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## *Southwest Windpower*

### Instruction Sheet - AIR-X Circuit Replacement Kit

#### Tools Required

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

#### Supplied With Repair Kit

- 1 - AIR-X circuit assembly
- 1 - Front cover o-ring
- 1 - External snap ring
- 2 - #8 - 32 x 1" rectifier mounting screw
- 3 - #6 - 32 x  $\frac{1}{4}$ " stator wire socket head screw
- 3 - #10 - 24 x 1- $\frac{1}{2}$ " face screw with Nyseal (Marine Only)
- 1 - Ground brush
- 2 - Brush spring
- 2 - Plastic spring base
- 2 - Plastic zip ties
- 1 - Insulator pad (spare)

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

**Try to get a feel for the tightness of each bolt as you remove it in order to get a feel of how tight they need to be when the parts are reinstalled. Be careful not to over-tighten.**

**Note where and how the stator leads are zip-tied to the stator coils in order to install new ones if it is necessary to clip the zip-ties to identify the leads.**

1. Disconnect the wires and remove the turbine from the mount as per the AIR-X Owner's Manual.
2. Remove the blade assembly with a  $\frac{5}{16}$ " hex key.
3. Using the  $\frac{5}{32}$ " hex key or Allen socket, remove the three screws from the 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 a single assembly. If so, 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. Moderate 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. Carefully note the routing of the wires connecting the stator windings to the circuit board. Note the parallel orientation of the three, stator ring-terminals and how they are isolated from one another. Also, take note of the circuit and the way it is positioned inside the body. Note how the yaw shaft is seated in the bearing and how the brushes make contact with the slip rings behind the yaw shaft. Take note of the **Exploded View** at the end of this document for part identification.
7. Using masking tape, immediately label the counter-clockwise-most lead as **#1** if it is not already labeled. See **Fig. 1**

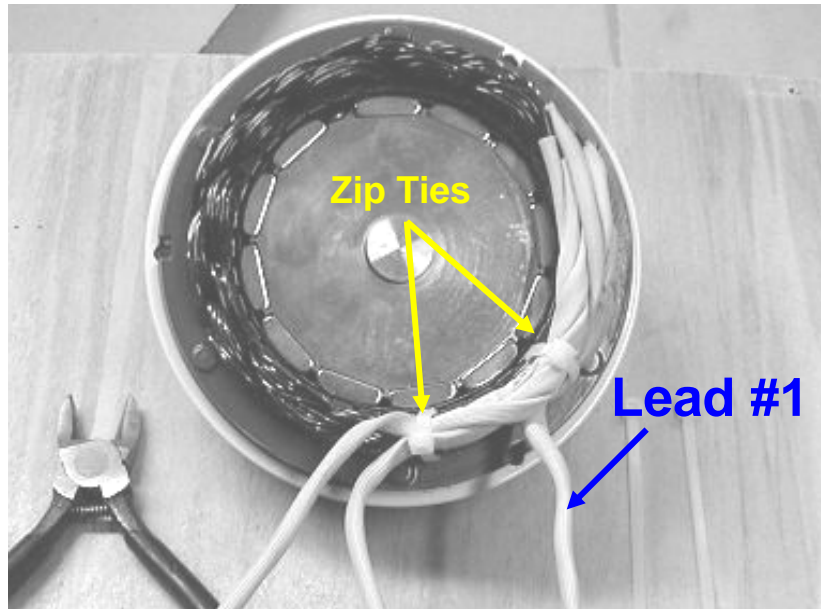


Fig. 1

8. Using the 7/64" hex key, remove the three small screws connecting the stator wires to the circuit. NOTE: (It is very easy to strip the threads on these screws when reattaching the stator wires. Try to get a feel for the factory torque setting on these bolts. They will need to be reattached in the same manner.)
9. Using the external snap ring pliers, remove the snap ring from its groove located below the slip rings on the yaw shaft assembly. A screwdriver may assist in the removal of the snap ring. See Fig. 2

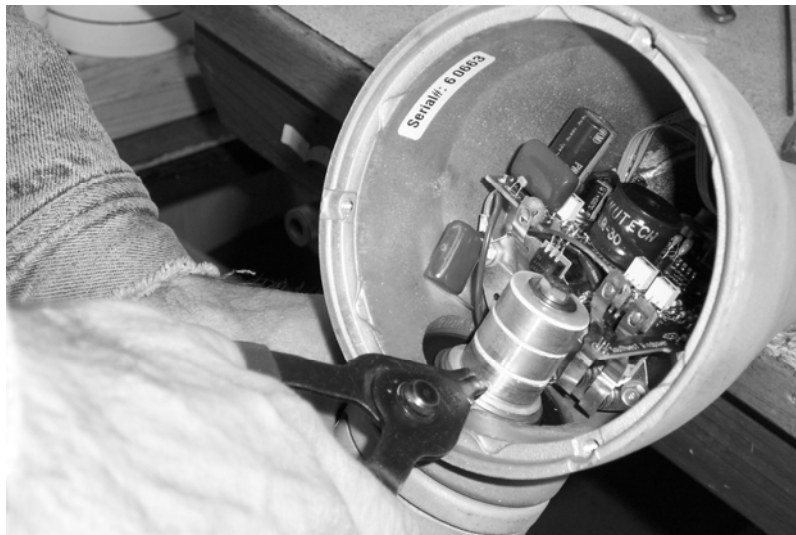


Fig. 2

10. 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, or use a screwdriver to separate the yaw shaft assembly from the body. This may take a little effort; so be careful. As the yaw assembly is removed, watch closely for the earth-ground brush and spring as they may release and be difficult to find. See Fig. 3

**VERY IMPORTANT:** If the yaw shaft requires more than moderate force to remove, or if there is concern for the well-being of the balance of components due to the force that is necessary to remove the yaw shaft, DO NOT attempt to force the yaw shaft. Damage to the body, yaw shaft, or both may result. Contact Southwest Windpower (928-779-9463) or nearest representative for advice on how to proceed or for alternate solutions to the replacement of the circuit. You may be asked to return the unit to the factory for repair.



Fig. 3

11. With the yaw shaft assembly removed, use a ¼" 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.
12. Carefully remove the circuit from the body as it is still connected by ribbon cable to the potentiometer and LED light. See Fig. 4

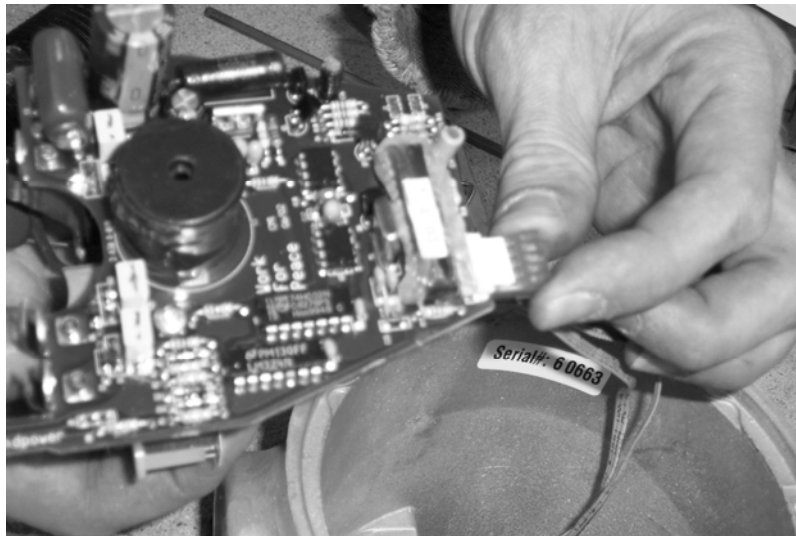


Fig. 4

13. Unclip the ribbon cable from the circuit, leaving the ribbon cable attached to the body via the LED and the Potentiometer mounts.
14. There should be nothing attached to the turbine body at this point except the ribbon cable, the yaw bearing and the yaw bearing snap ring. **Turn the body open-side down and shake it to remove any debris.**
15. Thoroughly clean the flat surface on the body where the circuit is mounted. Also, clean 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 debris. Any miscellaneous metal particles in this area could short-circuit the turbine and cause a malfunction.
16. Inspect the new circuit. **Carefully unpack and examine the circuit to ensure that the small, insulating stand-offs and springs are located beneath the brushes on the circuit board.** If any pieces are missing from the circuit or the bolt package, please contact the factory. Owners of serial numbers below 68000 will note that the new circuit is dissimilar to the old one in several ways. While the circuit itself is interchangeable for all models, the PIC or programmable part of the circuit is specific to your serial number range. Ensure that the packaging literature refers to your unit's serial range. If not, contact the factory as in **step 10**. Be very careful with the insulator pad on the new 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.

17. Connect the ribbon cable clip to the new circuit. The clip has a polarity that is important to observe. The correct connection orientation is shown in **Fig. 5** below:

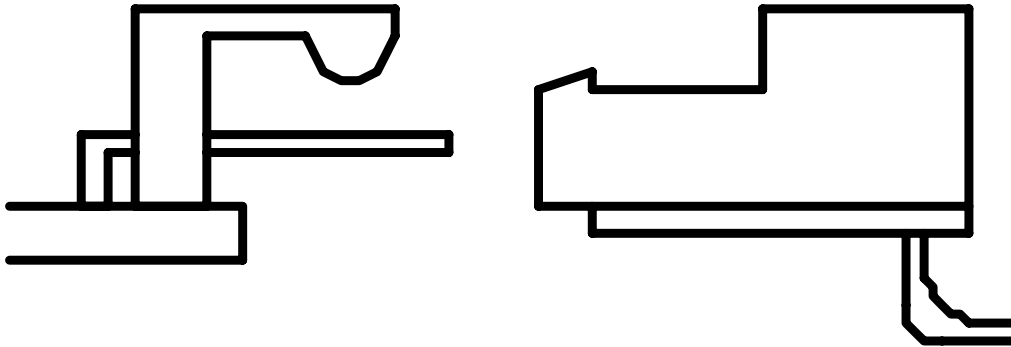


Fig. 5

18. Place the circuit in position in the body aligning the two mounting screw holes. Ensure that the insulator pad adheres to the rectifier and is not peeled or bent away from the rectifier. While orienting the circuit in the turbine, try to tuck the ribbon cable down towards the tail of the body to prevent it from being pinched as the circuit is bolted down. See **Fig. 6** below for correct orientation.

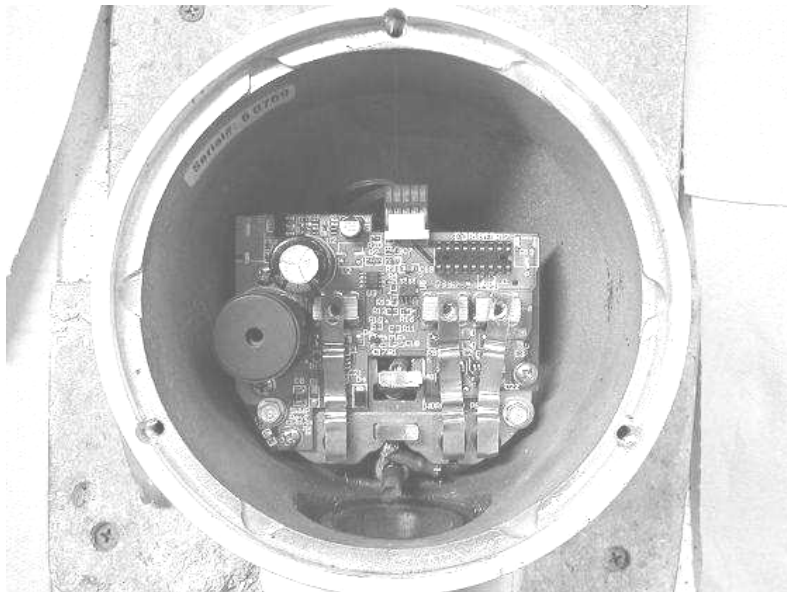


Fig. 6

19. Tighten the two screws so they snugly secure the circuit to the body. **DO NOT** over-tighten the screws as the white, plastic insulators may distort and cause future malfunction.
20. Ensure that the ring terminal on the end of the red wire attached to the bottom of the rectifier plate does not touch the body. This will connect battery positive to the turbine case, will short-circuit the turbine, and cause a malfunction.
21. At this point it is advantageous to stand the body on end with the body opening pointing straight up. Sit in a firm chair and hold the body between your knees with the tail resting on the floor.
22. 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 springs and brushes are working together. Check that the spring remains vertical and is not sliding out of the rectifier slot.

23. Make sure the bottom brush wire is between the rectifier and the circular ground sleeve on the body casting. A small screwdriver may be necessary to push this wire into its proper position. Be sure that the brush moves freely inside the slot.
24. 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 is extending from the hole.
25. Clean any debris from the yaw shaft bearing seat.
26. 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.
27. Ensure that 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. **Place the external snap ring just over the slip rings of the yaw shaft prior to setting the brushes.** While holding each brush in its respective guide, insert the yaw shaft into the hole the rest of the way. See Fig. 7. Secure one brush at a time as the yaw shaft is inserted. A rubber mallet may be necessary to tap the yaw shaft in place once all of the brushes are completely seated. Repeat the same operation with each brush until the yaw shaft is fully seated. Use caution with the brushes, they are brittle and may break with too much force applied. Ensure that the gaps between the slip rings do not “grab” the brushes while the yaw is being installed.

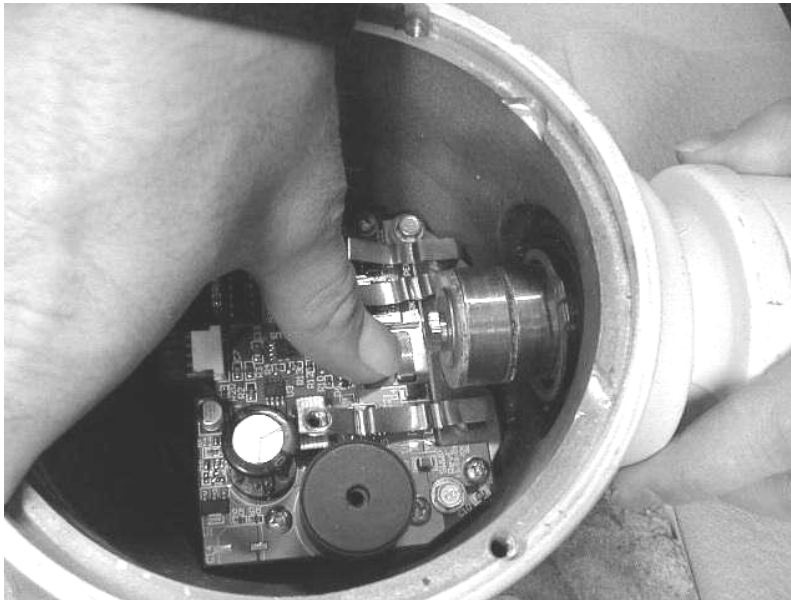


Fig. 7

28. 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.
29. Use the snap ring pliers to place the snap ring into the groove on the yaw shaft. **Make certain the yaw shaft is fully seated in the yaw bearing and the external snap ring is fully seated in its groove.**
30. If the stator, rotor, and face are together as one assembly then 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 striking the front of the face casting with a rubber mallet (Ensure that the face holes are aligned with the slots in the stator). Work your way around the face until the stator is completely seated in the face casting. **DO NOT strike or support the stator by the copper windings.** IMPORTANT: Only strike or 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. Repeat the above procedure to reinsert the stator into the face. At this point the stator, rotor, and face should be one complete assembly.
31. Check the magnets on the rotor to make sure there is no metal stuck to the magnets. Any metal debris inside the turbine could cause the turbine to short-circuit and malfunction.

32. Orient the body as described in step 20. If at least two of the stator leads are labeled, using the three, small socket-head screws, connect the wires in the following order from left to right on the circuit board: **#2 - Left Terminal, #3 - Center Terminal, #1 - Right Terminal**. See **Fig. 8** below for clarity. It is important that the three ring terminals are parallel and cannot contact one another once tightened.

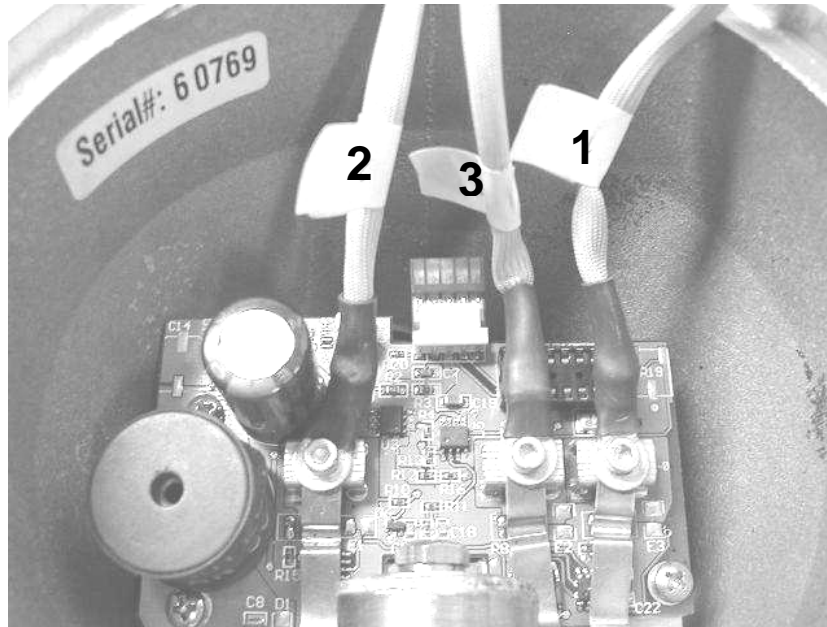


Fig. 8

If at least two of the stator leads are unlabeled, perform the following steps on the stator to identify the stator leads:

- A) Immediately label the counter-clockwise-most stator lead **#1**. See **Fig. 1**
- B) Make careful observation of the location and manner of connection of the white plastic zip ties. Below the wire bundle, there are specific gaps in the copper windings that accommodate the zip ties. Be certain to re-use these locations.
- C) Using the diagonal cutters, very carefully snip and remove the zip-ties holding the stator wires in a bundle on top of the copper windings. Do not damage the copper windings.
- D) Untwine the leads from the wire bundle and lay out for labeling as shown in **Fig. 9** below. Label the wire leads **1, 2, and 3** near their ring terminal connectors.

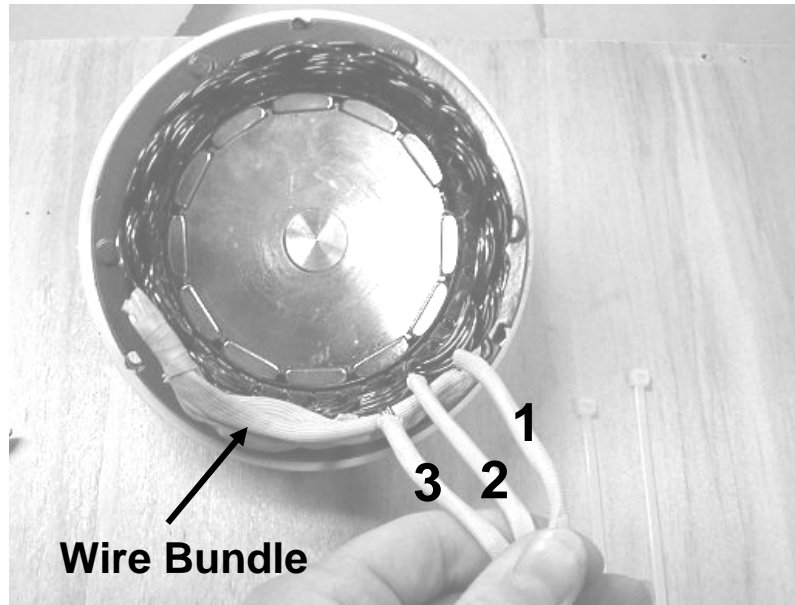


Fig. 9

- E) Once labeled, lay the three leads back across the wire bundle and secure using the zip ties provided.
- 1) First, capture all three leads with the zip tie in the counter-clockwise-most wide-slot in the copper windings beneath the wire bundle. See **Fig. 1**
  - 2) Next, Capture only the #2 and #3 leads with the zip tie in the clockwise-most wide-slot in the copper windings such that the stator matches the illustration in **Fig. 1**. Now perform **step 32**.
- 33.** Carefully snug each of the three stator wire mounting screws ensuring that the connectors maintain the correct alignment. **DO NOT over-tighten these screws as the threads are easy to strip.** 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.
- 34.** After ensuring that the two copper brushes are not contacting one another, spin the rotor by hand to check for a short-circuit. If the rotor does not spin smoothly (cogs), then the circuit is either improperly installed 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. Perform **step 1** from the **TESTING** section toward the end of this document.
- 35.** Push the three stator wires inside the body so they will not interfere with the circuit or rotor. See **Fig. 10**



Fig. 10

36. Assemble the AIR-X Stator Assembly to the body. Loosely place the alternator on the body opening in such a manner that the wire bundle of the stator is oriented toward the top of the body casting. Slowly re-orient the alternator assembly to align the alternator mounting bolt holes of the face with the mounting holes in the body. Be sensitive to “grabbing” of the alternator assembly during this step. Grabbing may indicate the stator wires are interfering with the circuit.
37. Loosely thread in the face bolts. Place the black O-ring around the perimeter of the AIR-X Stator Assembly and loosely fit it into the gap between the face and body castings.
38. Once the O-ring is in place tighten the 3 face bolts (approximately 35 in-lbs of torque).

**TESTING: To test the turbine, do the following:**

- 1) Spin the shaft by hand so that it is spinning very fast. Periodically touch the black and red yaw wire together while spinning the rotor for a sample of the regulation resistance.
  - a. There should be resistance to rotation while spinning the rotor when the black and red wires are contacting one another.
  - b. There should be very little resistance to rotation while spinning the rotor with the black and red wires disconnected.
  - c. If there is cogging, or braking resistance while spinning the rotor with the wires disconnected, then there is a short-circuit in the unit. In this case, remove the face and attempt to locate the short.
- 2) Connect the red and black turbine wires to the positive and negative of the battery terminals or an adjustable voltage supply. Immediately upon making the battery connection, the AIR-X LED light should blink two times.
  - a. During these two blinks, the AIR-X applies the internal electrical brake, and the rotor should be extremely hard to rotate. After the two blinks, the rotor should again spin freely.
  - b. If the LED does not blink when the turbine is connected to a battery or power supply, the circuit is defective or there is an internal open-circuit.
  - c. If the rotor shaft spins freely during the first two LED blinks, the circuit is defective. If the circuit does not spin freely after the first two blinks, the circuit is defective or there is an internal short-circuit.

## Exploded View:

Note: Exploded view shown is that of AIR 403 and AIR Industrial. Your AIR-X will not precisely match the drawing below but it may serve as a reference to define terms used in the AIR-X Circuit Replacement Kit instructions.

