

One - Important Safety Instructions

READ THESE INSTRUCTIONS IN THEIR ENTIRETY BEFORE ASSEMBLING, INSTALLING OR OPERATING YOUR AIR BREEZE

- 1) SAVE THESE INSTRUCTIONS. This manual contains important instructions that must be followed during assembly, installation and maintenance.
- 2) Read, understand and respect all warnings.
- 3) Do not install Air Breeze on a windy day.
- 4) If unusual noise or operation is experienced turn off machine and contact authorized service personnel.
- 5) During assembly and installation properly torque all fasteners.
- 6) Use only proper grounding techniques as established by the NEC.
- 7) Properly complete the warranty registration card.
- 8) Breeze must be installed in accordance with this manual and local and national building codes. Failure to comply with this manual and local codes may affect and possibly void your warranty.
- 9) Rotating blades are a serious mechanical hazard. Install Breeze so no one can come into contact with blades.
- 10) Observe wire size and fuse recommendations listed in the Wiring Section of this manual.

In this manual you will see the following icons:



IMPORTANT: Indicates instruction or advice that is critical for correct assembly or operation. Damage to equipment may result if not heeded.



TIP: Indicates instruction or advice that may simplify or ease task or operation.



PROFESSIONAL INSTALLATION: Indicates a task requiring specialized skills or equipment; therefore Southwest Windpower recommends hiring professional services.



WARNING: Indicates risk of severe injury or death or severe damage to equipment is possible – proceed with caution and follow instructions.



LAND USE: Specific to Land Use.



MARINE USE: Specific to Marine Use.

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Air Breeze Technical Specifications

Model	Air Breeze
Weight	13 lb / 6 kg
Rotor Diameter	46 in / 1.17 m
Start Up Wind Speed	6 mph / 2.7 m/s
Kilowatt Hours/month	38 kWh/month @ 12 mph / 5.4 m/s avg. wind speed
Maximum Wind Speed	110 mph
Rated Power	200 watts @ 28 mph / 12.5 m/s wind speed

Voltage Regulation Set Point (factory setting)

12 Volt Systems	14.1 Volts
24 Volt Systems	28.2 Volts
48 Volt Systems	56.4 Volts

Regulator Adjustment Range

12 Volt Systems	13.6 to 17.0 Volts (approximately)
24 Volt Systems	27.2 to 34.0 Volts (approximately)
48 Volt Systems	54.4 to 68.0 Volts (approximately)

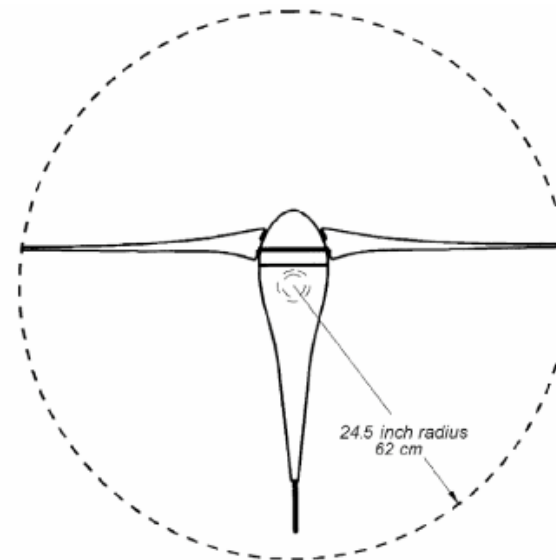
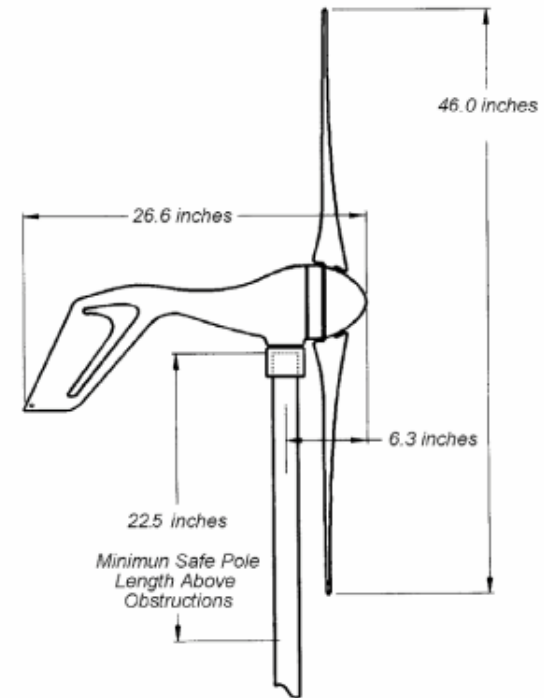
Recommended Fuse Size

12 Volt Systems	50 amp (slow blow)
24 Volt Systems	25 amp (slow blow)
48 Volt Systems	15 amp (slow blow)

Tower Loads

Shaft Thrust* 52 lb @ 100 mph wind speed (230 N @ 45 m/s)

*Value does not include safety factor. SWWP recommends safety factor of 1.5



Two - Air Breeze Turbine Assembly

Your Air Breeze is delivered partially assembled. Assembly requires mounting the blades on the blade hub, securing the hub to the turbine body and installing the nose cone on the blade hub. The necessary hex key (Allen) wrenches are furnished with Air Breeze.

Torque Specifications:

Blade to hub screw, 1/4 - 20 x 1.25, socket head screw 10 ft-lbs (13.6 Nm)

Hub to rotor nut, 5/8-18, 50 ft-lbs (68 Nm)

Yaw clamp bolts, M5-0.8 x 35 mm 6 ft-lbs (8 Nm)

Start the assembly by mounting the blades (Item 1) to the blade hub as shown in **Fig. 1**. Place a nylock nut (Item 4) in the hexagonal detent on the back of the blade hub while positioning the blade on the hub.

The blades must be “tilted” into position on the hub and can only be installed in one orientation.

Place a washer (Item 2) on a 1/4 - 20 socket head screw (Item 3) and coat the screw threads with Tef-Gel. Pass the screw through the base of the blade and screw it into the nylock nut. Tighten the screw to 10 ft-lbs (13.6 Nm). Repeat for the remaining two blades. Nylock nuts may only be used one time; replace after each use.



IMPORTANT: Tef-Gel is a corrosion inhibitor and is especially important in marine applications.

If Air Breeze is to be installed on a “tilt-up” tower mount the blade/hub assembly to the turbine now. Coat the alternator rotor shaft threads and blade hub bore with Tef-Gel and slide the hub onto the shaft. Start the 5/8-18 hub nut on shaft threads and “spin” the hub completely onto the turbine alternator shaft. Fully tighten the hub to 50 ft-lbs (68 Nm) by inserting a 5/16 inch hex key wrench in the turbine alternator shaft and turning the shaft while turning the blades.

If Air Breeze is to be installed after the tower is erected, it will be safer and easier to first install the turbine body on the tower and then install the hub/blade assembly. This will avoid attempting to mount the turbine while the blades are spinning – a dangerous condition.



WARNING: Don't attempt to mount the turbine while blades are spinning.

Snap the nose cone into position over the outside edges of the blade hub. Make sure all three edges of the nose cone snap over the edge of the blade hub. After installation tug on the nose cone to make sure it is securely attached.

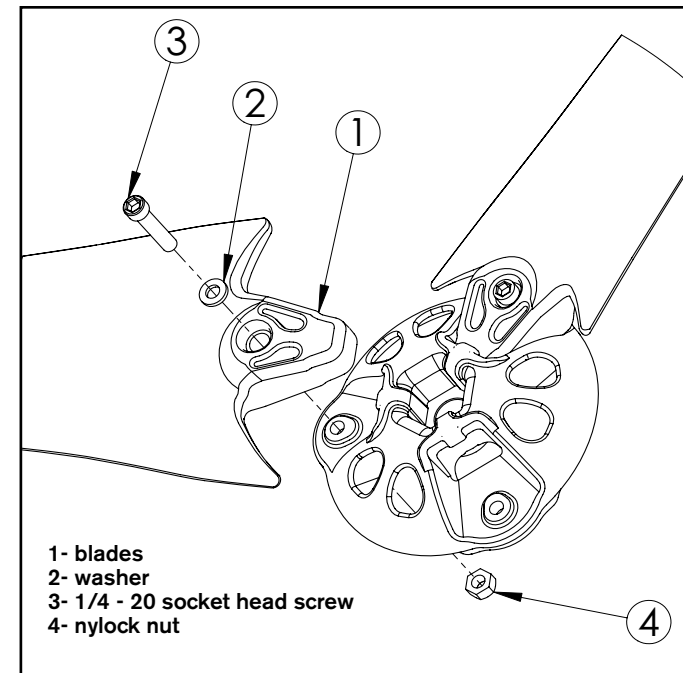


Fig. 1 Air Breeze Blade Attachment Detail.

Three - Air Breeze Siting

Small changes in wind speed can have a dramatic effect on power production. The siting of your wind turbine should be carefully considered. Each installation is different and is often a compromise between tower height, distance from the battery bank, local zoning requirements and obstacles such as buildings and trees.

In general the higher the tower the greater the wind speed and ultimately power production. However, towers are expensive and can easily exceed the cost of the turbine.

The minimum recommended tower height is 25 ft (7.6 m) on open ground or 20 ft (6 m) above nearby obstructions. **(Fig. 2)** Try to locate the wind turbine in the “cleanest” turbulent free air as possible. Turbulence will reduce the efficiency of the wind turbine and may accelerate wear on rotating components.

Safety must be the primary concern when selecting the mounting location. Install Air Breeze so there is no possibility of accidental contact with rotating blades even if it requires installing the wind turbine in a less than ideal location. Safety has precedence over efficiency.



WARNING: Install Air Breeze so there is no possibility of accidental contact with rotating blades even if it requires installing the wind turbine in a less than ideal location.

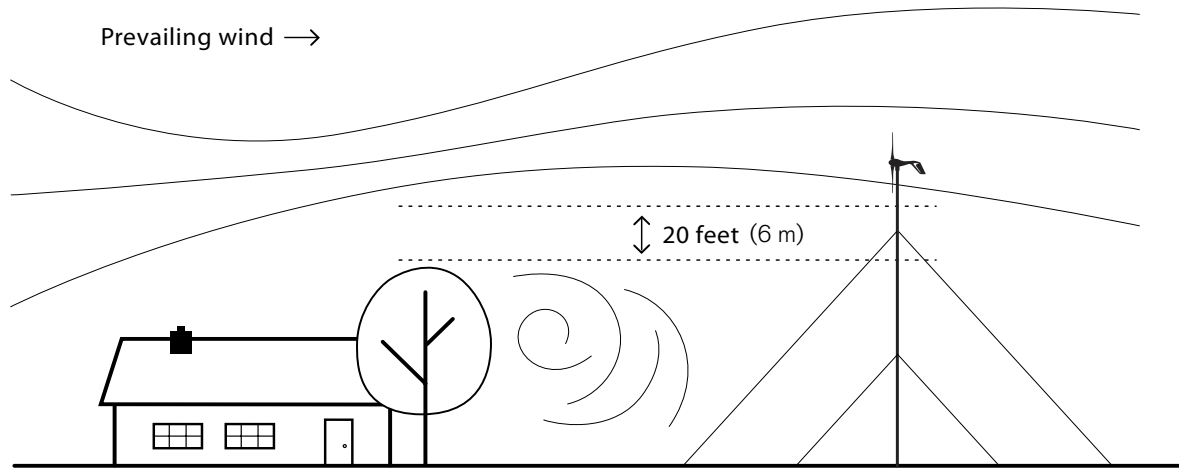




Fig. 2 Optimal Air Breeze location.

Four - Air Breeze Towers

The Air Breeze is designed to mount on tubing or pipe with a nominal 1.875 – 1.900 inch outside diameter. This dimension enables constructing a tower from a range of readily available materials including 1 1/2 inch Schedule 40 pipe and 2 inch SS-20 galvanized fence tubing (0.090 inch wall thickness). Under no circumstances should plastic pipe be used to construct a tower.

 **WARNING:** Plastic pipe should NEVER be used to construct a tower.

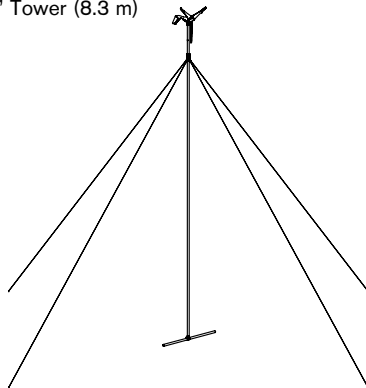
 **IMPORTANT:** User manuals for towers and tower kits are available online. Southwest Windpower recommends reviewing them to make an appropriate tower selection for your Air Breeze.

4-1 Tower Options

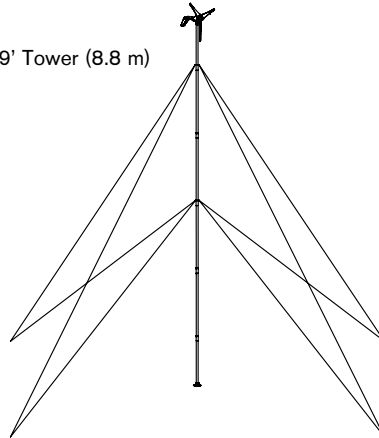
Southwest Windpower offers a number of tower choices for Air Breeze. The following section provides a summary of the available towers. User manuals for the towers and tower kits are available online and the user is encouraged to review them in order to make the most informed tower selection. See **Fig. 3**.

Fig. 3. Tower Options

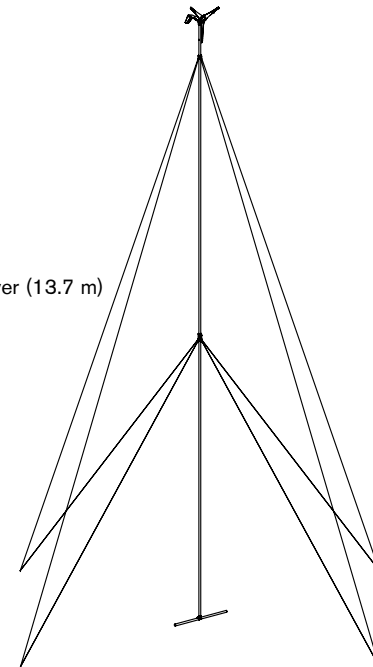
27' Tower (8.3 m)



29' Tower (8.8 m)



27' Tower (13.7 m)



4-1-1 27 (8.3 m) Tower Kit
(Southwest Windpower part number 1-TWA-10-01)

The 27 ft (8.3 m) Tower Kit includes a tower clamp/guy wire assembly and all necessary hardware and fasteners to erect a 27 ft tilt-up tower using pipe or tubing with an outside diameter of 1.875 inch. See **Fig. 4**.

Note: Anchors and pipe or tubing are not furnished with the kit thus the user has the flexibility to use the most appropriate components for the installation.

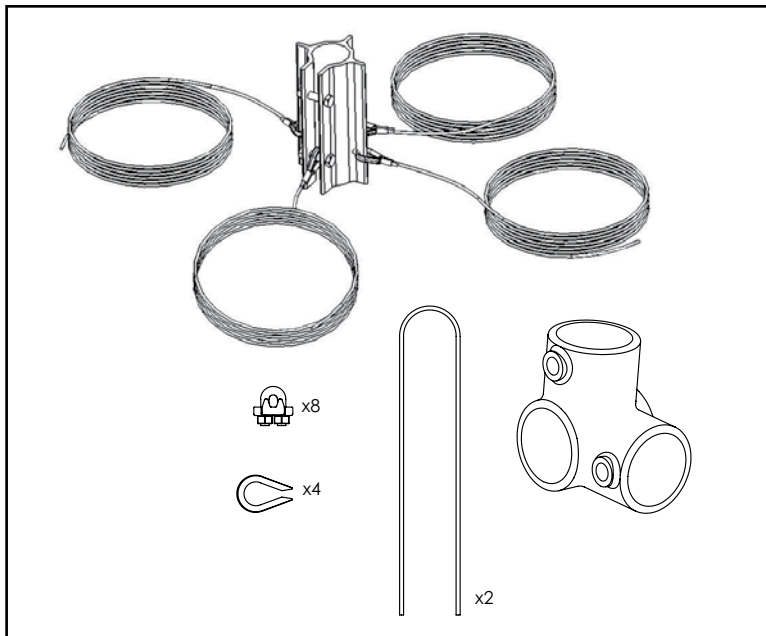


Fig. 4. 27 ft (8.3 m) Tower Kit

4-1-2 29 ft (8.8 m) EZ – Tower
(Southwest Windpower part number 1-TWA-11-01)

The 29 ft (8.8 m) EZ Tower is a complete kit that includes all materials required to assemble a 29 ft guy wire tilt-up tower. Anchors, guy wire assemblies, galvanized steel tubing and all fasteners are included with the kit. See **Fig. 5**.

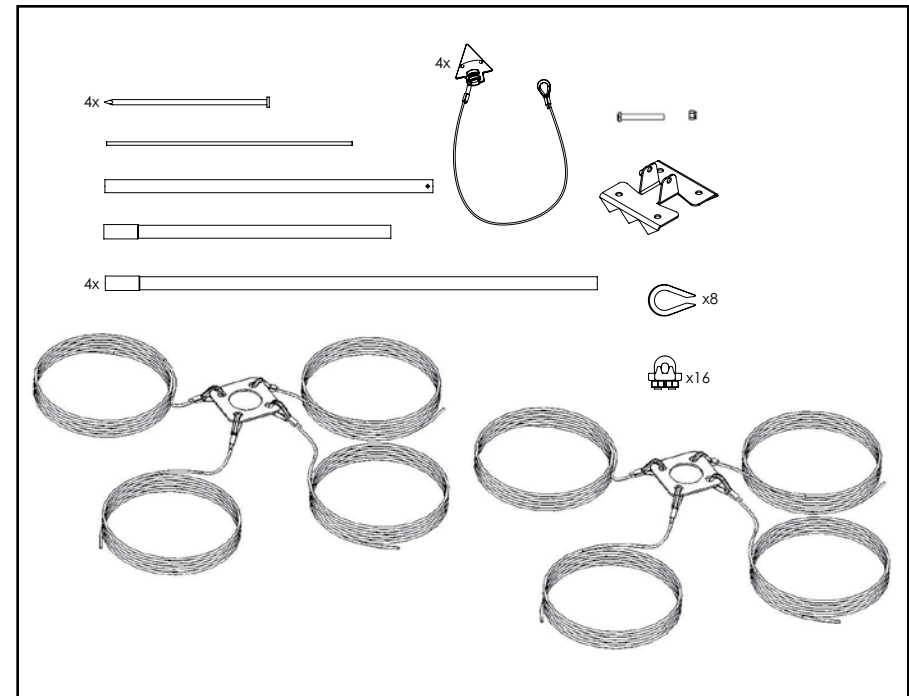


Fig. 5. 29 ft (8.8 m) Tower Kit

4-1-3 45 ft (13.7 m) Tower Kit
(Southwest Windpower part number 1-TWA-10-02)

The 45 ft (13.7 m) Tower Kit includes tower clamp/guy wire assemblies and all necessary hardware and fasteners to erect a 45 ft tilt-up tower using pipe or tubing with an outside diameter of 1.875 inch. See **Fig. 6**.

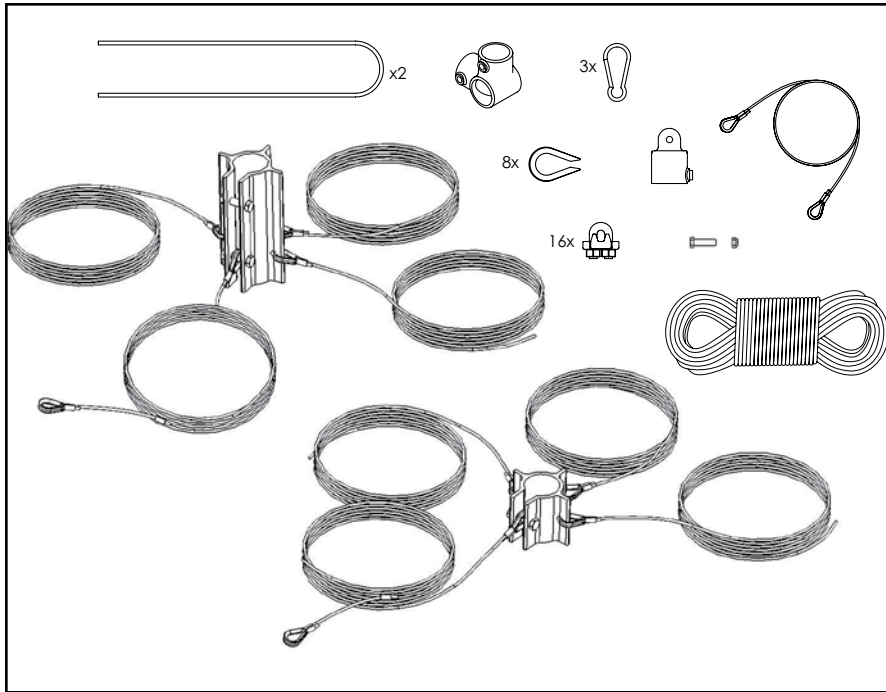


Fig. 6. 45 ft (13.7 m) Tower Kit

4-1-4 Marine Tower Kit
(Southwest Windpower part number 1-TWA-20-02)



The marine tower kit is specifically designed to aid mounting the turbine on a boat deck. Kit includes powdercoated aluminum mast and stays, vibration damping mounts and all necessary marine grade hardware to install the kit. See **Fig. 7**.

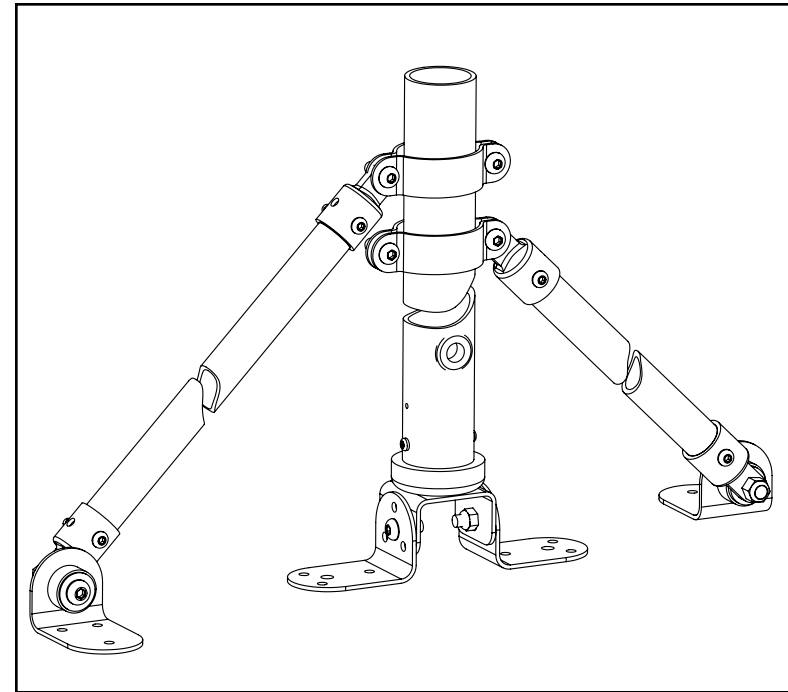


Fig. 7. Marine Tower Kit



IMPORTANT: User manuals for towers and tower kits are available online. Southwest Windpower recommends reviewing them to make an appropriate tower selection for your Air Breeze.

4-1-5 RV Tower Kit
(Southwest Windpower part number 1-TWA-12)

The RV tower kit is a telescoping tower system specifically designed for use with RV's. The un-extended tower is approximately 6.5 ft (2 m) tall and extends to a height of 25 ft (7.6 m) using a twist and lock mechanism. The tower also folds for easy storage. See **Fig. 8**.

! **IMPORTANT:** User manuals for towers and tower kits are available online. Southwest Windpower recommends reviewing them to make an appropriate tower selection for your Air Breeze.



Close-up of RV Tower Kit



Fig. 8. RV Tower Kit

Five - Air Breeze Wiring Options

The recommended way to connect the turbine to your battery bank is to wire the turbine directly to the battery bank to its own set of battery posts. This will allow the turbine to operate independently and the Air Breeze's internal regulator will monitor the battery and maintain the charge as necessary. **Figs. 9 and 10** represent typical single turbine installations. **Fig. 10** includes an up-tower junction box for UL (Underwriters Laboratory) compliance. Contact Southwest Windpower for more information about this configuration.

TIP: Wire turbine directly to battery bank to its own set of battery posts.

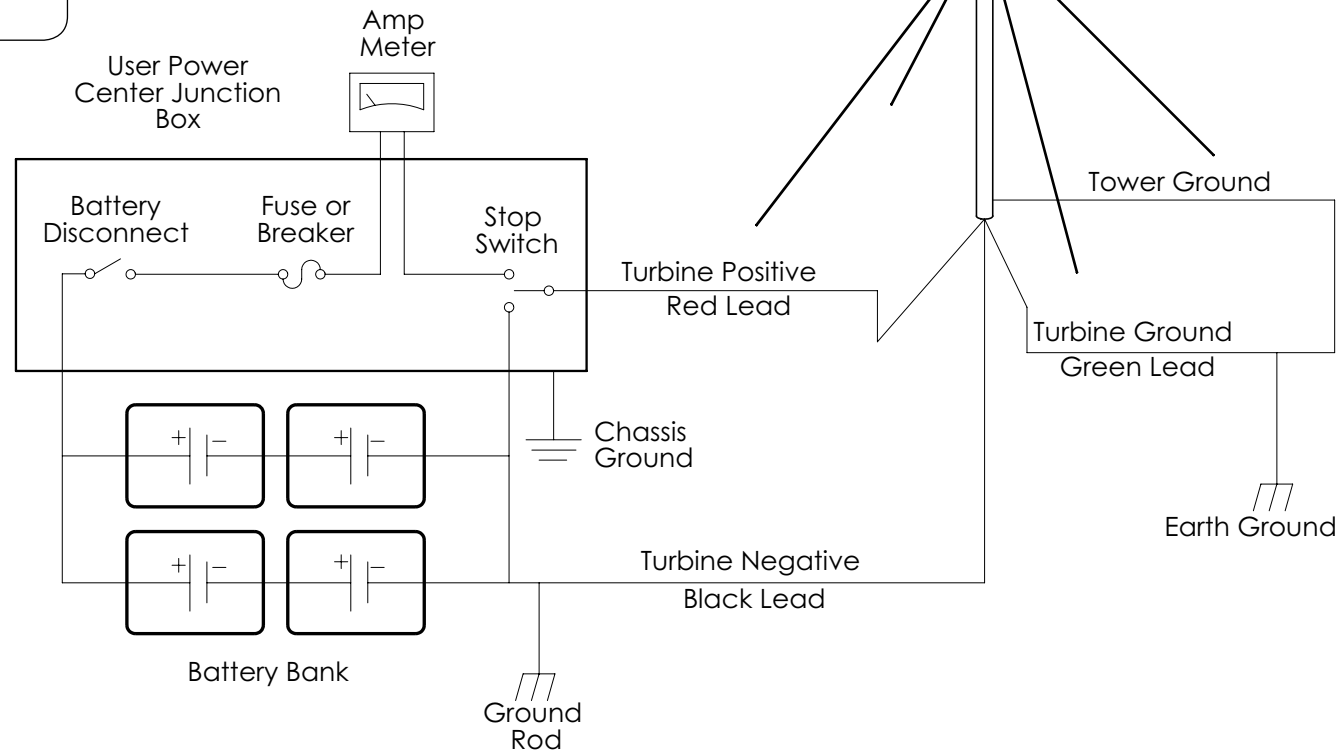


Fig. 9. Single Turbine Installation

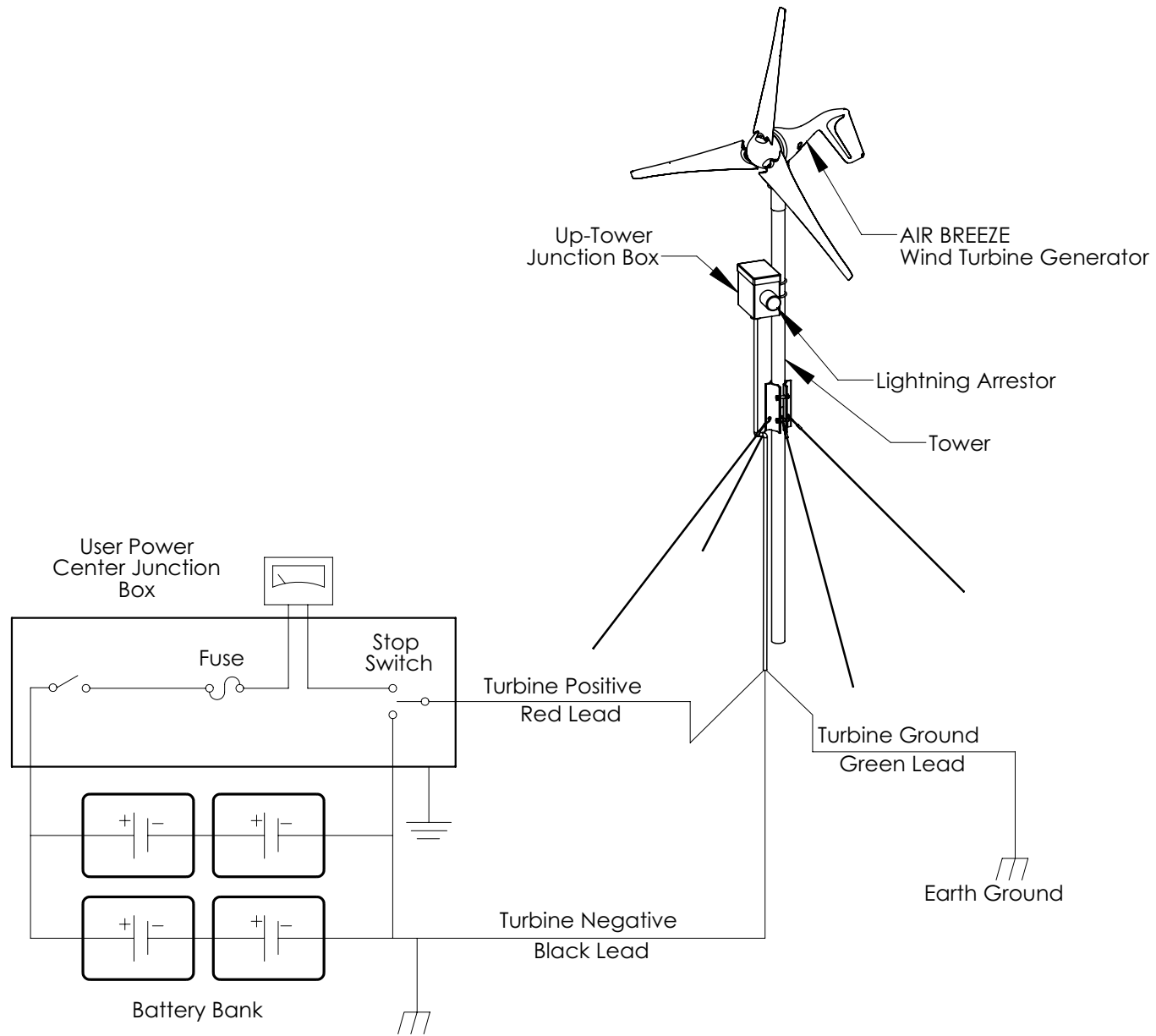
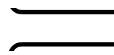


Fig. 10. Single Turbine Installation with Up Tower Junction Box



5-2 Multiple Air Breeze Wiring

It is possible to wire multiple Air Breeze turbines together. A typical multi-turbine system is depicted in **Fig. 12**.

There are two methods used to accomplish this task.

Method One:

Each Air Breeze is treated separately. The turbines will have their own wires, stop switch, fuse and connect directly to the battery using the internal regulator to control charging.

Method Two:

Wire each turbine to a "bus" and then run one set of wires from the bus to the battery. Each turbine's internal regulator or an external diversion type regulator may be utilized. A "bus" system typically results in reduced wire costs.

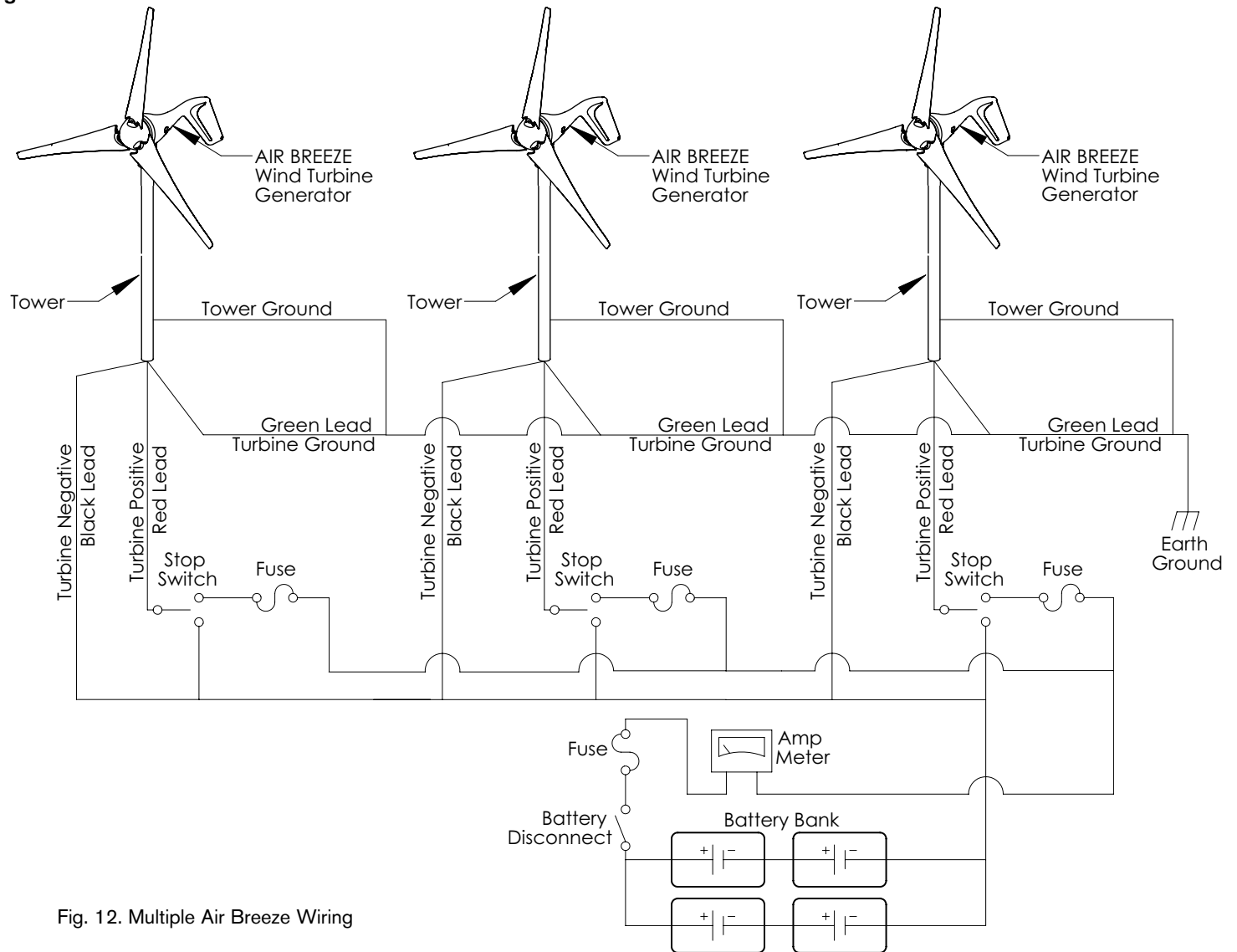


Fig. 12. Multiple Air Breeze Wiring

5-3 Wire Size

All electrical systems lose energy due to resistance in conductors: the wires.

- Large wires have less resistance but can be considerably more costly.
- Resistance losses will also increase with increasing current, therefore, if yours is a high wind site it may be worthwhile to go with a larger size wire to take advantage of greater power production potential of your site.
- Conversely, in low wind sites it may not be cost effective to increase the wire size since power production will be low.

The following wiring sizes provide maximum annual energy losses of 5% or less for sites with a 12 mph average wind speed (assuming the standard Rayleigh distribution of wind speeds) which is sufficient for most sites.

To determine the size wire, measure the distance from the batteries to your Air Breeze. Be sure to include height of the tower. Refer to the appropriate chart for your system voltage and number of turbines and select the wire size.

We recommend these as the minimum wire sizes; for optimal performance use the largest wires that are practical and affordable. Local, state, and national electrical codes have precedence over these recommendations, and must be followed to insure the safety of your system.

Note: Wiring Resistance and Regulation

Depending on your exact system configuration including other charging sources in your system, wiring resistance may affect the regulation set point of the turbine. Higher wiring resistance (smaller wires) will tend to lower the voltage at which the turbine enters regulation and stops charging. The recommended wiring sizes should provide little effect on the regulation set point, but all installations should be observed over time to ensure that the batteries are charged to the proper voltage.



TIP: Smaller wires will lower the voltage at which the Air Breeze enters regulation and stops charging.

12 Volt Systems, AWG / Metric Wire Size mm²

Number of Turbines:	0-30 ft (0-9 m)	30 ft-60 ft (9-18 m)	60 ft-90 ft (18-27 m)	90 ft-150 ft (27-46 m)	150 ft-190 ft (46-58 m)	190 ft-250 ft (58-76 m)	250 ft-310 ft (76-95 m)	310 ft-390 ft (95-119 m)	390 ft-500 ft (119-152 m)
1	8/10 mm ²	6/16 mm ²	4/24 mm ²	2/35 mm ²	1/50 mm ²	0/50 mm ²	00/10 mm ²	000/90 mm ²	000/90 mm ²
2	6/16 mm ²	4/25 mm ²	1/50 mm ²	00/70 mm ²	000/90 mm ²	0000/120 mm ²	***	***	***
3	4/25 mm ²	2/35 mm ²	0/50 mm ²	000/90 mm ²	0000/120 mm ²	***	***	***	***

*** If your system requires this length of wire consider using parallel wires.

24 Volt Systems, AWG / Metric Wire Size mm²

Number of Turbines:	0-30 ft (0-9 m)	30 ft-60 ft (9-18 m)	60 ft-90 ft (18-27 m)	90 ft-150 ft (27-46 m)	150 ft-190 ft (46-58 m)	190 ft-250 ft (58-76 m)	250 ft-310 ft (76-95 m)	310 ft-390 ft (95-119 m)	390 ft-500 ft (119-152 m)
1	14/2.5 mm ²	12/4 mm ²	10/6 mm ²	8/10 mm ²	6/16 mm ²	4/50 mm ²	4/10 mm ²	4/90 mm ²	2/90 mm ²
2	12/4 mm ²	8/10 mm ²	6/16 mm ²	4/25 mm ²	4/25 mm ²	2/35 mm ²	2/35 mm ²	1/50 mm ²	0/50 mm ²
3	10/6 mm ²	8/10 mm ²	6/16 mm ²	4/25 mm ²	2/35 mm ²	2/35 mm ²	1/50 mm ²	0/50 mm ²	00/10 mm ²

48 Volt Systems, AWG / Metric Wire Size mm²

Number of Turbines:	0-30 ft (0-9 m)	30 ft-60 ft (9-18 m)	60 ft-90 ft (18-27 m)	90 ft-150 ft (27-46 m)	150 ft-190 ft (46-58 m)	190 ft-250 ft (58-76 m)	250 ft-310 ft (76-95 m)	310 ft-390 ft (95-119 m)	390 ft-500 ft (119-152 m)
1	14/2.5 mm ²	14/2.5 mm ²	14/2.5 mm ²	12/4 mm ²	12/4 mm ²	12/4 mm ²	10/6 mm ²	8/10 mm ²	8/10 mm ²
2	12/4 mm ²	12/4 mm ²	12/4 mm ²	8/10 mm ²	8/10 mm ²	8/10 mm ²	6/16 mm ²	4/25 mm ²	4/25 mm ²
3	10/6 mm ²	10/6 mm ²	10/6 mm ²	8/10 mm ²	8/10 mm ²	8/10 mm ²	6/16 mm ²	4/25 mm ²	4/25 mm ²

5-4 Stop Switch (Southwest Windpower part number 2-ARAC-101)

Southwest Windpower recommends the use of a stop switch to provide a convenient method for shutting down your Air Breeze. A switch is supplied with each Marine Breeze as standard equipment and is available from Southwest Windpower for the Land Breeze.

Wire the switch as shown in **Fig. 13**. A “break then make” switch must be used. The switch first disconnects the battery and then shorts the turbine output wires together causing the turbine to stop spinning (in high winds the blades may spin slowly). Shorting the turbine does not cause any damage or additional wear.

The stop switch model offered by Southwest Windpower is sufficient for most systems, but it should not be used in applications where a code compliant switch is necessary.

NOTE: The center post must be positive from the turbine. Outside posts can be swapped as either battery positive or battery/turbine negative.

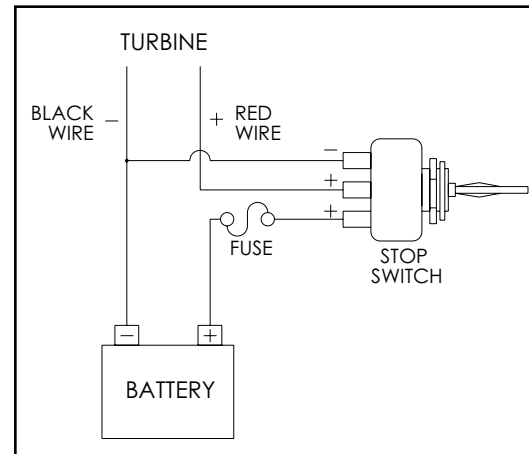



Fig. 13. Stop Switch Wiring

MARINE USE:
 A Stop Switch is standard equipment with the Marine Breeze.

5-5 Fuses, Circuit Breakers and Ammeter

Air Breeze is capable of producing high amperages. As with all electrical installations, you must protect each of your turbines with a fuse or circuit breaker. Wire Air Breeze with an appropriate size “slow-blow” fuse or circuit breaker between it and the batteries. Refer to installation figures at the start of **Section 5**. If a stop switch is used, the fuse or circuit breaker should be placed between the switch and the batteries.

Recommended Size for Circuit Breakers or Slow-Blow Fuses

- 12-volt model: 50 amps D.C.
- 24-volt model: 30 amps D.C.
- 48 V systems: 10 amp D.C.

Circuit Breakers are available from Southwest Windpower. Part numbers are listed below.

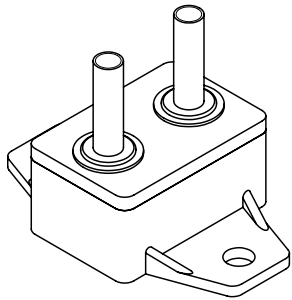


Fig. 14 Circuit Breaker
30A: PN 2-ARAC-103
50A: PN 2-ARAC-104

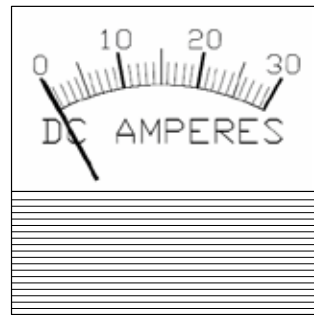


Fig. 15 Ammeter
(Amp Meter)
PN 2-ARAC-103

While not necessary an ammeter (sometimes called an Amp Meter) is an excellent addition to any system. The Amp Meter allows you to monitor the current output of your turbine. Place it in between your turbine and the battery on the positive lead. It will give you instantaneous readings of output in amps.

5.6 Batteries

There are many battery choices available – flooded lead acid, absorbed glass mat (AGM), gell cell and nickel cadmium. The type of battery utilized will depend largely on the battery bank location and cost. For battery installations where fumes can be safely ventilated and the potential for acid leakage accommodated the flooded lead acid battery is typically the most economical choice.

Minimum recommended battery bank size:

- 12 volt systems – 400 Amp-hours
- 24 volt systems – 200 Amp-hours
- 48 volt systems – 200 Amp-hours

There are several informative web sites with battery information including:

- www.batterycouncil.org
- http://www.windsun.com/Batteries/Battery_FAQ.htm



IMPORTANT: Never use “automotive” batteries or any battery other than a “deep-cycle” battery.

5.7 Tower Grounding

Every wind turbine and turbine tower should be grounded at the tower base even though the system may be grounded at the battery bank or service panel by means of the yaw ground lead. Grounding the tower at its base may prevent shocks to persons touching the tower due to lightning or electrical faults.

The following sections are provided as a guide to properly grounding the tower and should not be considered completely comprehensive. The reader is encouraged to reference the National Electrical Code (NEC) and local building and zoning regulations for complete requirements. Relevant sections of the National Electrical Code are referenced.

Tower grounding may be accomplished in several ways; the most common method is a copper clad steel electrode(s) driven into the soil and connected to the tower using a wire conductor.

5.7.1 Electrodes Driven in Soil

Electrodes should a minimum of 8 ft (2.5 m) in length and free of non-conductive coatings such as paint. Hollow electrodes of pipe or conduit should not be smaller than trade size 3/4 (metric designator 21) and must be galvanized or otherwise protected from corrosion. Solid rod electrodes must be at least 5/8 inch (16 mm) diameter. Stainless steel rods less than 5/8 inch diameter, nonferrous rods or their equivalent less than 1/2 inch diameter shall be "listed" by an organization having jurisdiction in the area. For example UL and CSA in the USA and Canada.

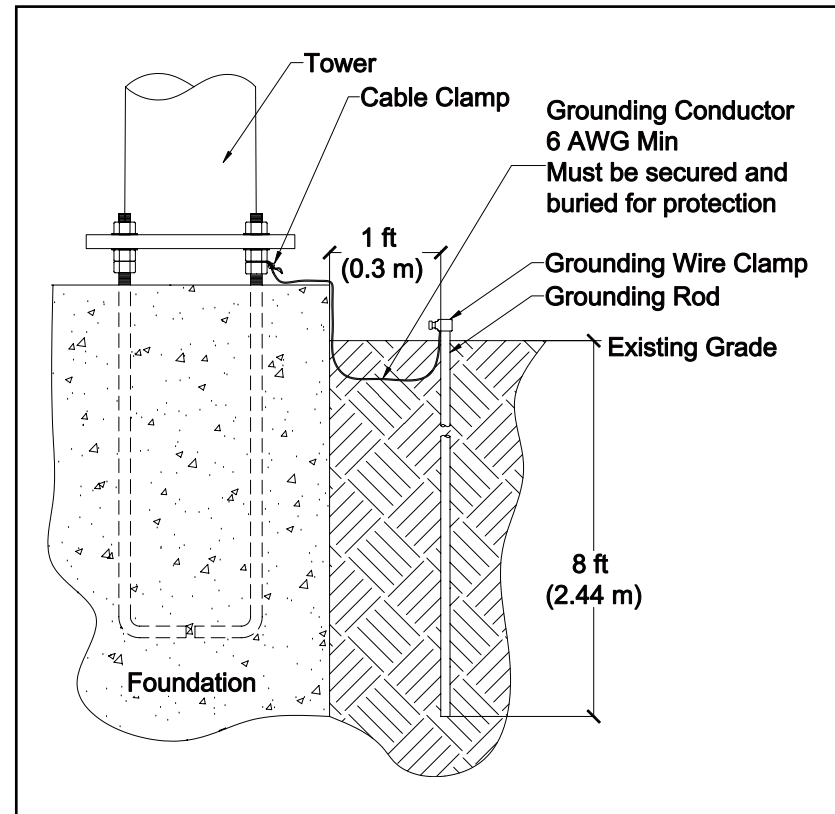
Electrodes shall be installed such that 8 ft (2.5 m) is in contact with the soil. It should be driven into undisturbed soil within 1 ft of the tower foundation. Electrodes should be driven to a depth of 8 ft (2.5 m) except that where rock is encountered, the electrode may be driven at an angle not to exceed 45 degrees from vertical. Some local authorities permit burial of the electrode in a trench that is a minimum of 30 inch (76 cm) deep.

The upper end of the electrode and its connection to the grounding conductor should be below grade or if above ground it must be protected from damage.

Bonding the grounding conductor to the electrode and to the tower may be accomplished by exothermic weld or by a "listed" mechanical connector. Solder connections are not permitted. Most local authorities require a minimum grounding conductor size of 6 AWG for copper and 4 AWG for aluminum (if aluminum is permitted).

The grounding conductor may be buried directly or contained in conduit; in either case it is important that it have no sharp bends to keep its inductance low should have no sharp bends.

The accompanying figure depicts a typical tower grounding techniques and the following sections of the NEC are listed for reference.



2005 NEC Section
Article 250.52, item 5
Article 250.53, item A
Article 250.53, item G
Article 250.64
Article 250.66, item A
Article 270.70,

Topic
Tower Grounding
Tower Grounding
Grounding Electrode Installation
Grounding Conductor Routing and Placement
Grounding Conductor Size
Bonding of Grounding Conductor

Six - Air Breeze Installation

The following are general guidelines for the installation of Air Breeze. Because each wind turbine installation is unique specific step by step installation instructions cannot be provided. However before attempting final installation the following basic steps should be completed:

- Completely review Air Breeze Owner's Manual.
- Assemble Air-Breeze. Blades and hub may be left off depending on tower type – see **Section 2.0** Turbine Assembly.
- Select tower and tower site and install tower. See Sections 3.0 and 4.0
- Determine wire size. **See Section 5.2**
- Design system including batteries, switches, circuit breakers, and ammeter. Draw wiring diagram.
- Obtain required components – batteries, switches, circuit breakers, wire, tools etc.

Once these steps are completed final assembly is fairly simple consisting primarily of making good electrical connections according to the wiring diagram and mounting Air Breeze on the tower.

6.1 Wire Connections to Air Breeze



WARNING: Don't connect wires to batteries until all electrical connections are completed.

Connect wire leads from Air Breeze to wires to be run down the tower using “split bolt” or solder connectors. Follow good practice and use color coded wires – red for battery positive, black for battery negative, and green for earth ground. Wires must be sized based on turbine to battery bank distance. Refer to **Section 5.2**. Insulate connections with heat shrink tubing or good quality electrical tape. Leave sufficient service loop in the wires to accommodate removal of the turbine from the tower.

Follow system wiring diagram and run wires to disconnect switch, fuse or circuit breaker and ammeter. If a switch is utilized (highly recommended) turn switch to OFF until all connections are completed.

6.2 Mounting on Tower

After wires are connected to Air Breeze, route the wires down the tower and slide the turbine yaw over tower top. After the yaw is completely lowered onto tower top lift the yaw approximately 1/8 inch (3 mm) to 1/4 inch (6 mm) so that the only contact between the yaw and tower top is through the rubber isolation pad. This will reduce noise and vibration transmission to the tower.

Once the yaw is positioned on the tower secure the yaw clamp screws using the supplied 5/32 inch hex key wrench. Torque to 5 ft – lbs (6.8 Nm).

If blade/hub assembly is not already installed on turbine it may be installed now. Position the 5/8-18 nut in the hexagonal detent at the center of the hub. Coat the shaft threads and blade hub bore with Tef-Gel and “spin” the hub completely onto the turbine alternator shaft. Fully tighten hub to 50 lb-ft by inserting a 5/16 inch hex key wrench in the turbine alternator shaft and attempting to turn the shaft while holding the blades.

Snap the nose cone into position over the outside edges of the blade hub. Make sure all three edges of the nose cone snap over the edge of the blade hub. After installation tug on the nosecone to make sure it is securely attached.



IMPORTANT: Tef-Gel is a corrosion inhibitor and is especially important in marine applications.

6.3 Final Connections

Before making final connections to the batteries make sure circuit breakers and stop switch are in the OFF position. Attach wires to battery Red to positive battery terminal and Black to negative battery terminal.



WARNING: If the battery connections are reversed Air Breeze's electronics will be damaged. The polarity of Air Breeze's wires may be checked by connecting a voltmeter to the wires and spinning the rotor by hand.

Complete battery connections and switch on circuit breakers and stop switch. When power is first switched on the Breeze LEDs will blink twice to indicate that the internal controller is functioning properly. If there is available wind and Air Breeze starts charging the batteries the LED remain illuminated.

The installation is now complete.

Seven - Air Breeze Operation

7-1 Operational Summary

Wind turbines operate by capturing the kinetic energy of moving air, **the wind**. They convert it to rotational motion to turn an alternator that produces electrical power. The electrical power must be regulated to a voltage to charge the system batteries. And there must be a system to prevent overcharging the batteries and resume charging as the battery voltage drops. A means to protect the wind turbine from extreme wind damage must also be provided.

The Air Breeze accomplishes all these goals by incorporating a three phase brushless permanent magnet alternator and microprocessor controlled electronics to optimize its power production capability. The microprocessor continuously adjusts the loading of the alternator to keep the blades operating at their optimal angle of attack. The result:

- high power production
- high blade efficiency
- lower blade noise.

7-2 Operating Modes

Charging: With Air Breeze connected to batteries with the voltage below the voltage regulation set point the blades will spin in response to the wind. With an available wind the blades will continue to spin until the battery voltage matches the regulation set point.

Note that Air Breeze requires a minimum battery bank voltage (approximately 10.5 volts on a 12 volt system) or the controller will behave as if an open circuit condition existed. Refer to **Open Circuit/Free Spinning** section. When charging the batteries the Air Breeze LED will be continuously illuminated.

Regulation: As Air Breeze produces power and the battery voltage rises to the regulation set point voltage, Air Breeze will go into "regulation". At that point it stops producing power and the blade rpm will lower dramatically (almost stopping). Air Breeze will remain in regulation until the battery voltage drops slightly below the regulation set point – this is often referred to as the **cut-in voltage**. When the cut-in voltage is reached the blades will resume spinning in response to the available wind. Regulation mode is indicated by the Air Breeze LED blinking at a rate of approximately twice a second.

Stall Mode: Stall mode is marked by a dramatic reduction in turbine speed to approximately 500 – 700 rpm. Air Breeze will enter stall mode when a wind speed of 35 mph (15.6 m/s) is sensed and remain in stall mode until the speed drops to 32 mph (14 m/s). If a wind speed of 50 mph (22 m/s) is detected the turbine will completely shut down for 5 minutes.

When in stall mode the Air Breeze LED will blink slowly – approximately ten times per second.

Braking Mode: Air Breeze may be placed in braking mode by directly shorting the turbine positive and negative wires together or by the use of a stop switch. The stop switch first disconnects the turbine from the battery and then shorts the positive and negative wires. In very strong winds the blades may rotate slowly even with the switch activated.

Open Circuit/Free Spinning: Air Breeze will freely spin if disconnected from the batteries and the positive and negative wires are not shorted together. As Air Breeze freely spins in response to the available wind the internal controller will attempt to protect the circuit from high voltage conditions by slowing the turbine. This eliminates the high voltage and if the wind is still available Breeze will spin up again.

The result is a repeating cycle of high speed spinning followed by turbine braking which can cause excessive wear. Southwest Windpower recommends that the turbine not be left in open circuit for extended periods of time. Leave turbine connected to batteries, install a stop switch, or short positive and negative wires together.

7-3 Voltage Regulation

Air Breeze continually monitors the battery voltage and compares it to the voltage regulation set point. Refer to specifications for voltage regulation set points. The voltage regulation set points are factory set to the values listed in the specifications. These values may be adjusted to suit individual applications.

When the voltage regulation set point is achieved Air Breeze enters regulation mode – effectively switching off and waiting for the battery voltage to drop to the cut-in voltage. The cut-in voltage is slightly lower than the voltage regulation set point. The difference between the two values is referred to as “hysteresis” and is purposely done so the turbine does not bounce in and out of a single regulation set point. Refer to specifications for specific voltage cut-in values.

7-3-1 Adjusting Regulation Voltage

The voltage regulation set point is adjustable using the potentiometer on the side of Air Breeze body. **Please read the accompanying caution before attempting to adjust the voltage regulation set point.**

The most accurate method of setting the regulation voltage is to disconnect the turbine from the batteries and using an adjustable voltage source and multi-meter to apply the desired voltage across the positive and negative turbine leads. With the target voltage applied turn the potentiometer fully counter-clockwise and then slowly turn the potentiometer clock-wise until the LED just illuminates. The regulation set point will then be set to the voltage applied across the turbine leads.

Alternatively, the regulation set point voltage may be adjusted using a trial and error method. Use the accompanying chart as a guide to increase or decrease the voltage regulation set point. Monitor the battery voltage over a period of time and make small adjustments until the regulation set point voltage is at the desired level.

System Voltage	Voltage Regulation Set-Point Adjustment Range*	Voltage Change due to 1/8 Turn of Potentiometer**
12 Volt	13.6 – 17.0 Volts	0.56 Volts
24 Volt	27.2 – 34.0 Volts	1.12 Volts
48 Volt	54.4 – 68.0 Volts	2.24 Volts

* Adjustment ranges are approximate, actual ranges may be greater

** Turn clockwise to increase voltage, counter-clockwise to decrease voltage



CAUTION: Increasing the voltage regulation set point above the initial factory setting will NOT increase the power output of Air Breeze. This adjustment changes the point at which the turbine stops charging the batteries. By setting the voltage too high you may increase the probability of overcharging and damaging the batteries.

7-3-2 Using an Alternate Charge Controller

There are some conditions in which the Air Breeze internal regulator is not appropriate as the primary regulator. These conditions include:

- **Systems where battery temperature varies widely**

Battery charge efficiency varies in extreme temperatures. If these conditions exist, an external regulator with a temperature compensation sensor should be used to optimize the charge rate. There are several regulators available that adjust the charge rate based on ambient battery temperature.

- **Batteries that are extremely sensitive to charge voltage**

Follow the recommendations of the battery manufacturer. For most battery systems the Air-Breeze internal voltage regulator is completely adequate.

- **Multiple turbines with a bus system**

Multiple turbine installations will typically function best using a single voltage regulator close to the battery bank. This is particularly true if the wire lengths connecting each turbine to the bus vary by distance or wire gauge.

The Air Breeze internal voltage regulator cannot be completely turned off, however, by setting the voltage regulation set-point to its highest value (potentiometer turned completely clockwise) Air Breeze internal regulator may be virtually eliminated from the battery charging system.

If a charge controller other than the Air Breeze internal controller is utilized it must be a diversion style regulator. A diversion style regulator charges the batteries and as the batteries become charged the excess power is diverted to a resistive load. This technique allows for the capture of full turbine power even after the batteries are charged.

Do not use a pulse width modulated (PWM) or shunt style controllers; Air Breeze is not designed to work with these types of controllers. Additionally, most controllers designed to work with solar panels are not suitable for use with Air Breeze. These controllers go “open” when the batteries would therefore cause the turbine to spin free which is not recommended.



CAUTION: Do not use a pulse width modulated (PWM) or shunt style controllers; Air Breeze is not designed to work with these types of controllers. Additionally, most controllers designed to work with solar panels are not suitable for use with Air Breeze. These controllers go “open” when the batteries would therefore cause the turbine to spin free which is not recommended.

Eight - Air Breeze Maintenance

Although your Air Breeze has been designed to run for long periods without requiring any maintenance, reliability and performance will be enhanced if you periodically inspect your system.



CAUTION: Never approach the turbine during operation.

After one month and every six months thereafter:

- Check blades for chips or nicks. Replace blades if damaged. Do not operate the turbine with chipped or unbalanced blades. This can cause severe wear, damage, and possible failure. Do not install individual blades. The blades are balanced as sets.
- Check the blade bolts and the hub nut for tightness.
- Check nosecone for proper cracks and proper fit.
- Wash off any built-up dirt or debris from the blades.
- Check all electrical connections to make sure they are tight and free from corrosion.
- As with all charging systems, check your battery water levels and add distilled water in accordance with manufacturer's recommendation.
- Check the nose cone.
- Southwest Windpower suggests replacing the blades and bearings every five years for optimal performance.

Nine - Air Breeze Trouble Shooting

Three quick bench tests can verify if your Air Breeze is working correctly. Test 1 does not require any equipment. For tests 2 and 3 you will need a battery bank and a power drill.

TEST 1

- 1) Remove the blade/hub assembly from the turbine and place in a safe location. Replace the rotor hub nut on the rotor shaft.
- 2) Attempt to quickly spin the rotor shaft with your fingers while connecting and disconnecting the red and black wires (turbine must not be connected to batteries). **A second person is may be helpful to perform this test.**
- 3) With the red and black wires connected to each other the shaft should be more difficult to turn. Replace the rotor hub nut on the rotor shaft. With the yaw wires disconnected it should spin freely. Spinning the shaft quickly makes difference easier to detect. **If these conditions do not exist, you should contact your turbine dealer or Southwest Windpower.**

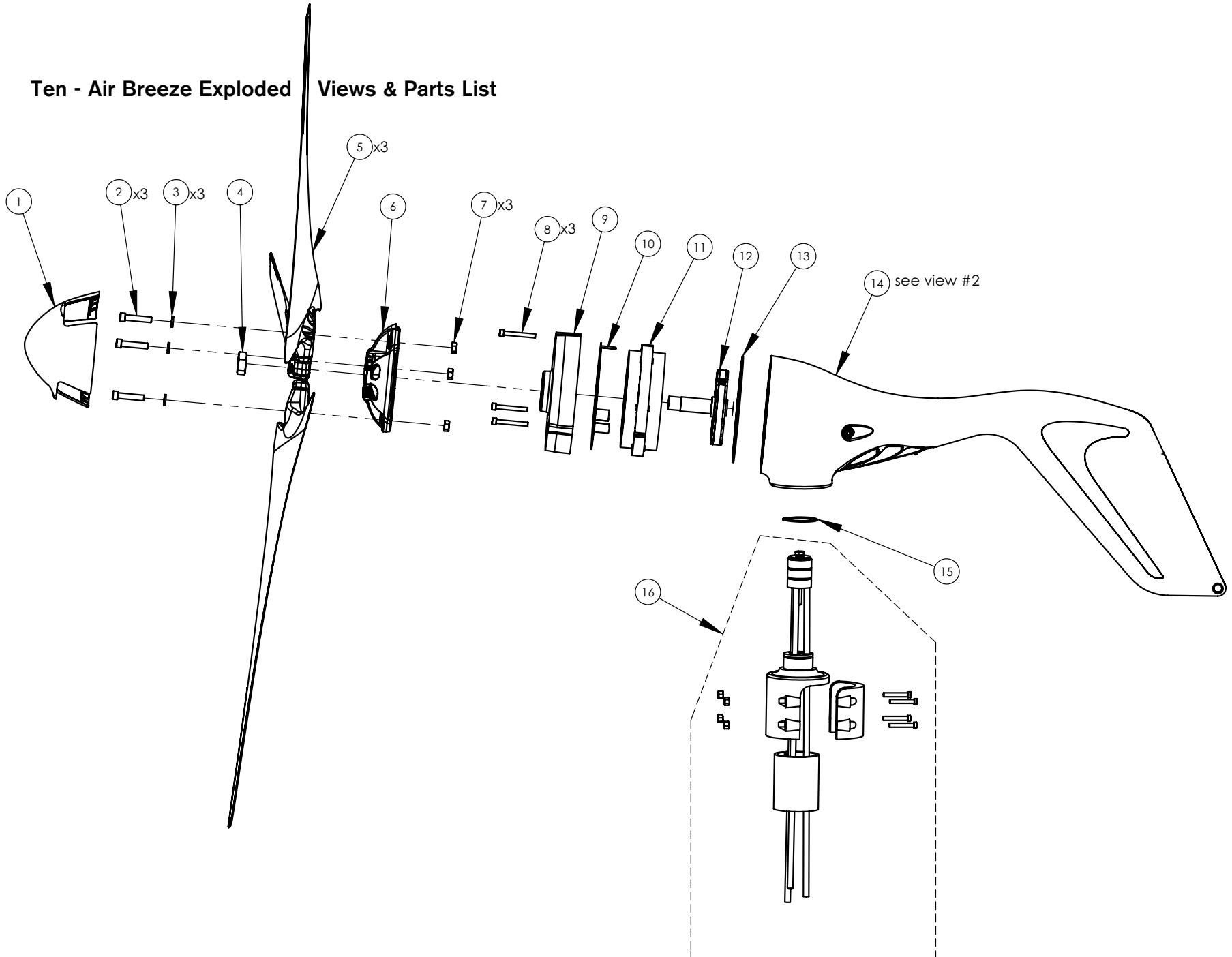
TEST 2

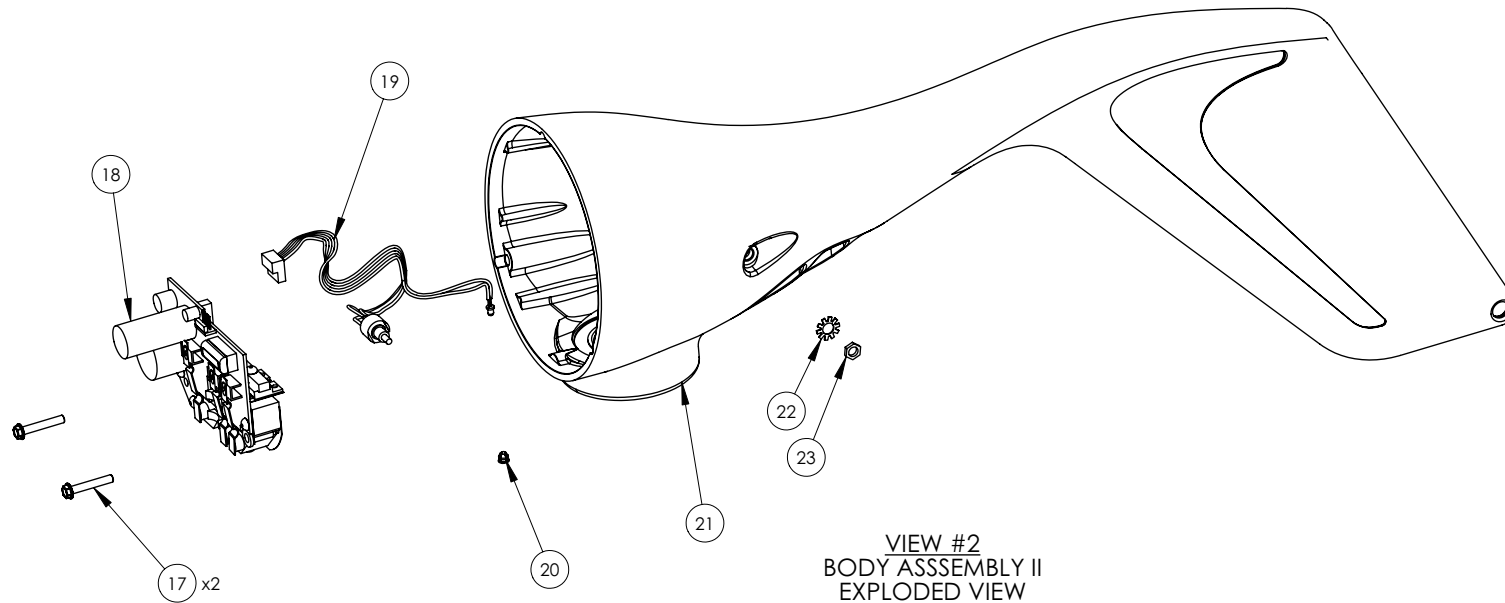
- 1) Remove blade/hub assembly from turbine and place in a safe location.
- 2) Connect the turbine power wires to the appropriate terminals on your battery: RED= Positive, BLACK = Negative.
- 3) Each time the Air Breeze is connected to a battery, the LED will blink two times to indicate that the controller is running properly. You may need to wait 10 seconds between iterations of this test in order to let the microprocessor to reset. **If the LED does not blink when the Air Breeze is connected to a battery, you should contact your turbine dealer or Southwest Windpower.**

TEST 3

- 1) With Air Breeze connected to your battery bank; use an electric drill to spin the rotor shaft while observing the LED. A short length cut from the 5/16 inch hex key wrench can serve as a drive if necessary.
- 2) Below 500 RPM, the rotor should spin freely and the LED should remain off.
- 3) At 500 RPM and above, the Air Breeze should be charging the battery. There should be resistance on the rotor shaft and the LED should turn on. If the shaft is cogging (difficult to rotate), contact your turbine dealer or Southwest Windpower. Be sure your battery voltage is not high enough to activate the regulation mode during this test.

Ten - Air Breeze Exploded Views & Parts List





item	item number	item name	13	3-CAOT-1002	O-RING
1	3-CMBP-2015-01	NOSECONE - LAND	14	3-CMBP-2019-01	BODY ASSEMBLY II - AIR BREEZE - LAND - 12V (SEE VIEW #2)
	3-CMBP-2015-02	NOSECONE - MARINE		3-CMBP-2019-02	BODY ASSEMBLY II - AIR BREEZE - LAND - 24V (SEE VIEW #2)
2	3-HDBT-1000-06	SCREW - SOCKET HEAD - 1/4 20 X 1 1/4" - SS		3-CMBP-2019-03	BODY ASSEMBLY II - AIR BREEZE - LAND - 48V (SEE VIEW #2)
3	3-HDWA-919	WASHER - AIR BREEZE SPECIAL		3-CMBP-2019-04	BODY ASSEMBLY II - AIR BREEZE - MARINE - 12V (SEE VIEW #2)
4	3-HDNT-100-13	NUT - JAM - SAE - 5/8-18 - ZINC		3-CMBP-2019-05	BODY ASSEMBLY II - AIR BREEZE - MARINE - 24V (SEE VIEW #2)
5	3-CMBP-2017-01	BLADE - AIR BREEZE - LAND		3-CMBP-2019-06	BODY ASSEMBLY II - AIR BREEZE - MARINE - 48V (SEE VIEW #2)
	3-CMBP-2017-02	BLADE - AIR BREEZE - MARINE	15	3-CAOT-1006	SNAP RING - 32MM EXTERNAL
6	3-CMBP-2016-01	HUB - AIR BREEZE-LAND	16	3-CMBP-1004-01	YAW SHAFT - AIR - LAND - 34"WIRES
	3-CMBP-2016-02	HUB - AIR BREEZE-MARINE	17	3-CMBP-1004-04	YAW SHAFT - AIR - MARINE - 34"WIRES
7	3-HDNT-102-05	NUT - NYLOCK - SAE - SS - 6-32	18	3-HDBT-9000	SCREW - TAPTITE - 8/32 X 1"
8	3-HDBT-1000-577	SCREW - SOCKET HEAD - 10-24 X 1-1/2"	18	3-CMBP-2020-01	CIRCUIT AND RECTIFIER TOTAL ASSEMBLY -12V
	3-CMBP-1013-01	FACE ASSEMBLY - AIR - LAND		3-CMBP-2020-02	CIRCUIT AND RECTIFIER TOTAL ASSEMBLY -24V
	3-CMBP-1013-02	FACE ASSEMBLY - AIR - MARINE		3-CMBP-2020-03	CIRCUIT AND RECTIFIER TOTAL ASSEMBLY -48V
10	3-CMBP-1341	STATOR ISOLATOR	19	3-CMBP-1033	WIRE HARNESS - POTENTIOMETER
11	3-CMBP-1019-02	STATOR - AIR (FOR 12V BREEZE)	20	3-ELOT-1000	LED CLIP
	3-CMBP-1019-03	STATOR - AIR (FOR 24V BREEZE)	21	3-CMBP-1011-01	BODY ASSEMBLY I - AIR LAND
	3-CMBP-1019-05	STATOR - AIR (FOR 48V BREEZE)		3-CMBP-1011-02	BODY ASSEMBLY I - AIR MARINE
12	3-CMBP-1313	ROTOR - AIR	22	3-HDWA-101-07	WASHER - EXT STAR WASHER SS 1/4"
			23	3-HDNT-101-12	NUT - JAM - SAE - SS