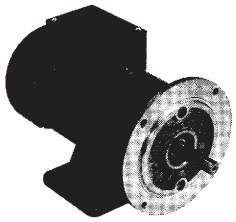
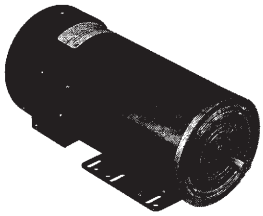
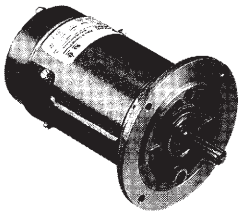
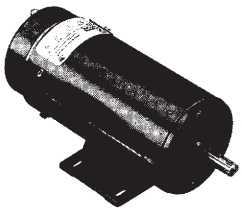
PERMANENT MAGNET DC MOTORS

INSTALLATION, TROUBLESHOOTING & MAINTENANCE BULLETIN

Scope

This bulletin is a guideline for the installation, troubleshooting, and maintenance of the most widely used Pacific Scientific PMDC motors. This bulletin covers motors rated up to and including three horsepower.

Nameplate Data

The motor nameplate provides the operational specifications of the motor. The beginning letter designations of the catalog listing describe the motor type. Designations are as follows:

- SR or SRF. A motor operated by a full wave rectified, 1.4 form factor maximum, SCR control that supplies 90 or 180 volts to the motor.
- PWM or PWMF. A motor operated by a filtered pulsewidth modulated (PWM) control that nominally supplies 130 or 240 volts to the motor.
- BA or BAF. A motor operated by a battery or a low voltage control that typically supplies 12, 24 or 36 volts to the motor.
- EP. These motors are similar in operation to the SR and BA model types, except they are built in an explosion proof housing. While the physical construction of an EP motor is special, all the technical information contained in this bulletin is applicable to these motors.
  Caution:
  1. *All repairs requiring disassembly of an EP motor must be performed at a UL accepted service facility or Pacific Scientific.*
  2. *The explosion proof enclosure is not sealed-tight construction. Explosion proof motors should not be used in applications where hose down is necessary. The ST (sealed-tight) series described below is designed for this purpose.*
- ST, STF or STC. These motors are similar in operation to the SR and BA model types, except they are built in a sealed tight configuration. While the physical construction of a ST motor is special, all the technical information contained in this bulletin is applicable to these motors.

Additional data typically given on the nameplate includes, armature voltage, full load current, rated horsepower, RPM at rated load, insulation class, and duty rating.

Installation Precautions

- To prevent damage to the motor, insure that it is sized properly for the application. Excessive current draw, above the rating stated on the nameplate, may cause overheating of the motor.
- SR, PWM, and 90 or 180 Vdc ST and EP motors should be protected with a circuit breaker set at 90 to 100 percent of rated nameplate current.
- Inspect the motor installation to insure the load is free to move, and that the area around the motor is clear to allow good ventilation.
- PMDC motors typically run in a clockwise direction (as viewed from the shaft end of the motor) with a positive voltage connected to the A1 terminal of the motor and the negative connected to A2. To reverse the direction of rotation, reverse the connections at A1 and A2.
- Some motors may be equipped with internal thermal overload protection. The thermal overload device is connected via lead wires or rear endbell terminal connections depending on the motor configuration. The thermal overload device is not designed to handle motor current. They are designed for pilot duty only and must be interlocked with an external relay.
- Silicone vapors around PMDC motors will cause rapid brush wear. Avoid Silicone vapors to ensure adequate PMDC motor performance. Sources of Silicone vapors are: RTV, oils, mold release agents and varnishes.
- Always follow local and national electrical and safety codes when installing the motor.
- Normal motor exterior operating temperatures may cause burns. Use caution when touching the exterior of the motor.

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Troubleshooting

Performance problems may result from something as simple as worn brushes or as complex as improper sizing or controller failure. Use the following chart as a guide to return the motor to service:

SYMPTOM	POSSIBLE CAUSE	CORRECTIVE ACTION	PROCEDURE
Won't run	• Worn brushes • Loose power leads • Brush hung up • Open armature	• Replace brushes • Check wiring • Check brushes • Replace armature	• See Brush Replacement • Tighten leads • Free brush • Contact repair facility
Runs in wrong direction	• Power leads reversed	• Check lead polarity	• Reconnect leads
Runs slow	• Controller overcurrent adjustment incorrect	• Adjust current limit	• Consult controller literature or contact controller supplier
Runs fast (no-load speed more than 15% higher)	• Possible over-current damage or open armature	• Motor may require major overhaul	• Contact repair facility
Blows breaker	• Shorted armature • Brush dust accumulation in motor	• Replace armature • Replace rear end bell and clean	• Contact repair facility • Contact repair facility
Blows breaker, runs hot	• Mechanical overload operating range	• Check load throughout	• Contact original equipment manufacturer
Blows breaker, runs hot, motor shaft turns hard	• Bad bearing(s)	• Motor may require overhaul	• Contact repair facility

Maintenance

Brush and Commutator

Brushes must be inspected periodically to insure uninterrupted service. Damage to the commutator may occur if the brushes are allowed to wear down below 0.56 inch minimum length.
Brush life expectations vary based on speed and load. Generally, high speed and high current (periodically over nameplate rating) operation will cause higher wear on the brushes. Also, high brush or commutator wear may be experienced in light load (continuously below nameplate rating) situations. To avoid damage to the motor, a preventive maintenance inspection interval should be determined for each new application. You are encouraged to inspect the brushes and commutator after 500 hours of use. The brush length after 500 hours verses length when new can be used to project an appropriate maintenance schedule. The length (when new) of the most widely used brush for brush access motors is 1.03 inches. Non-brush access motors typically use a brush that is .88 inches long when new. Minimum brush length for all brush types is 0.56 inch. Always clean out brush dust when inspecting or changing brushes. When inspecting brushes, check the commutator for wear. If the commutator is worn more than 0.031 inch (measured on the diameter) or it is pitted, turning and undercutting is recommended. This can be accomplished by a reputable motor repair facility. Usually three sets of brushes can be used for one commutator turning.

Motor Breakdown

Review the following motor figures prior to beginning replacement procedures. These diagrams show the major components of the motor, brush and spring positioning, and the parts terminology, which will be beneficial in understanding the procedures.

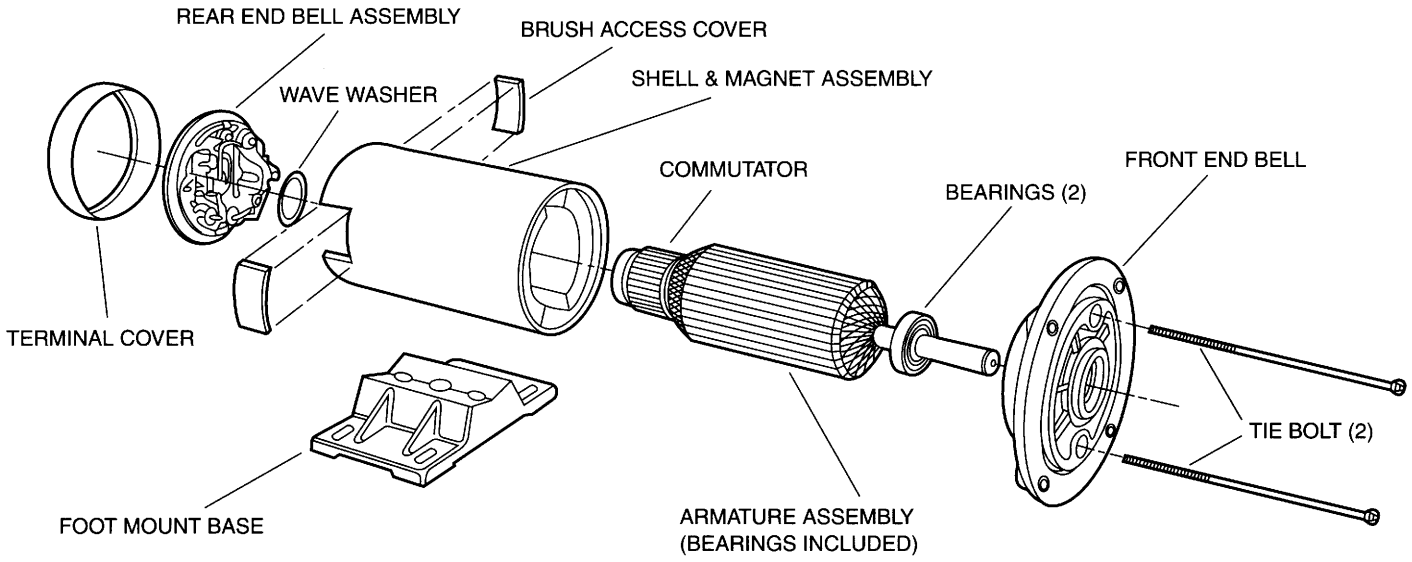

Figure 1 Exploded View

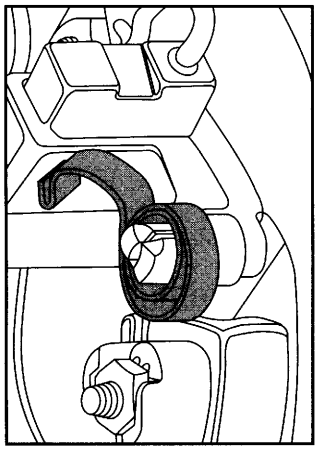

Figure 2 Brush removal / installation integral brush spring

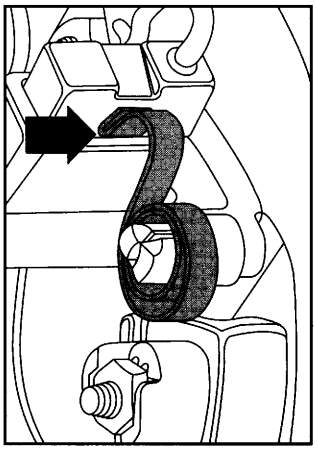

Figure 3 Integral brush spring cocked for assembly

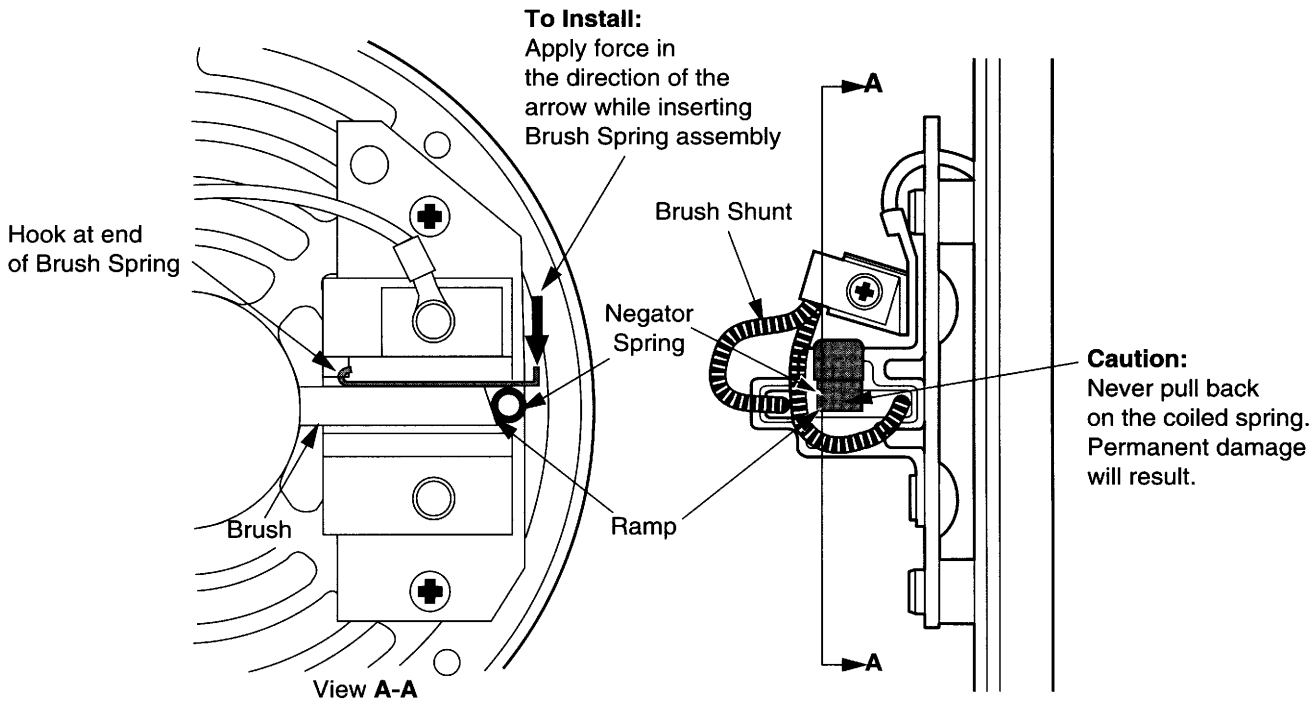

Figure 4 Brush removal / installation, Negator style spring

Brush replacement procedures

Motors with brush access covers.

Motors with Negator style springs.
(Typically motors larger than 1 horsepower)

1. Disconnect motor from the power source.
2. Remove each brush cover and any insulators if used.
3. Move the brush shunts out of the way from the spring.
4. Note the brush ramp position and negator spring location prior to removing the brushes. You will need to duplicate these positions when installing the new brushes.
5. Push the negator spring handle until you hear a click. The spring is now disengaged from the brush holder.
6. Carefully remove the spring (Do not pull on the coiled spring.) Disconnect the brush shunt from the brush holder and remove brush.
7. Carefully remove any brush dust accumulation from the inside of the motor. A soft brush and compressed air might be helpful.
8. Place new brushes in the brush holder. Remember to position the ramp exactly the same as the brush you removed.
9. Install the negator spring assembly so that the bottom of the brush ramp is closest to the spring assembly.
10. While installing the negator spring you will need to apply force towards the brush (see Figure 4) to ensure the hook on the end of the spring engages with the brush holder.
11. Connect the brush shunts and install any insulators and brush covers.

Motors with brush springs integral to brush holder.

(Typically motors 1 horsepower and below)

1. Disconnect motor from the power source.
2. Remove each brush cover and lift the white insulator flap out of the way.
3. Pull the end of the spring from the top of each brush and place the end of the spring on the step of the casting so that it is out of the way for brush replacement (reference Figure 2).
4. Remove the brush shunt connection. Some brush connections will use a .250 quick disconnect, others will use a spade lug. For the quick disconnect style simply pull on the shunt terminal to remove. The spade lug will require the power connection stud to be loosened.
5. Note the brush ramp orientation and remove each brush.
6. Carefully remove any brush dust accumulation from the inside of the motor. A soft brush and compressed air might be helpful.
7. Replace with new brushes and reposition the end of the spring on the top of each brush.
   Caution: Orient the brush in the brush guide so the bottom of the ramp is adjacent to the brush spring and the brush shunt is closest to the end bell (reference figure 2).
8. Reconnect the brush shunts.
9. Reposition the insulator flaps and reinstall the brush covers.

Motors without brush access covers.

1. Disconnect motor from the power source.
2. Remove the terminal cover.
3. Place a reference mark on the edge of the rear end bell near the alignment key that fits into the notch in the housing. This will ensure proper assembly when maintenance is complete.
4. Remove the two nuts holding the rear end bell in place and remove the assembly.
5. Lift the white insulator flap out of the way.
6. Carefully pull the end of the spring from the top of each brush. Place the end of the spring on the step of the casting so that it is out of the way for brush replacement (reference Figure 2).
7. Slightly loosen the power connection stud and disconnect the brush shunt.
8. Note the brush ramp orientation and remove each brush.
9. Carefully remove any brush dust accumulation from the inside of the motor. A soft brush and compressed air might be helpful.
10. Replace with a new brush.
    Caution: Orient the brush in the brush guide so the bottom of the ramp is adjacent to the brush spring and the brush shunt is closest to the end bell (reference figure 2).
11. Place the spade lug under the power connection stud and tighten.
12. Before reinserting the end bell assembly, each brush must be held in position in the brush guide to allow clearance for the commutator. Brush position can be maintained by cocking the spring against the side of the brush (see figure 3).
13. Install the wave washer in the bearing bore (if it has fallen out) before replacing the end bell.
14. Partially install the end bell so the brushes are over the commutator. Uncock the brush by pushing in the brush until the spring clicks into the notch on top of each brush. This seats the brush on the commutator.
15. Reposition the insulators.
16. Insure that the key of the end bell is in the shell notch (see your reference mark) to prevent the motor from running in the reverse direction.
17. Tighten the two tie bolts to secure the end bell and replace the terminal cover.

Warranty Policy / Return Authorization

Pacific Scientific will repair or replace (at its option), at the factory, motor or motor parts which prove to be defective as a result of materials or workmanship provided that written notice be given to Pacific Scientific within two years after the date of the product date code that is affixed to the product. This warranty does not include brush or commutator wear since wear is normal. The foregoing is a summary of the warranty policy. For the complete Warranty and Limitation of Liability, contact the factory. Before returning any products for repair, authorization must first be received from Customer Service (815/226-3044). A Return Material Authorization number (RMA) will be issued that must appear on the outside of the (freight prepaid) package.

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