	409815	'A' Reservoir screw o-ring	0 – 1
26B	359071	'B' Reservoir screw thread seal	0 – 1
27	401072	Steel ball 3/16"	1
28	410288	Hex jam nut	1 – 2
29	* & **	Relief valve adjusting screw	1 – 2
30	411237	Reservoir seal – 'C' & 'D' **tanks**	0 – 1
31	414536	Reservoir cap – 'C' & 'D' **tanks**	0 – 1
32	413183 413358	Reservoir 'C' Reservoir 'D'	0 – 1 0 – 1
33	413222	Reservoir mount screws – 'C' **& 'D' tanks**	0 or 4
	634412	Seal Kit (fits all)	
	*	Please specify Model Code Description or 6-digit part number when ordering these items	
	**	Please specify relief valve setting(s) when ordering these items	

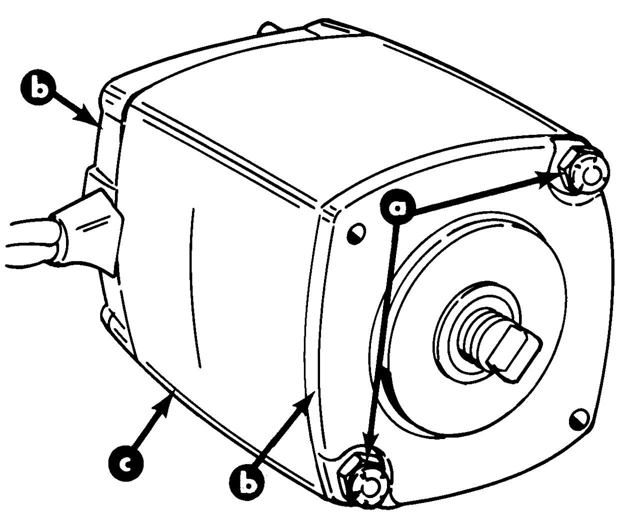
APPENDIX B – AA MOTOR INFORMATION

3. Remove motor assembly. Remove O-ring from motor base.

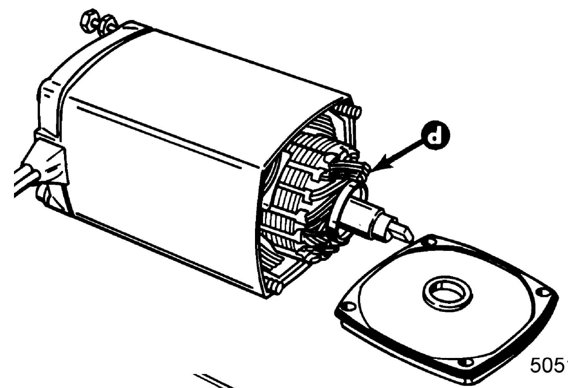


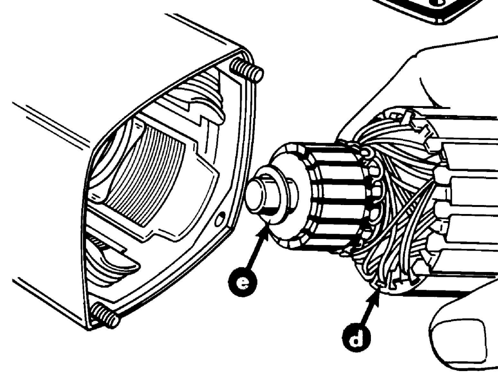
a - Locknuts (Studs May Turn Out)
b - DO NOT Loosen

4. Disassemble motor as follows:
    a. Remove end frame caps.
    b. Remove thrust washer (if equipped).
    c. Remove armature from field and frame assembly.



a - Locknuts
b - End Frame Caps
c - Field And Frame Assembly





d - Armature
e - Thrust Washer

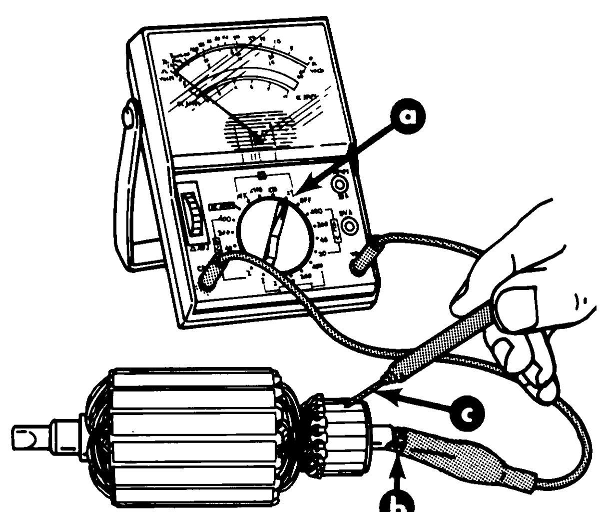
Armature Tests

CONTINUITY TEST

1. Check armature for continuity. Set ohmmeter on Rx1 scale. Place leads on armature shaft and on each commutator bar one at a time.

Continuity Indicated: Armature is grounded (replace armature).

Continuity Not Indicated: Armature is not grounded.



a - Ohmmeter
b - Meter Lead
c - Meter Lead

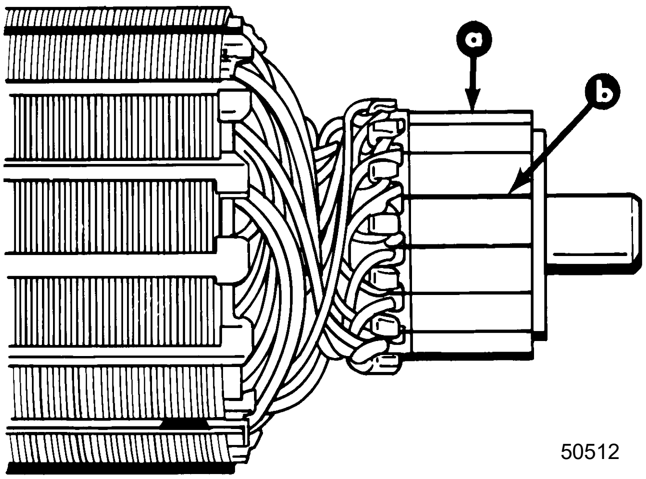
TEST FOR SHORTS

1. Check armature on a growler (follow growler manufacturers instructions). Indication of a short requires replacement.

CLEANING COMMUTATOR

NOTE: *If commutator is worn it can be turned down on a lathe or an armature conditioner tool.*

1. Clean commutator with “00” garnet grit sand paper. DO NOT use emery paper.
2. Check gaps between commutator bars for material. Remove material if present.



50512

a - Commutator
b - Gap

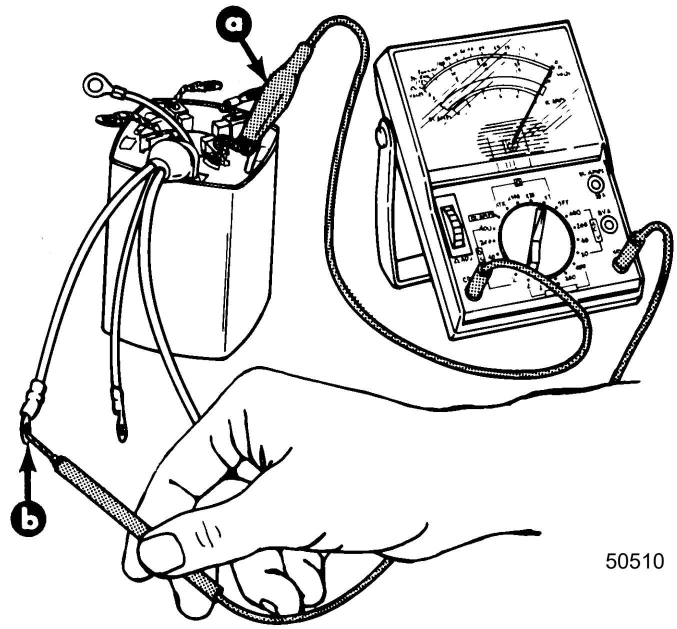
Field Test

TEST FOR OPEN CIRCUIT

1. Connect ohmmeter between field brush lead and BLUE/WHITE lead.

Zero Ohms Indicated (Full Continuity): Field OK.

Zero Ohms Not Indicated (No Continuity): Replace field assembly.



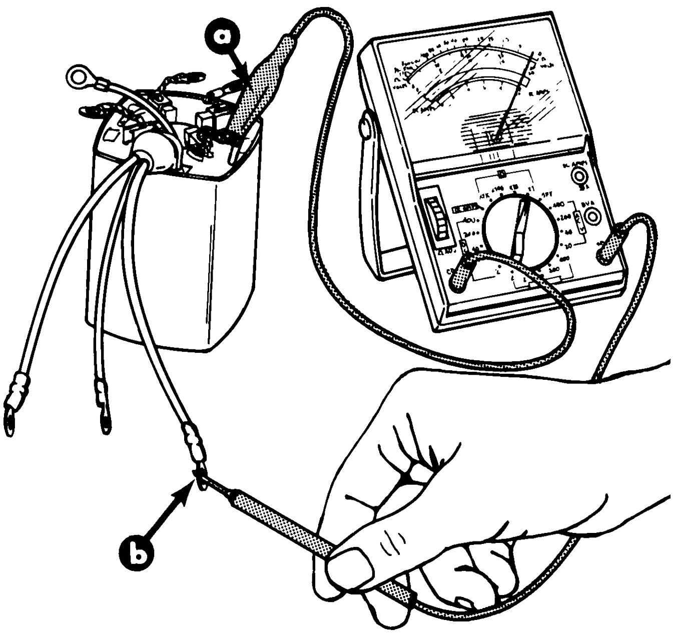
50510

a - Ohmmeter Lead- Connected to Field Brush Lead
b - Ohmmeter Lead - Connected To BLUE/WHITE Lead

2. Connect ohmmeter between field brush lead and GREEN/WHITE lead.

Zero Ohms Indicated (Full Continuity): Field OK.

Zero Ohms Not Indicated (No Continuity): Replace field assembly.



50510

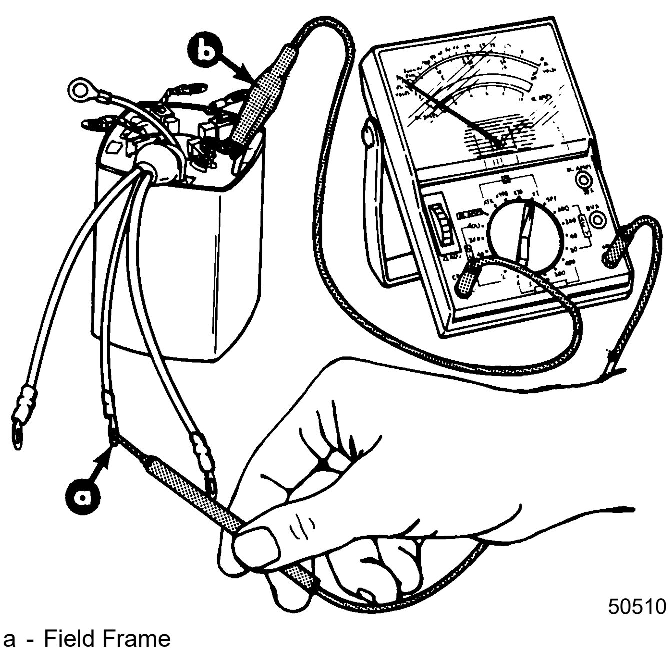
a - Ohmmeter Lead - Connected to Brush Lead
b - Ohmmeter Lead - Connected to GREEN/WHITE Lead

TEST FOR SHORT IN FIELD

1. Connect ohmmeter between field brush lead and field frame.

Zero Ohms Indicated (Full Continuity): Short indicated (Replace field assembly).

Zero Ohms Not Indicated (No Continuity): Field OK.



50510

a - Field Frame
b - Field Brush Lead

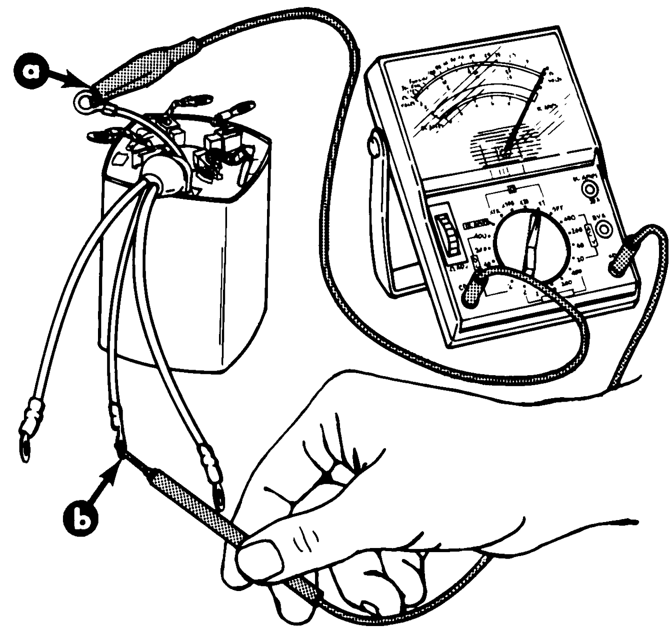
Thermal Switch Test

CONTINUITY TEST

1. Connect ohmmeter between black wires as shown.

Zero Ohms Indicated (Full Continuity): Switch OK.

Zero Ohms Not Indicated (No Continuity): Replace field assembly.

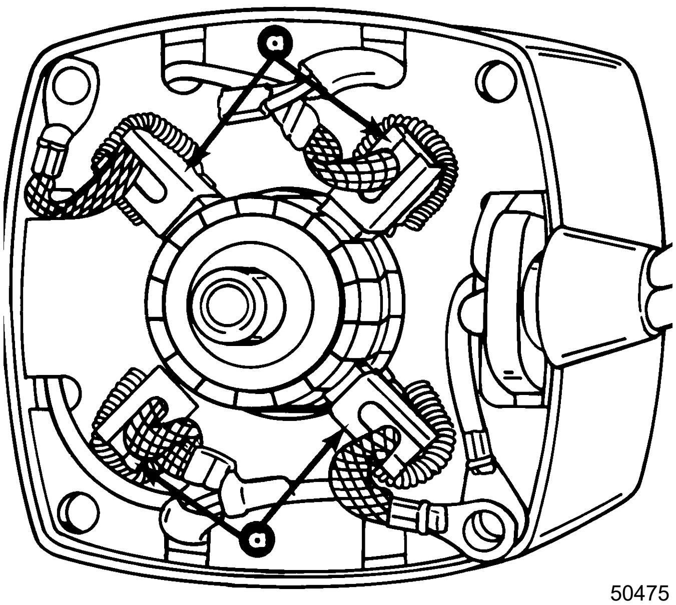


50510

a - Thermal Switch Wire
b - BLACK Field Wire

Brush Replacement

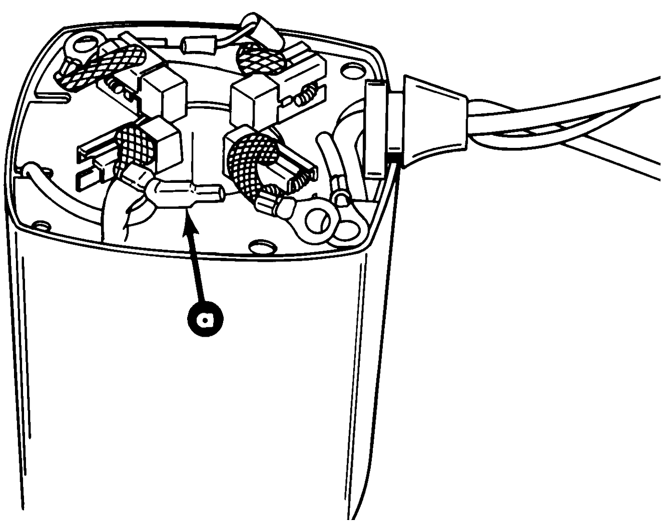
1. Replace brushes if:
   - Pitted
   - Chipped
   - Distance between brush pigtail and end of brush holder slot is 1/16 in. (1.6 mm) or less.



50475

a - Brushes

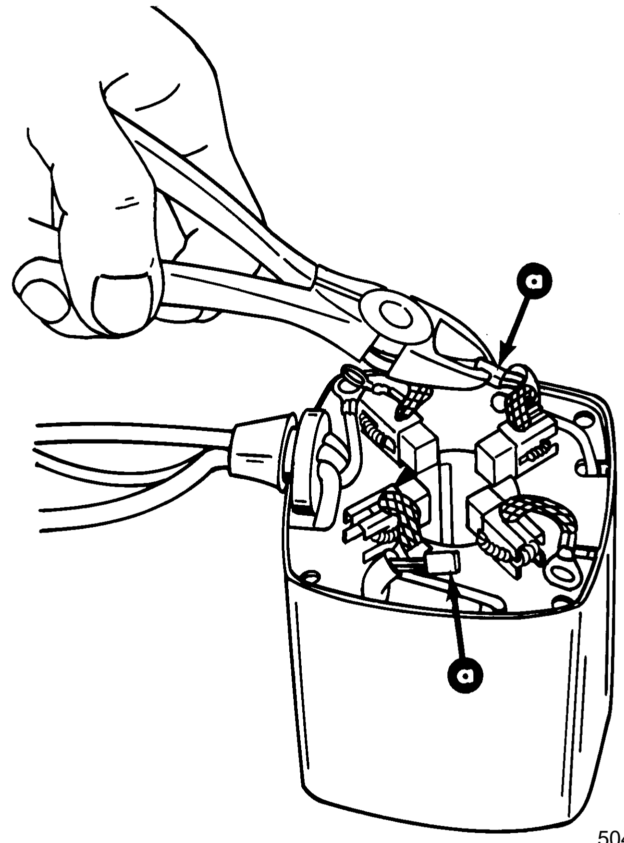
2. Remove plastic casing.



50471

a - Plastic Casing

3. Remove the metal connectors from the ends of the brush pigtails by separating the slit in the connectors using a side cutter. Retain connectors.



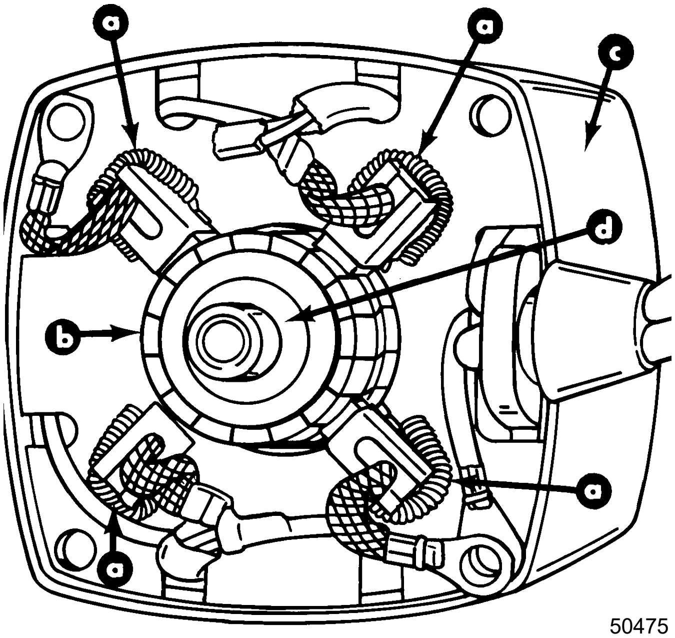
50475

a - Metal Connectors

4. Remove old brush card from field and frame assembly.
5. Insert new brush card into field and frame assembly.
6. Connect brush pigtails to field leads with metal connectors. Crimp metal connectors with a pliers.
7. Use shrink tubing to insulate the connections to prevent connections from grounding against end frame cap.

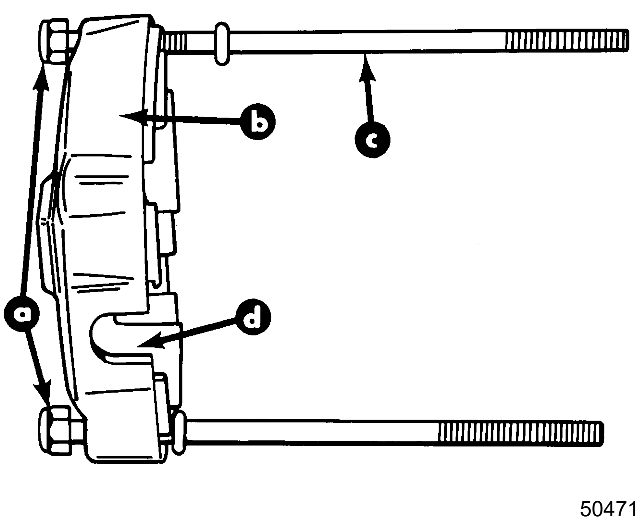
Reassembly

1. Spread brushes and install armature into field and frame assembly.
2. Install thrust washer, if equipped, onto armature shaft.



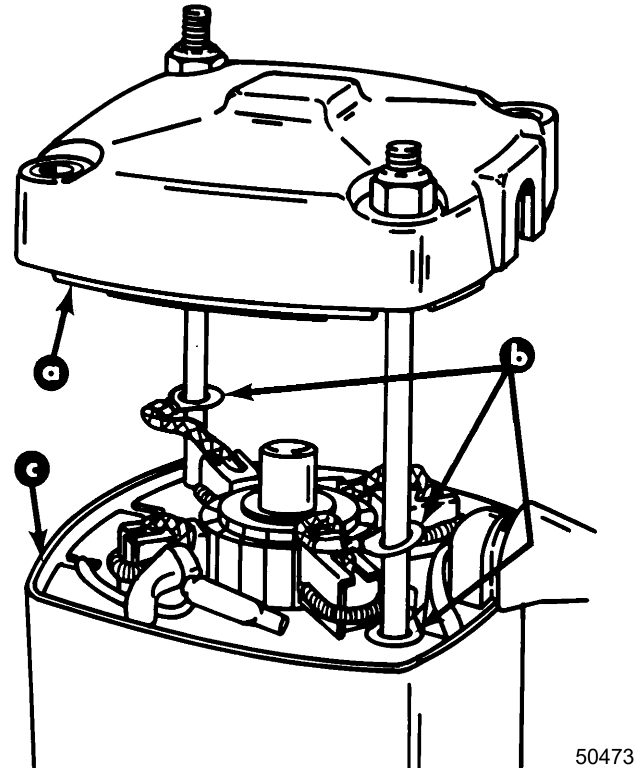
a - Brushes
b - Armature
c - Field and Frame Assembly
d - Thrust Washer (If Equipped)

3. Install through studs.
4. Hold studs in soft jawed vise and tighten locknuts against cap.



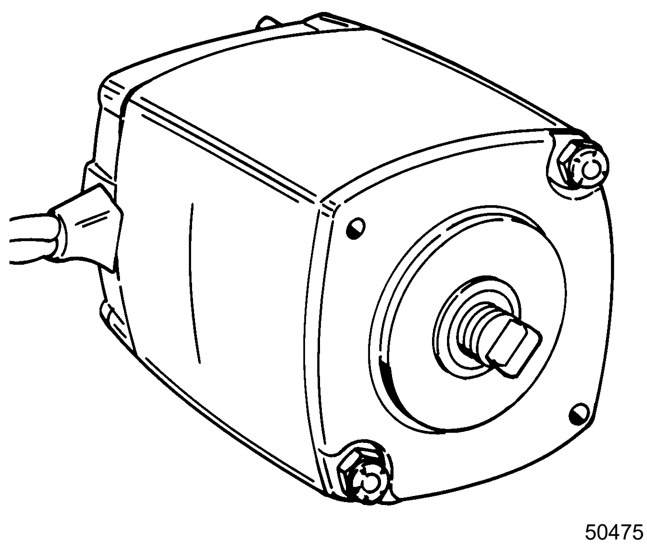
a - Locknuts
b - Upper End Cap
c - Longer Stud
d - End Cap Motor Lead Recess

5. Install upper end frame cap - insert studs through brush lead ring terminals and stud holes.



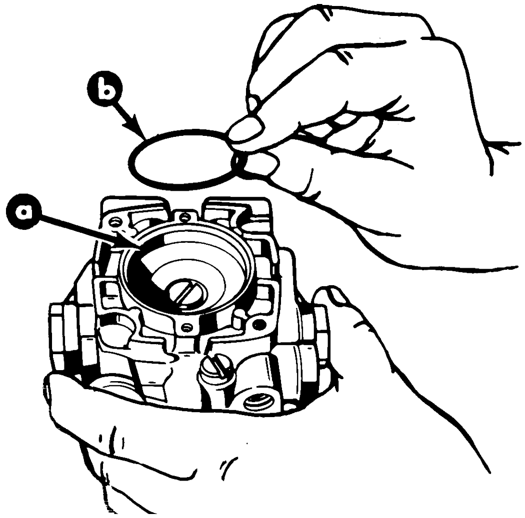
a - Upper End Cap
b - Brush Lead Ring Terminals
c - Field and Frame Assembly

6. Seal the seams between end frame caps and field and assembly with Liquid Neoprene (92-25711-1).
7. Install lower end frame cap onto through studs.
8. Install locknuts and tighten securely.



APPENDIX C – AM MOTOR INFORMATION

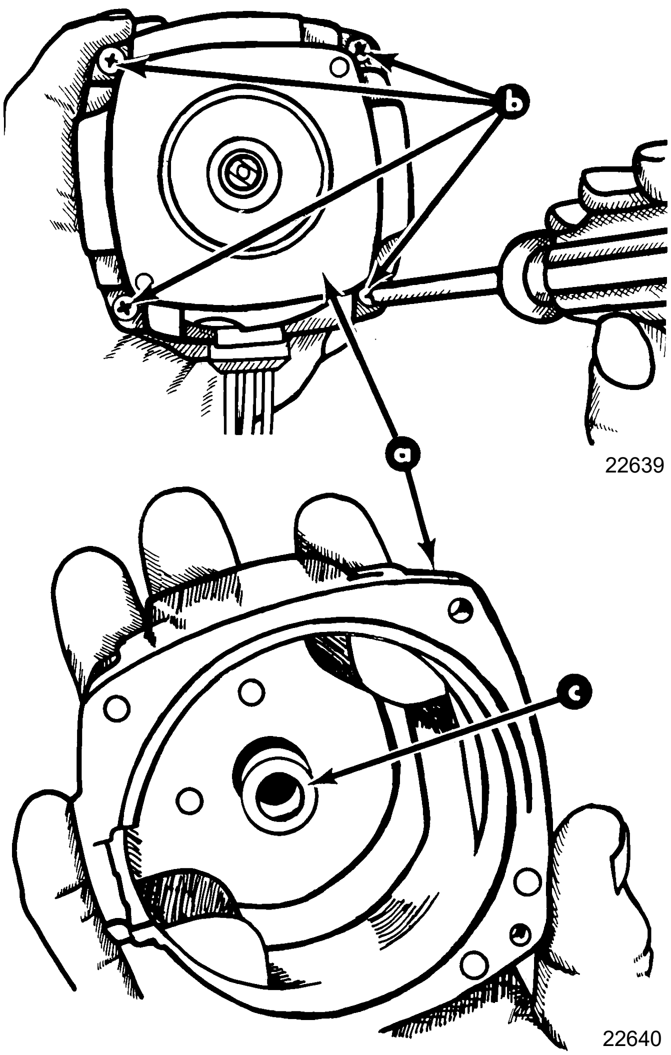
2. Remove (motor-to-adaptor) O-ring.



22498

a - Adaptor
b - O-ring

3. Remove motor end cover and washer from armature shaft bushing.

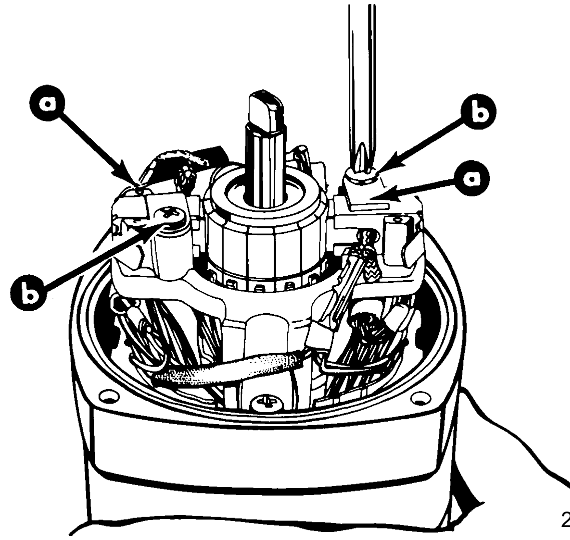


22639

22640

a - Cover
b - Screws (4)
c - Washer

4. Loosen brush hold down arms.

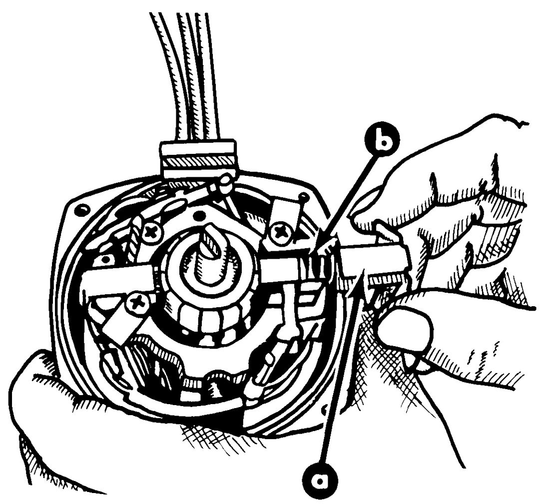


22648

a - Brush Hold Down Arms
b - Screws

IMPORTANT: Use care in removing brush holders so as not to lose springs.

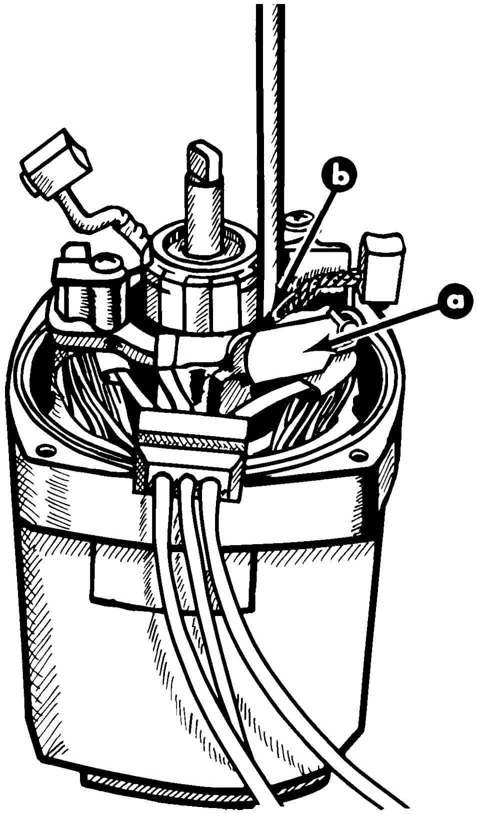
5. Remove brush holders and springs.



22638

a - Brush Holder
b - Spring

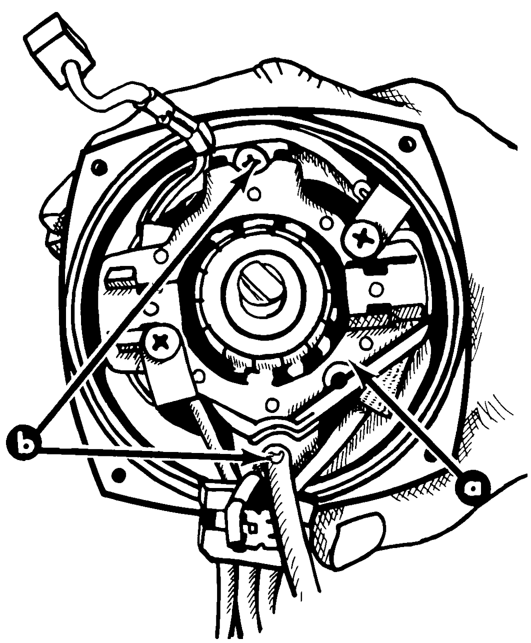
6. Remove thermal switch and brush assembly.



22637

a - Thermal Switch And Brush
b - Screw

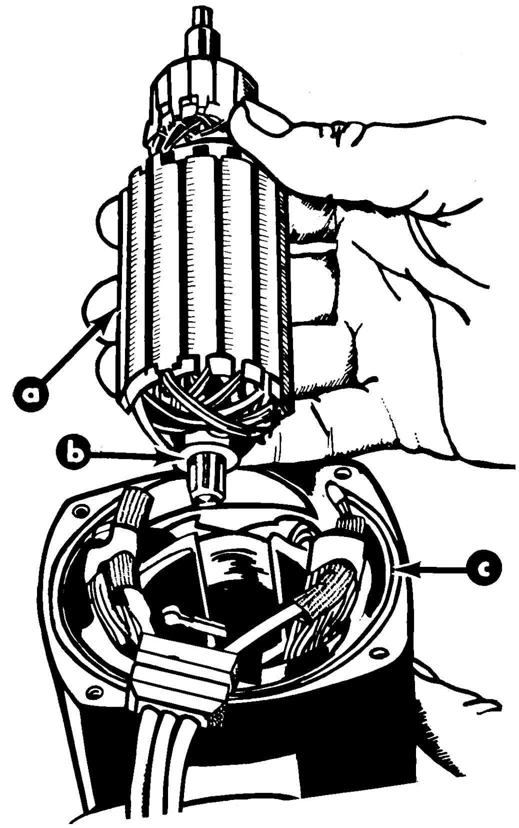
7. Remove brush assembly mounting bracket.



22636

a - Brush Assembly Mounting Bracket
b - Screws

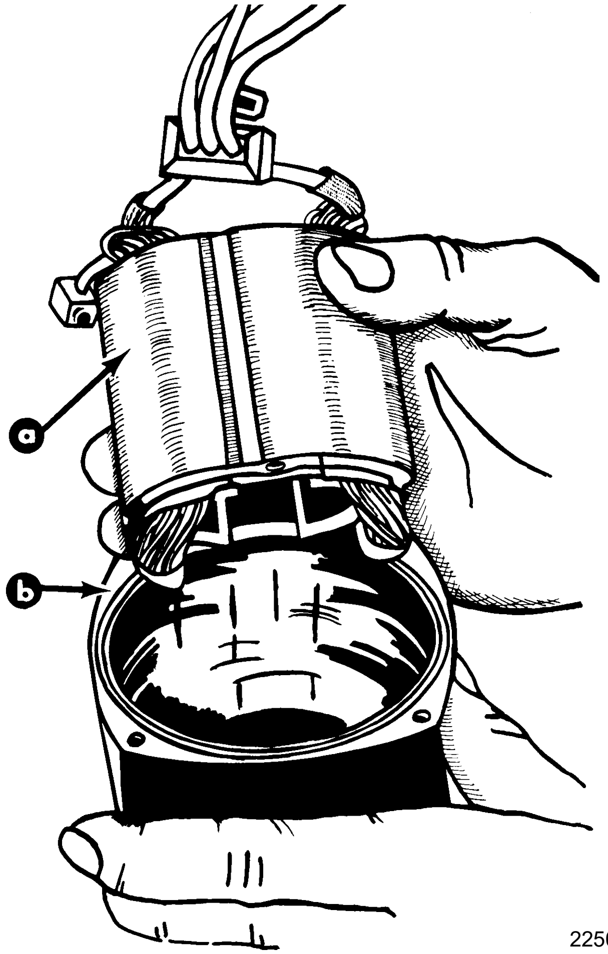
8. Remove armature and thrust washer from motor housing.



22499

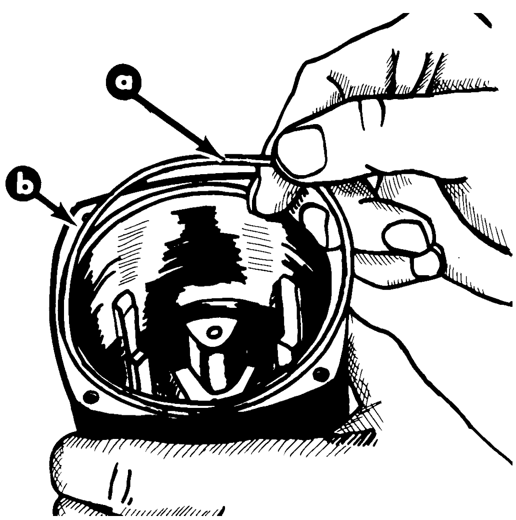
a - Armature
b - Thrust Washer
c - Motor Housing

9. Remove field assembly from motor housing.



a - Field Assembly
b - Motor Housing

10. Remove motor housing O-ring.



a - O-ring
b - Motor Housing

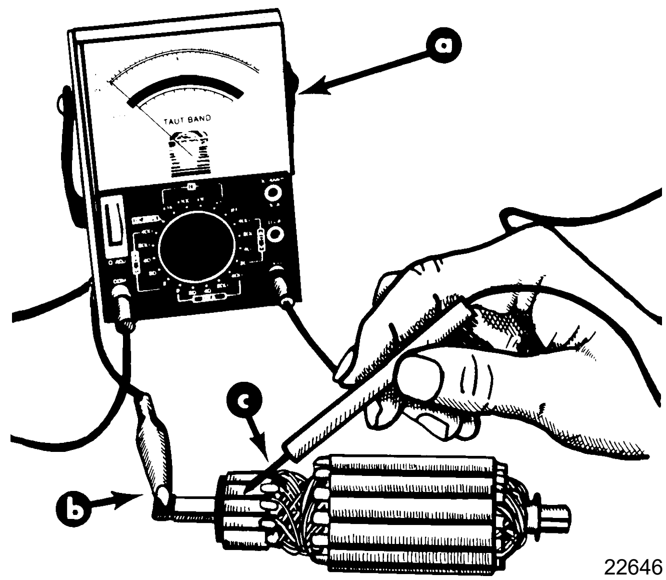
Armature Tests

CONTINUITY TEST

1. Check armature for continuity. Set ohmmeter on Rx1 scale. Place one lead on armature shaft and then place the other on each commutator bar.

Continuity Indicated-Armature is grounded (replace armature).

Continuity Not Indicated-Armature is not grounded.



a - Ohmmeter
b - Meter Lead-Place On Armature Shaft
c - Meter Lead-Place On All Commutator Bars (One At A Time)

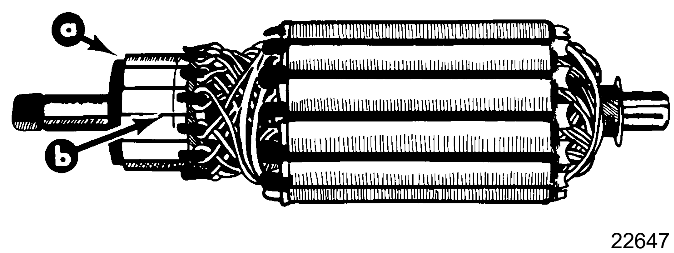
TEST FOR SHORTS

1. Check armature on a growler (follow growler manufacturers instructions). Indication of a short requires replacement.

CLEANING COMMUTATOR

NOTE: *If commutator is worn it can be turned down on a lathe or an armature conditioner tool.*

1. Clean commutator with “OO” garnet grit sandpaper. DO NOT use emery paper.
2. Check gaps between commutator bars for material. Remove material if present.



a - Commutator
b - Gap

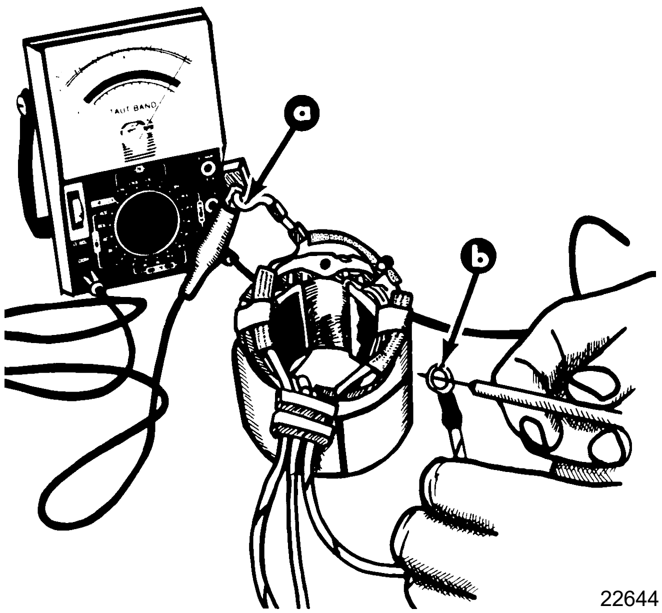
Field Tests

TEST FOR OPEN CIRCUIT

1. Connect ohmmeter between field brush lead and BLUE/WHITE lead.

Zero Ohms Indicated (full continuity)-Field OK.

Zero Ohms Not Indicated (no continuity)-Replace field assembly.



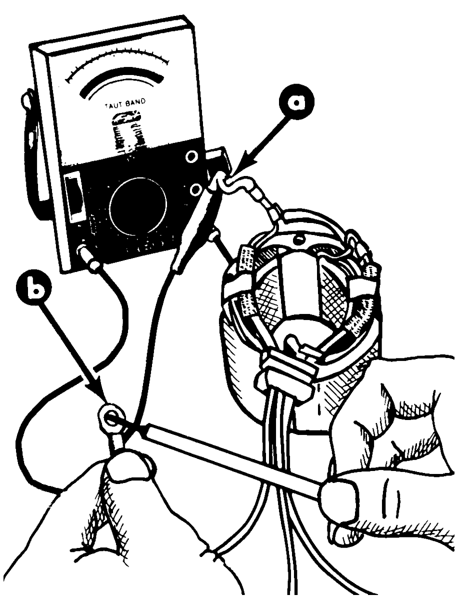
22644

a - Ohmmeter Lead-Connected To Brush Lead
b - Ohmmeter Lead-Connected To BLUE/WHITE Lead

2. Connect ohmmeter between field brush lead and GREEN/WHITE lead.

Zero Ohms Indicated (full continuity)-Field OK.

Zero Ohms Not Indicated (no continuity)-Replace field assembly.



22642

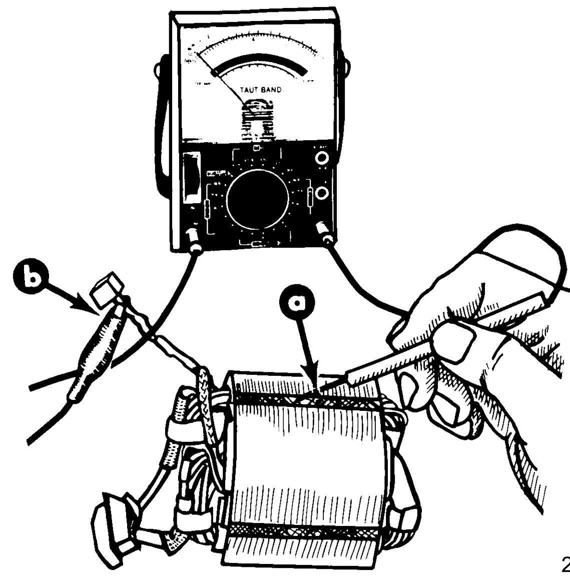
a - Ohmmeter Lead-Connected To Brush Lead
b - Ohmmeter Lead-Connected To GREEN/WHITE Lead

TEST FOR SHORT IN FIELD

1. Connect ohmmeter between field brush lead and field frame.

Zero Ohms Indicated (full continuity)-Short indicated (replace field assembly)

Zero Ohms Indicated (no continuity) - field OK.



22643

a - Field Frame
b - Field Brush Lead

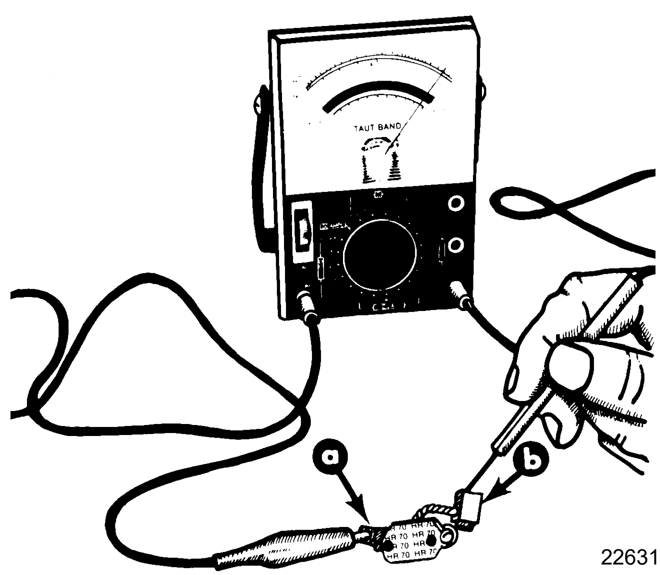
Thermal Switch Test

CONTINUITY TEST

1. Connect ohmmeter between spade connector and brush lead.

Zero Ohms Indicated (full continuity)-Proceed to Step 2.

Zero Ohms Not Indicated (no continuity)-Replace thermal switch.



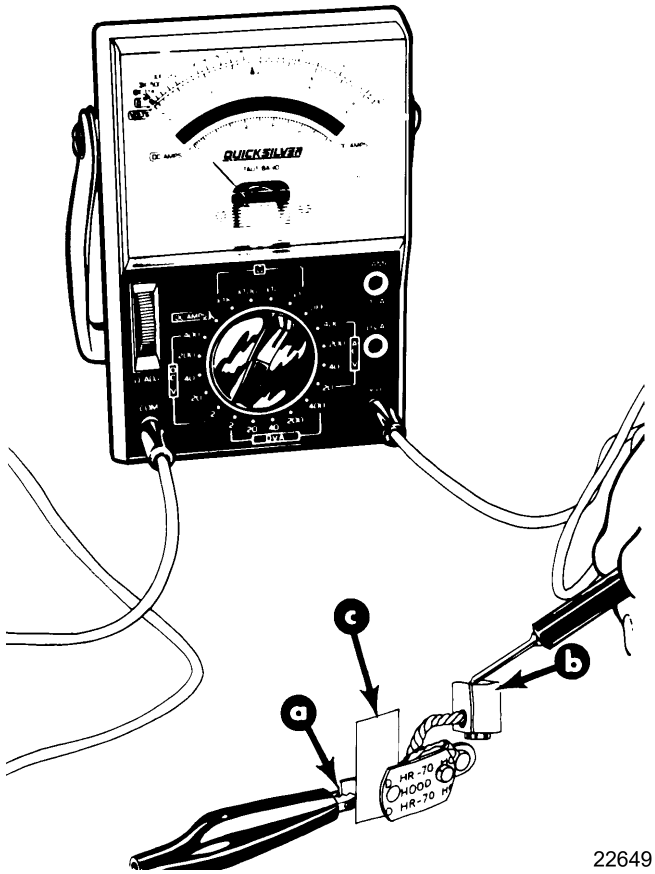
22631

a - Thermal Switch Spade Connector
b - Brush Lead

2. Insert an insulator (piece of paper) between contact points on ohmmeter between spade connector and brush lead.

Zero Ohms Indicated (full continuity)-Replace thermal switch.

Zero Ohms Not Indicated (no continuity)-Thermal switch OK.



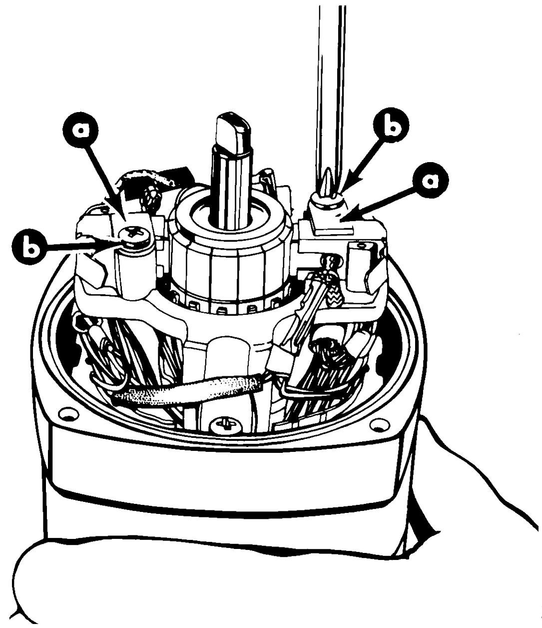
22649

a - Thermal Switch Spade Connector
b - Brush Lead
c - Insulator (Piece Of Paper)

3. Remove insulator from between contact points on thermal switch. Ensure all material is clear from points.

Brush Replacement

1. Loosen brush hold down arms.

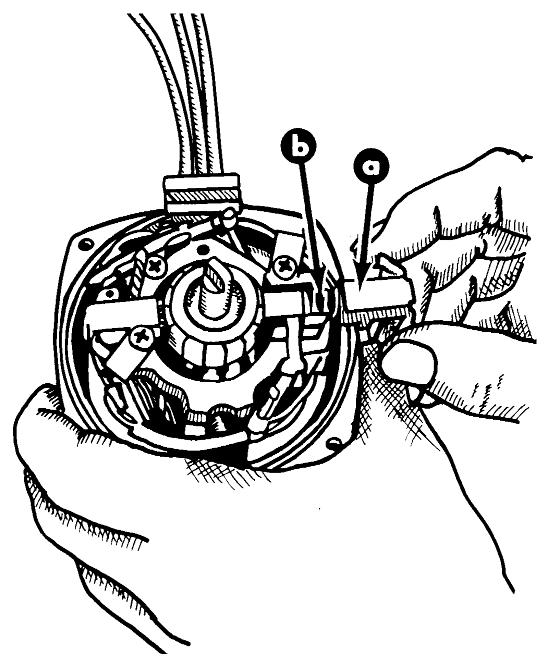


22648

a - Brush Hold Down Arm
b - Screws

IMPORTANT: Use care in removing brush holders so as not to lose springs.

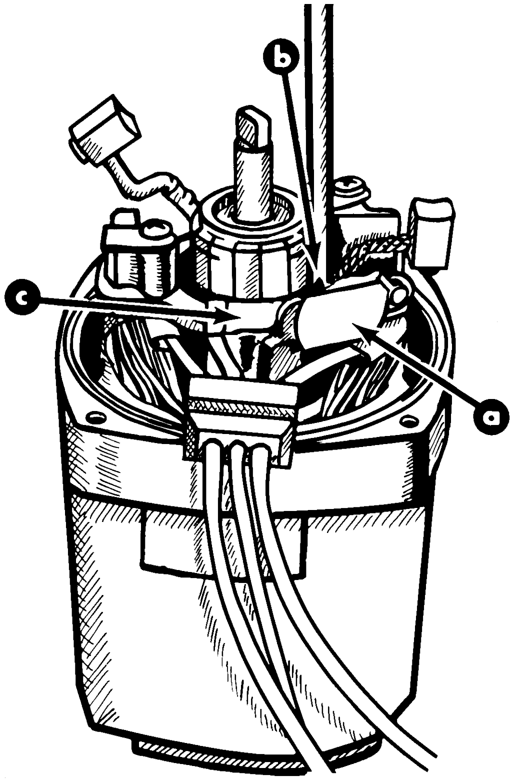
2. Remove brush holders and springs.



22638

a - Brush Holders
b - Springs

3. Remove and replace thermal switch and brush assembly.

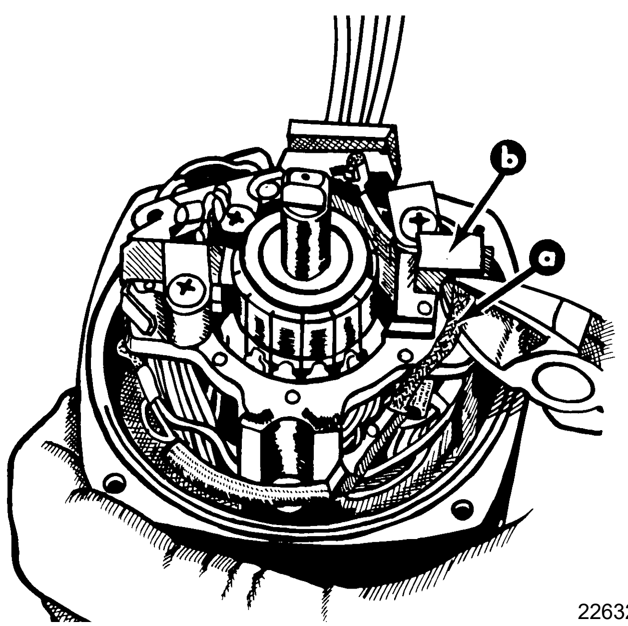


22637

a - Thermal Switch And Brush
b - Screw
c - Connector

IMPORTANT: When replacing the brush that is connected to the field wires; be sure to cut the brush wire as close to the brush as possible.

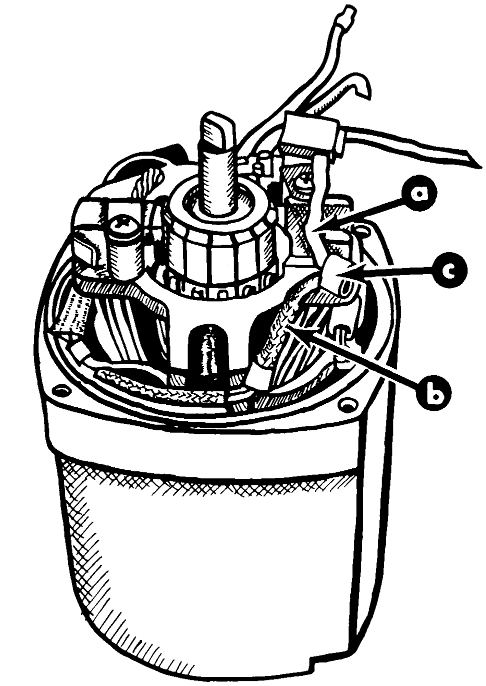
4. Cut brush wire at location shown and discard brush. (As close to brush as possible.)



22632

a - Brush Wire
b - Brush

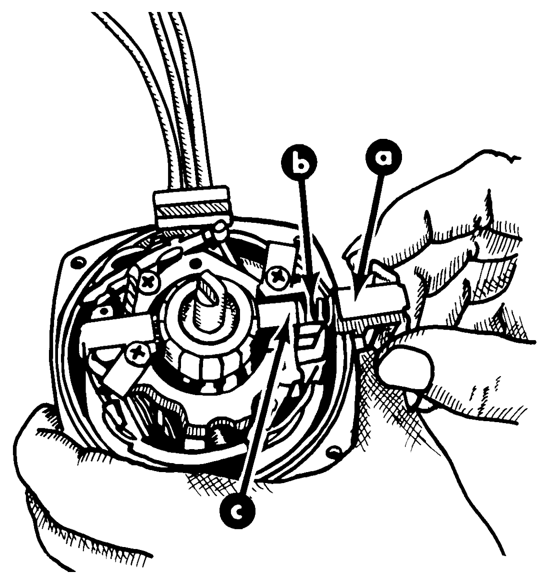
5. Connect new brush wire to field wire just cut in previous step. Secure by crimping both wires together as shown.



22635

a - Brush Wire
b - Field Wire (Old Brush Wire)
c - Crimp Connector

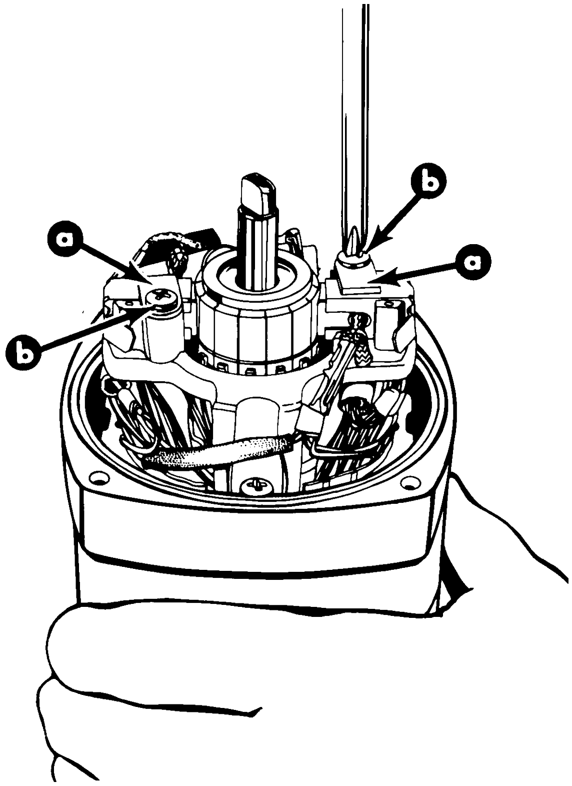
6. Reinstall spring and brush in brush holder.



22638

a - Brush Holder
b - Spring
c - Brush

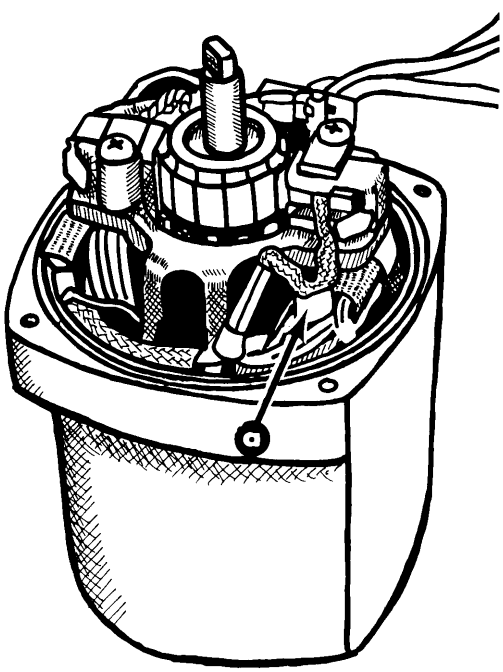
7. Position and tighten brush hold down arms and tighten securely. DO NOT OVERTIGHTEN.



22648

a - Brush Hold Down Arms
b - Screws

8. Position brush wire as shown before reassembly.



22634

a - Brush Wire

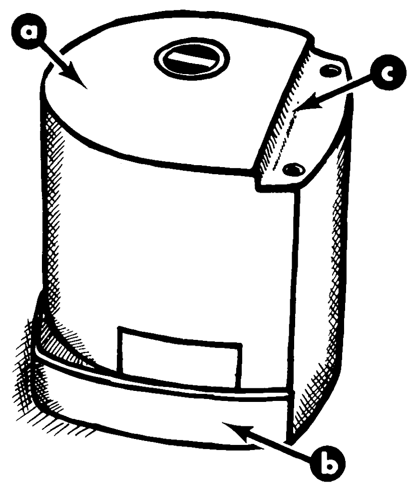
Reassembly

1. Install motor housing O-ring.

22645

a - O-ring
b - Motor Housing

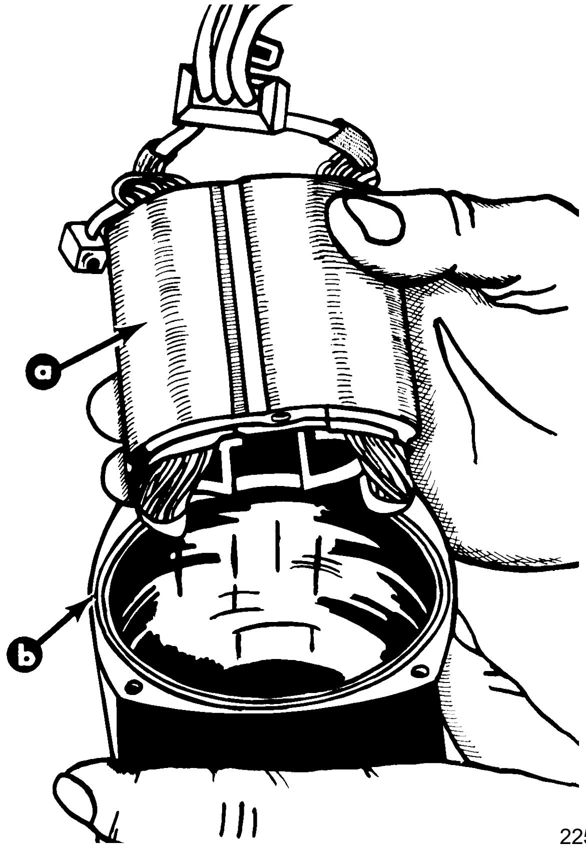
IMPORTANT: Field assembly wires must be facing toward the front of motor housing. Use the notched out area in housing as a reference in determining the front.



22633

a - Motor Housing
b - “Front”
c - “Notched Out” Area

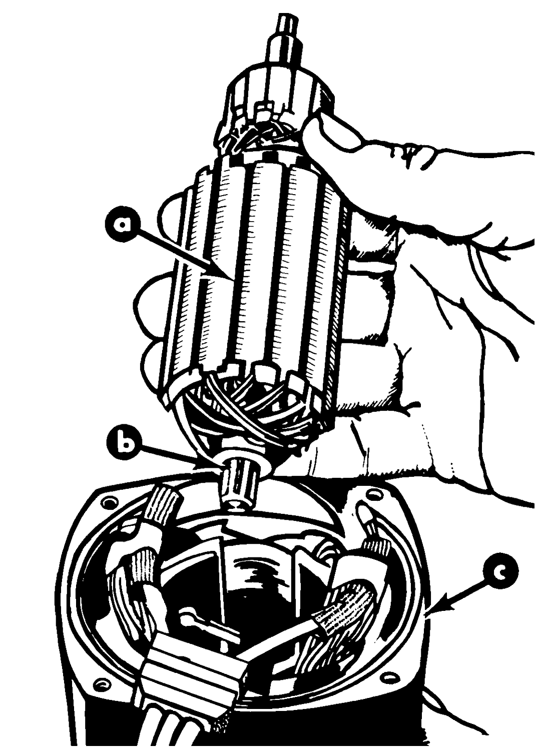
2. Install field assembly into motor housing.



22501

a - Field Assembly
b - Motor Housing

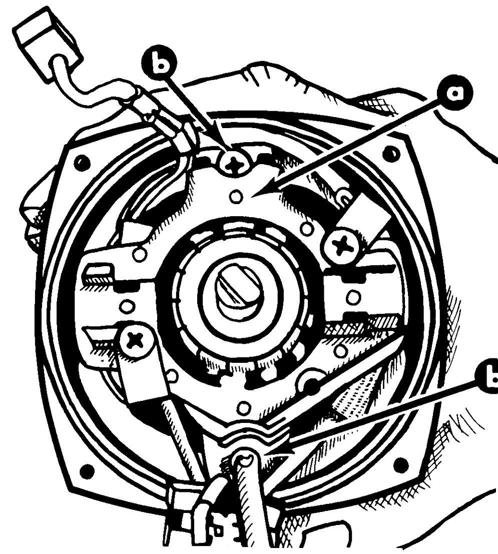
3. Install thrust washer on armature and install into motor housing.



22499

a - Armature
b - Thrust Washer
c - Motor Housing

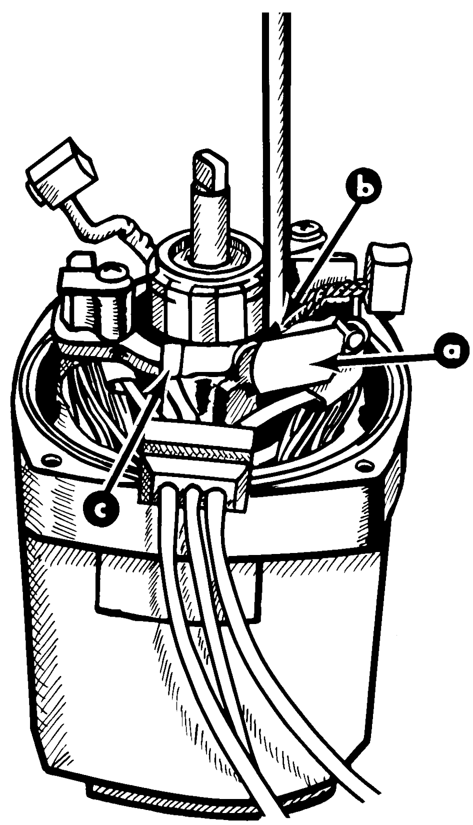
4. Install brush assembly mounting bracket. Tighten screws securely.



22636

a - Brush Assembly Mounting Bracket
b - Screw

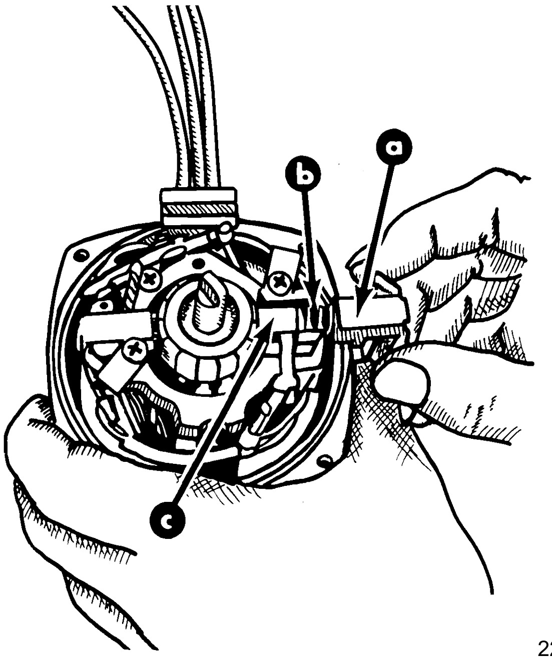
5. Install thermal switch and connect black wire. DO NOT overtighten screw.



22637

a - Thermal Switch
b - Screw
c - Black Wire Connector

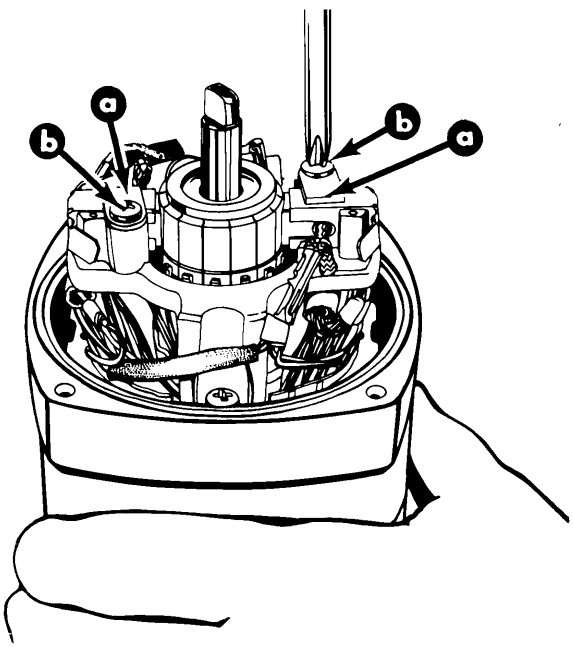
6. Install springs and brushes into brush holders.



22638

a - Brush Holders
b - Springs
c - Brushes

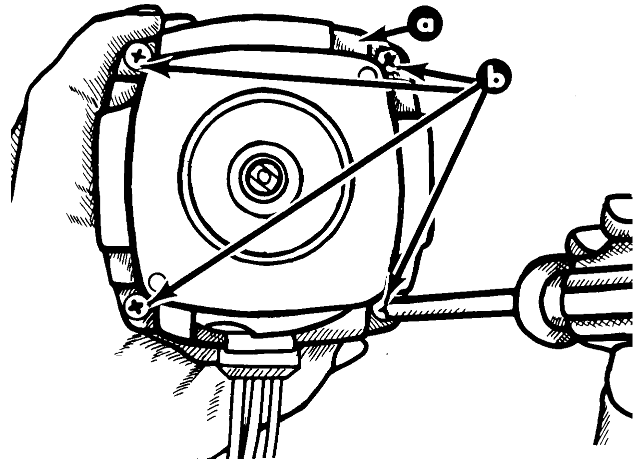
7. Position brush holders and secure with brush hold down arms. DO NOT overtighten screws.



22648

a - Brush Hold Down Arms
b - Screws

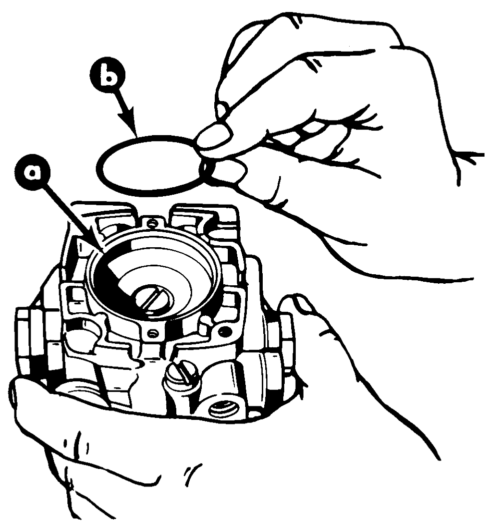
8. Install thrust washer and motor end cover. Apply Loctite to screws and tighten securely. DO NOT overtighten.



22639

a - Motor End Cover
b - Screws

9. Install (motor-to-adaptor) O-ring.



22498

a - Adaptor
b - O-ring