

# **Southwest Windpower**

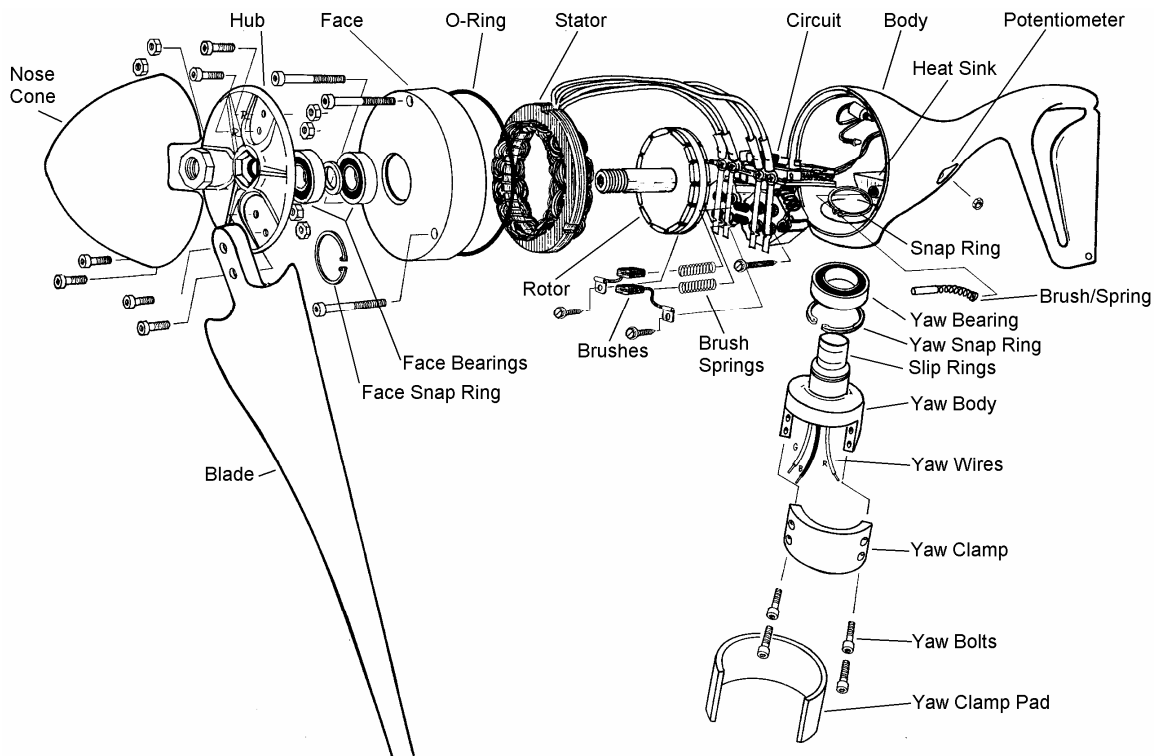
## **Instruction Sheet – AIR Marine 403 Circuit Replacement**

### Tools Required

- $\frac{5}{32}$ " Hex key
- $\frac{5}{16}$ " Hex key
- $\frac{7}{64}$ " Hex key
- $\frac{15}{16}$ " Wrench
- Standard screwdriver
- Phillips screwdriver
- Pair of external snap ring pliers
- Rubber mallet
- Hammer
- $\frac{1}{4}$ " Socket or nut driver
- $\frac{5}{16}$ " Socket or nut driver
- Long blunt object (for yaw shaft removal)
- Dental pick or equivalent
- Brillo pad or emery cloth
- Rag
- Silicone rubber sealant

### Supplied With Repair Kit

- 1 – 12, 24, 36 or 48 volt circuit assembly
- 1 – Front cover o-ring
- 1 - External snap ring
- 2 - LED clips
- 1 - Potentiometer nut and washer
- 1 -  $\frac{1}{4}$ "-20 x  $\frac{3}{4}$ " SS blade screw (unregulated units)
- 1 -  $\frac{1}{4}$ "-20 SS jam nut (unregulated units)
- 2 – #8 - 32 x 1" rectifier mounting screw
- 4 - #6 – 32 x  $\frac{1}{4}$ " stator wire socket head screw
- 1 - #10-24 x 1-1/2" face screw with Nyseal (spare)
- 1 – Ground brush
- 2 – Brush spring
- 2 – Plastic spring base
- 1 – Insulator pad (spare)
- 1 – Tef gel capsule



**Important: Please read all of the instructions before starting the replacement procedure.**

1. Remove the turbine from the mount then disconnect the wires.
2. Remove the blade assembly with a  $\frac{5}{16}$ " hex key and a  $\frac{15}{16}$ " wrench.
3. Using a  $\frac{5}{32}$ " hex key, remove the three screws from the front face of the turbine.
4. Remove the face by using a small standard screwdriver to pry open the front. If it is a marine unit, be careful not to damage the powder coating. Remove and discard the old o-ring.
5. The stator, rotor, and face should come off as one assembly. If so, then skip this step. Firmly grasp the rotor shaft with one hand and the body of the unit with the other hand and pull the rotor straight out. Considerable force will be necessary to overcome the magnetic field that holds the rotor inside the stator. Use a flathead screwdriver to pry the stator from the body. This is done by inserting the blade of the screwdriver into one of the three recessed areas where the stator meets the body of the unit, and carefully prying the stator out a little bit. Work your way around the stator prying little by little at all three of the recessed points until the stator is removed.
6. Pay attention to the wires connecting the stator windings to the circuit board because you will need to reattach them in the same manner. Note how the four stator ring terminals are all parallel and not touching one another. Also, take note of the circuit and the way it is positioned inside the body. Note how the yaw shaft sits in the bearing and how the brushes make contact with the slip rings.
7. Remove the four small screws connecting the stator wires to the circuit. NOTE: (It is very easy to strip the threads on these screws when you reattach the stator wires. Try to get a feel for the factory torque setting on these bolts because you will want to reattach them in the same manner.)
8. Using external snap ring pliers, remove the snap ring, from its groove, located below the slip rings on the yaw shaft assembly. You may need a screwdriver to assist you in the removal of the snap ring.
9. Once the snap ring is removed, use a hammer and a blunt object to drive the yaw shaft assembly out by hitting it on the top end of the slip ring assembly. (The black plastic area on top of the stack of copper rings.) If this does not work, use a screwdriver to separate the yaw shaft assembly from the body. This may take a little effort so be careful. As you remove the yaw assembly, watch for the ground brush and spring as they may pop out on their own and possibly go flying off somewhere.
10. With the yaw shaft assembly removed, use a  $\frac{1}{4}$ " socket or nut driver to remove the two screws holding the circuit to the body casting. These are the screws on the left and right side of the solid metal rectifier. Note how the right screw secured the green wire from the circuit to the body. This wire is the ground lead for the circuit.
11. Remove the circuit from the body. Be careful with the circuit because it is still connected to a ribbon cable.
12. Use a  $\frac{5}{16}$ " socket or nut driver to remove the potentiometer nut on the side of the unit. (The socket or nut driver may need to be modified by grinding or filing it to make a thinner wall of material on the tool. This will allow it to fit into the body contour to remove the nut.)
13. Note: If you have an unregulated unit, then use the  $\frac{1}{4}$ "-20 x  $\frac{3}{4}$ " SS blade screw and the  $\frac{1}{4}$ "-20 SS jam nut to plug the potentiometer hole. Be sure to apply a good amount of silicone to the screw before tightening.
14. Gently push the potentiometer from the unit. The potentiometer should give way very easily. Clean off the excess silicon on the turbine.
15. Use a blunt object to LIGHTLY push the LED into the body. Press only on the LED and not the black clip holding it. The LED should give way very easily. Pull the black LED clip from the turbine body. Clean off the excess silicone on the turbine.
16. There should be nothing attached to the turbine body at this point except the yaw bearing and snap ring. Turn the body face-side down and shake it to remove any debris.
17. Place the replacement circuit next to the front of the body. Holding the ribbon cable, carefully separate the two LED wires, as a pair, from the potentiometer wires. Leave about 7" of ribbon cable intact (in the five wide form) from the circuit.
18. Straighten out the wires that lead to the LED by running it between your thumb and index finger. Gently squeeze the wires near the LED together to allow it to properly fit into the LED clip.

19. Hold the empty body with the yaw hole on the top, and gently run the LED wire down the body. Push the LED through the LED hole.
20. Push the black LED clip onto the LED until you feel it snap lightly into place. The tip of the LED should stand approximately 1/8" above the clip.
21. Place silicone around the perimeter of the LED clip and gently pull the wire from the inside of the unit while guiding the LED with clip towards the hole.
22. Gently press the LED clip down until the assembly slides into the hole. None of the four tabs should catch on the edge of the hole. Use a dental pick or its equivalent to press down the LED CLIP flush into the unit. DO NOT push down directly on the LED. The LED clip should be flush with the body and the LED should stick out 1/8" above the clip.
23. Remove the excess silicone off of the body with a moist rag. Be careful not to push in the LED while cleaning the turbine.
24. Place a bead of silicone at the base of the threads of the new circuit potentiometer.
25. Insert the potentiometer into the hole on the side of the unit and place the star washer and the nut over the threads. Align the potentiometer slot with the dimple on the body to indicate the default setting for the internal regulator. (new circuits are preset for regulation at 14.1 volts and 28.2 volts, for 12 and 24 volt units, respectively) Holding the potentiometer only from the inside, being careful not to hold onto the potentiometer wires, tighten the nut until the potentiometer is snug. Be careful that the potentiometer wires do not interfere with the LED wires and make sure that the LED does not pull out of the clip when you tighten the potentiometer. Be careful not to crush the LED wires or potentiometer wires between the body casting and the potentiometer.
26. Thoroughly clean the flat surface on the body where the circuit is mounted. Also, clean off any debris from the insulator pad on the circuit. It is very important that the contact area between the circuit and body be free from any debris. Any miscellaneous metal particles in this area could short out the turbine and cause it to malfunction.
27. Be very careful with the insulator pad on the circuit. Check to make sure the pad is not cut or damaged. The pad must electrically insulate the rectifier from the body in order for the turbine to work properly. Any damage to the pad that allows an electrical contact between the rectifier and the body will cause the turbine to malfunction.
28. Place the circuit in its proper position with the two screw holes lined up. Make sure the insulator pad is still in its proper place and not bent over in any way.
29. Begin tightening the two #8-32 x 1" rectifier mounting screws to the body. Be sure the black wire is on the outside of the left screw and that it is not pinched between the rectifier and body. Make sure the right screw connects the ring terminal on the green wire to the top of the circuit.
30. Tighten the two screws so they snugly secure the circuit to the body. DO NOT over-tighten the screws to the point where the white plastic pieces are crushed!
31. Check that the ring terminal on the end of the black lead attached to the bottom of the rectifier plate does not touch the body. This is especially important if you are using a positive ground for your system because you will have a short if the black lead touches the body.
32. At this point it is advantageous to stand the body on end with the body opening pointing straight up. Sitting in a chair and holding the body between your knees with the tail resting on the floor can do this.
33. Lift the two brushes from the two slots on the rectifier. Insert a plastic spring standoff and then a spring in each of the two slots. Place the brushes on top of the springs and then push up and down to make sure the spring and brush are working together. Check that the spring remains vertical and is not sliding out of the rectifier slot.
34. Make sure the top brush wire is under the copper strips and is not pinched in any way.
35. Make sure the bottom brush wire is between the rectifier and the circular ground sleeve on the body casting. You may need to use a small screwdriver to push this wire into its proper position. Be sure that the brush moves freely inside the slot.
36. Insert the ground brush and spring into the circular ground sleeve on the body casting. Be sure that the spring side is inside the hole and the solid brush end is sticking out of the hole.
37. Clean any debris from the yaw shaft bearing seat.

38. Clean any grease or oxidation off of the slip rings on the yaw shaft with a Brillo pad or a piece of emery cloth. Wipe the slip rings with a rag. This procedure will improve the electrical contact between the brushes and the yaw shaft.
39. Make certain each brush properly operates in its brush holder prior to inserting the yaw shaft. Next, partially insert the yaw shaft assembly into the bearing hole. **Be sure to place the external snap ring over your slip rings prior to setting your brushes.** While holding the brushes down into their holes, insert the yaw shaft into the hole the rest of the way. This is best performed by securing one brush at a time as the yaw shaft is inserted. You may need to use a rubber mallet to force the yaw shaft back in. Repeat the same operation with each brush until the yaw shaft is back into place. Be careful with the brushes, they are brittle and may break with too much force.
40. Rotate the yaw shaft. Take a close look at each of the brushes to make sure they are properly contacting the appropriate slip ring. Make sure each spring is properly seated in the rectifier slot and that the brush wires are not being pinched.
41. Use a snap ring tool to place the snap ring into the groove on the yaw shaft.
42. **Make certain the yaw shaft is fully seated in the yaw bearing and the external snap ring is fully seated in its groove.**
43. If the stator, rotor, and face are together as one assembly then you can skip this step. Place the stator over the face with the holes in the face aligned with the slots in the stator. Use the edge of a workbench to support the stator laminates while you hit the front of the face casting with a rubber mallet (be sure face holes are aligned with the slots in the stator). Work your way around the face until the stator is completely attached to the face casting. DO NOT hit or support the stator by its windings. It is very important that you only hit and support the stator by its laminates. Insert the rotor into the face so that the magnets pull it into the stator. The rotor may have pulled the stator up from the face casting so you need to repeat the above procedure to reinsert the stator into the face. At this point the stator, rotor, and face should be one complete assembly.
44. Turn the body face-side down and shake out any miscellaneous debris or use an air hose to clean out the inside. Check the magnets on the rotor to make sure there is not any metal such as a washer stuck to a magnet. Any metal debris inside the turbine could cause the turbine to self-destruct during operation.
45. Reconnect the stator wires to the circuit using the four small socket screws. Hold the body as described in step 32. Connect the four wires in the following order from left to right: green, black, white, and yellow. It is important that the four ring terminals are all parallel and not touching one another. Make sure the circular thermostat(s) is not touching any of the surrounding ring terminals.
46. Carefully tighten each of the four screws making sure that the connectors maintain their proper alignment. DO NOT over-tighten these screws because you will strip the threads on the circuit tab. Tighten the screws to the point where a light push in either direction on the ring terminal does not rotate the screw or ring terminal.
47. If you do strip the threads on the circuit tab, use one of the four small phillips head screws, included with the circuit kit, to attach the stator wire to the circuit. Be very careful not to strip the threads again with the phillips head screw.
48. After making sure the two brushes are not touching one another, spin the rotor by hand to check for a short. If it spins smoothly then everything is O.K. If it does not spin smoothly (cogs), then you have either improperly installed the circuit or the circuit is defective. In the case where the turbine does not spin smoothly (cogs), check the stator wires and the rectifier plate for any indication of a short. (In order to understand the difference between spinning smoothly and cogging, it is best to perform a cog test. Touch the black and red yaw wires together while spinning the rotor as quickly as you can by hand for a sample of the regulation resistance. You should feel resistance while spinning the rotor when the black and red wires are touching. You should feel very little resistance while spinning the rotor when the black and red wires are not touching. If you are feeling regulation resistance when spinning the rotor with the wires not touching, then you have a short somewhere inside the unit.)
49. Push the four stator wires inside the body so they will not interfere with the circuit or rotor. It is O.K. to slightly bend the four ring terminals on the stator wires in order to tuck the wires into the body.
50. Replace the alternator assembly on the body casting, being careful not to pinch any copper stator wires between the face and body. Align the holes, placing the three socket head face screws in the face and hand-tighten. Place the supplied o-ring between the castings and then, using a mallet, tap the face back onto the body. NOTE: Make sure that when you close the castings, the wires do not rub on the rotor assembly or yaw slip rings.
51. Tighten the three face screws (approximately 35 in-lbs. of torque). Place Tef gel on face and yaw bolts.

NOTE: To test the turbine, do the following:

Connect a voltage meter to the positive and negative leads and spin the shaft by hand so that it is spinning very fast. It is easier to spin the shaft if the nut is attached to the rotor. The nut provides more surface area for you to grip your hand around. It should spin smoothly with little or no resistance. The voltage meter should read about 3 - 4 volts while spinning the shaft. Also note the LED under the belly should glow. Touch the black and red yaw wire together while spinning the rotor for a sample of the regulation resistance. You should feel resistance while spinning the rotor when the black and red wires are touching. You should feel very little resistance while spinning the rotor when the black and red wires are not touching. If you are feeling regulation resistance when spinning the rotor with the wires not touching, then you have a short somewhere inside the unit. In this case, take the face off the unit and try to find the short.