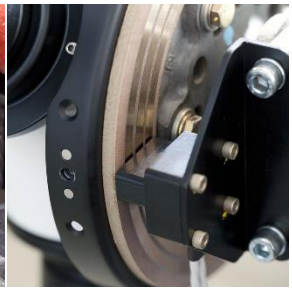
Techniques for Replacing the Airmaster AP Series Brushes

By
Bud Yerly
Custom Flight Creations, Inc.

Brushes wear out in any DC electric motor. The Airmaster is no different. Unlike the easy to replace brushes in the latest battery powered electric drills, the Airmaster brush block is more like the brush change in the older DC electric drills which have a brush with a wire braid attached that must be soldered. Aircraft standards require the brushes to be soldered so please do not modify or change the brush installation as it is quite secure, robust and resistant to vibration.

The useful life-time frame for changing the brushes depends on the environment but is typically between a low of 250 hours to a high of 400 hours. The type brush blocks used are the mini-slip ring (for through the prop shaft Rotax engines) and the standard slip ring attached to the propeller spinner back plate or in some engine installation an extension plate or even in the Lycoming engines the slip ring attached to the ring gear housing. The longest service is normally found on the mini slip ring due to the smaller diameter of the slip ring. The larger standard slip ring will wear the outer slip ring brush wear significantly faster than the inner ring.

Shown below are the mini slip, the standard slipring and the Lycoming slip ring attachments.


The Airmaster Operation and Installation Manual contains the repair procedure (see attachment 3). I am including some of my techniques to improve your understanding of how to do accomplish a successful brush change and am providing some additional drawings and techniques to allow a less stressful brush change out.

Tools needed:

1. A soldering iron or gun of a minimum of 20 watts and a maximum of 40. The tip should be fairly small and a wedge shaped tip or taper tip is preferred over a flat or square tip.
2. A “Solder Sucker” or Solder Wick to remove old solder.
3. 60/40 electrical solder. Normally electrical solder does not have a hollow center with flux. Flux assists the flow of the solder. The solder should be no larger in diameter than 1/16 to 1 mm. Avoid silver solder as it requires more heat and is a devil to remove.
4. A very sharp side cutter or sharp scissors to trim the brush wire braid.
5. A #2 Phillips Screwdriver
6. Metric Allen Wrenches to remove the brush block components.

Techniques:

First, clean the slip rings with a clean cloth and denatured alcohol and inspect. If corrosion is present, use a fine (white) scotch bright to slightly brighten the rings. Do not use sandpaper as it is too coarse.

Removal of the brush block is straight forward. Simply unscrew the Allen head screws holding the brush block fixture. Remove the four small #8x3/8 screws from the back of the block support remove the fixture and to expose the circuit card. Use the soldering gun to heat the screws as they are Loctited.

The brushes (shown below) come as a set of three. Part number is P0265 and is approximately $20 US.

Note:
The brushes are curved for installation in a drill motor. Disregard the curve and install the brushes in the orientation that fits the brush block. The curve will wear off quickly.

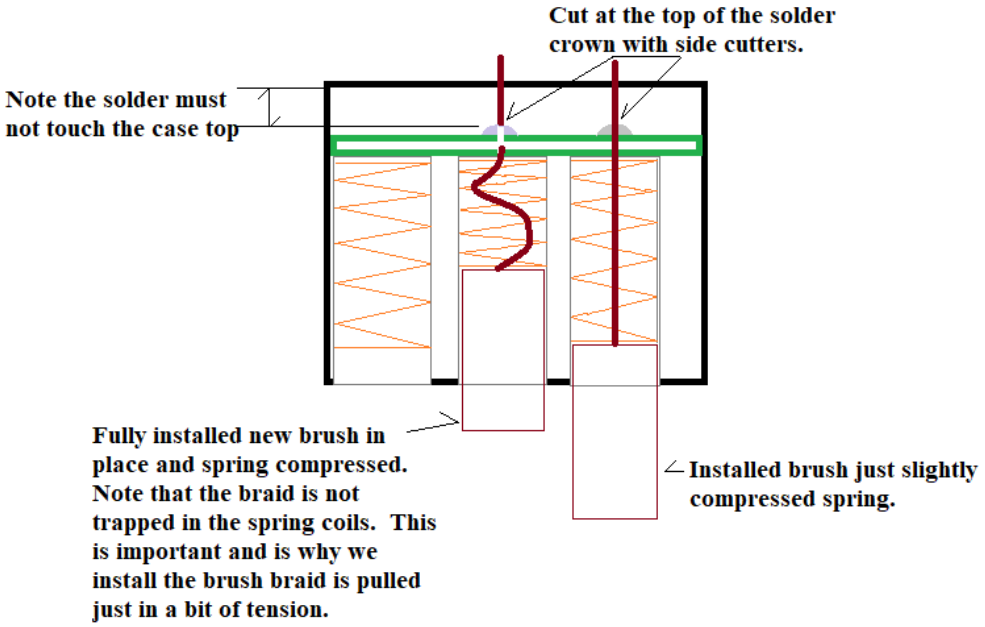
Using a 20 watt soldering iron (low heat is best), a solder wick or sucker, heat each of the brush wire braid attachments until liquid and remove the solder. Carefully apply heat only to the solder hole (that bubble of shiny solder). Don't push the tip hard into the board, just rest it on the solder bubble. Remove as much of the solder as possible. Then heat the small pigtail or soldered braid remaining and pull on the carbon brush while applying heat to pull the brush out of the block. Clean up the solder that may remain in the hole. Use a very small number bit if necessary to clear the hole, but normally a bit of heat and air or solder wick/solder sucker vacuum will make quick work of the cleanup.

Photo below of the wire pigtail, twisted tight, straight and inserted through the hole and clamped.

Pull the new brush pigtail through the hole. I find a bit of solder on the very end of the new wire braid keeps the wire together, then I use my side cutters to angle the end of the soldered tip pointed, which makes insertion through the hole quite easy without fraying the wire.

Finally, pull the pigtail through the hole, make it tight enough to <u>just compress</u> the spring about ½ mm. Clamp the excess braid to the outside of the block to keep tension as described. I find a light pressure with a vice grip using just the set screw to clamp the pigtail over the side of the housing, is sufficient.

Warning:
If the brush braid is not installed with the wire braid compressing the spring in slight tension, it may be trapped in between the spring coils and be cut by the spring eventually causing premature failure of the electrical contact. It is sufficient to simply twist the wire braid, then straighten out the braid as shown and this will normally prevent the braided pigtail from catching in the spring coil.



Shown above is the intended installation of a brush and its pigtail to assure two things. The soldered joint does not contact the case top, and the braid is clear of the coiled spring when compressed.

Solder the circuit board ring to the wire braid. Once you have a solid solder joint and inspected your work. Push the brush up and down to assure the brush does not bind. One can feel if the wire braid is caught in the spring due to either braid coiling during compression of the brush. It is essential the solder joint be a neat dome and is free of voids or contamination. It should be a clean and bright solder joint with a slight dome around the braid and through it. If all is well, use your side cutters to trim the excess braid. Use a straight edge to assure the soldered brush joint to the circuit card will not contact the aluminum brush block support before reassembly. Otherwise it will short out the circuit.

Installation of the block to its bracket and the assembly to the aircraft is the same as removal. The small #8 screws use a #2 Phillips screwdriver. Do not over torque. Use a small amount of Loctite (blue) thread locker on each screw. Wipe off and I use a Torque Seal paint to verify the screw has been seated.

Once the brushes and bracket are installed, be sure to complete and operational test of the propeller.

Attachment 2: Typical tools needed to replace the brushes in an Airmaster Propeller.
All of this can be bought as a kit on Amazon for cheap.

Typical soldering iron station used for electrical repairs.

Typical Side Cutter ideal for electrical work:

Solder Suckers:

Typical Electric soldering iron suction device.

Solder Bulb

Solder Wicks are handy to absorb solder:

Clamps such as Vice Grips or Paper Binder Clamps:

Attachment 3 from the Airmaster Manual:

AP332 Operations Manual Part 11.2.2 Page 57

Section 11.2.2. Replacement of Slipring Brushes

The sensor/brush assembly brushes that run on the slipring will progressively wear down, as they act on the sliprings. Once they have become so worn that the spring behind them is at full extension, they will no longer have good contact with the slipring. This may be observed during an inspection of the propeller, or may become apparent as a result of an open-circuit failure of the pitch change mechanism (indicated by all three controller indicators flashing red). To replace the brushes, follow the following procedure:

Note: Brushes are available from the manufacturer as a spare part (AP-P-0265).

a. Remove the sensor/brush assembly from the engine. This may be achieved by either of the following two methods, depending on what is most convenient:

- Remove the block with the brushes and sensor from its mounting bracket by removing the four countersunk screws, and carefully sliding the block from between the bracket and the slipring assembly. Insert a piece of card between the brushes and the sliprings to protect the brushes.
- Remove the complete assembly, including the mounting bracket from the engine. This is the reverse of the process used to install the assembly. Then remove the block with the brushes and sensor from its mounting bracket by removing the four countersunk screws.

b. De-solder the three brush leads from the large pads (1, 2 & 3) on the circuit board, and remove the brushes from the front of the block. Clear old solder from pad.

c. Insert new brushes from the front of the block, carefully guiding their braided leads through the holes in the circuit board.

d. Pull leads through hole so that the brush just starts to compress the spring, and the lead is just taut (the brush should protrude approximately 12mm(0.5in) from the block). Bend the lead across the face of the solder pad and temporarily secure.

e. Solder leads to solder pad with high quality electrical solder.

f. Clip off excess lead close to the circuit board. Ensure that no part of the solder joint or the leads can contact on the bracket and cause a short circuit.

g. Reassemble the sensor/brush assembly to the engine in the reverse order of the removal process. Ensure that the four countersunk screws are installed with medium strength thread-locking compound such as Loctite 243 (clean old compound from the holes). If the complete assembly including the bracket was removed from the engine, refit this assembly in accordance with the installation instructions in CHAPTER 5, Installation.

h. Check that no electrical continuity exists between the brushes and the sensor/brush mounting screws, by using a resistance meter. (Resistance should be greater the 1KΩ.)