SOUTHWEST WINDPOWER™

Whisper 200

OWNER'S MANUAL

Installation
Operation
Maintenance

CE

TABLE OF CONTENTS

Whipser 200 Owners Manual
3-CMLT-1033-02 Revision E

Southwest Windpower

Congratulations on your purchase and welcome to our family!

Dear Whisper™ Owner,

Thank you for your purchase of a Whisper wind turbine. We congratulate you on your choice and are confident you will experience years of dependable service.

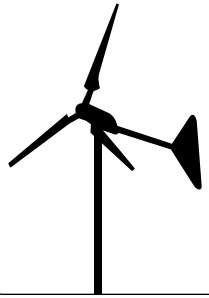
Before going any further, please complete and return the enclosed Warranty Registration Card. **The conditions of your warranty are dependent upon the proper installation of Whisper.** Furthermore, this will assure you of being kept up-to-date with the latest developments from Southwest Windpower. These include new options, performance tips, updated software to maximize output and user notices. It is important to know that we do not sell or distribute your information to any third party. We understand your privacy is important.

Again, welcome to our family and thank you for investing in the future of wind energy with Whisper.

Sincerely,

Southwest Windpower

CE Compliance: The CE marking is a mandatory compliance requirement in EMEA and the UK and although it is self-certification, testing and evidence support testing is preferred from an independent test house. All Southwest Windpower turbine are third party tested and fullfil all the relevant provisions of the following directives: Machinery Directive 2006/42/EC, Low Voltage Directive 2004/95/EC, Electromagnetic Compatibility Directive 2004/108/EC. The report and declaration of conformity are available for inspection on request. The serial number refers to a specific Southwest Windpower product. This product is considered compliant to CE.



Enter the serial and model number below

Serial Number _____

Model Number _____

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Designed in the USA by Southwest Windpower. Manufactured under license by Luminous Renewable Energy Solutions, India.

IMPORTANT SAFETY INSTRUCTIONS

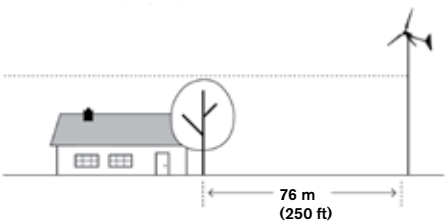
Read these instructions in their entirety before installing or operating.

SAVE THESE INSTRUCTIONS. Enclosed are important instructions that must be followed during installation and maintenance.

Turn Whisper "OFF" and contact Southwest Windpower Technical Service if unusual noise or operation is observed.

Install Whisper on a calm day - no wind at ground level.

Locate your tower well away from occupied buildings and power lines; a minimum of 76 m (250 ft) is recommended.



High voltage systems present a shock hazard and should be wired and maintained by a qualified and licensed electrician.

NEVER place objects on top or near the Whisper Controller enclosure.

These devices must dissipate heat as part of normal operation. FAILURE AND FIRE may result if airflow is blocked.

In this manual

IMPORTANT: Please take note

TIP: Helpful information

WARNING: Risk of injury or death - proceed with extreme caution

MARINE: Information specific to corrosive environments

Recommended Tools, Equipment and Materials for Installation

Rounded File	Electrical Tape
Ground Rod & Clamp	Electrical Wire and Voltmeter
Wrenches (2) 13mm and 17mm or Adjustable Wrenches	Torque Wrench (20N-m or 15ft-lb) and 17mm Socket
Electric Drill Motor & 10mm (3/8") Metal Cutting Drill Bit	Sodering Iron and Solder or Split Bolt Connectors
Leather or Strong Fabric Strap (secures casting while handling)	Cable Grip/Strain Releif (support wires inside tower)
Metric Hex Wrench Set	Loctite 242
Center Punch Tool (marks for drilling)	Sawhorses
Pliers	Small Flashlight

Whisper 200 Technical Specifications

WHISPER 200

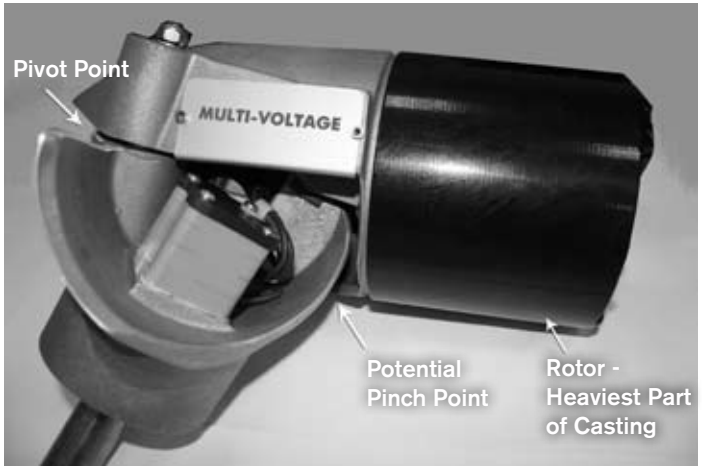
Rated Power	1000 watts at 11.6 m/s (26 mph)
Monthly Energy	200 kWh/mo at 5.4 m/s (12 mph)
Start-Up Wind Speed	3.1 m/s (7 mph)
Rotor Diameter	2.7 m (9 ft)
Voltage	12, 24, 48 VDC*; HV Available at 120v, 230v
Overspeed Protection	Patented side-furling
Turbine Controller	Whisper controller (Optional with all Units)
Mount	6.35 cm pipe (2.5 in schedule 40)
Body	Cast aluminum with corrosion resistant finish
Blades	(3) Carbon reinforced fiberglass
Survival Wind Speed	55 m/s (120 mph)
Weight	30 kg (65 lb) box: 39.46 kg (87 lb)
Shipping Dimensions	1295 x 508 x 330 mm (51 x 20 x 13 in)
Warranty	5 year limited warranty

*Power ratings are normalized for sea level.

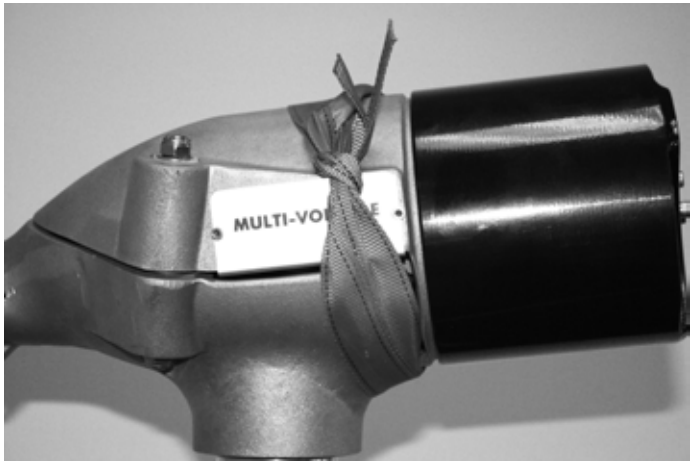
*** The Whisper Controller is factory set for 24-volt operation. If your system is other than 24 volts, the controller MUST be configured to your system voltage. Ensure turbine voltage is consistent with rest of your system voltage.**

Note the weight above. Use safe lifting techniques and protective footwear.

Turbine casting pivots open to a 45 ° angle creating a potential pinch point.

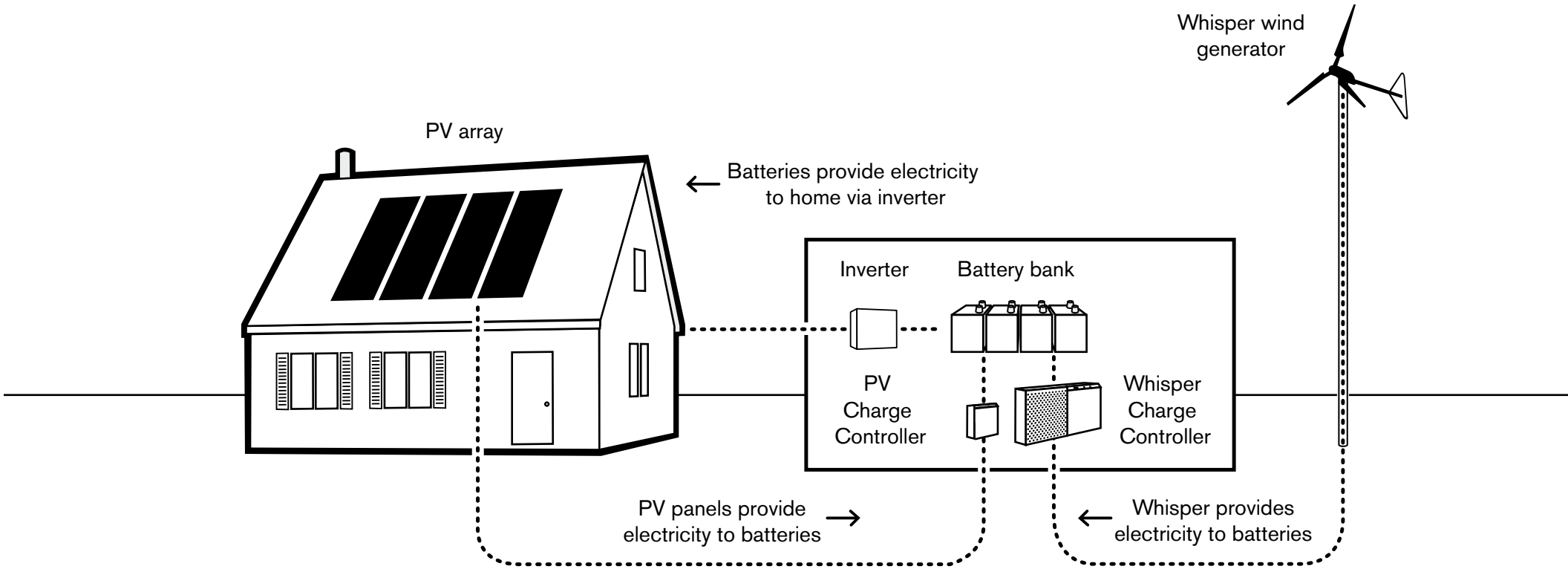


Southwest Windpower strongly recommends:
Straping or securing the casting (as shown below) while handling so it cannot pivot open.



Do not remove strap until casting is secure on tower.

EXAMPLE OF AN OFF-GRID HYBRID INSTALLATION

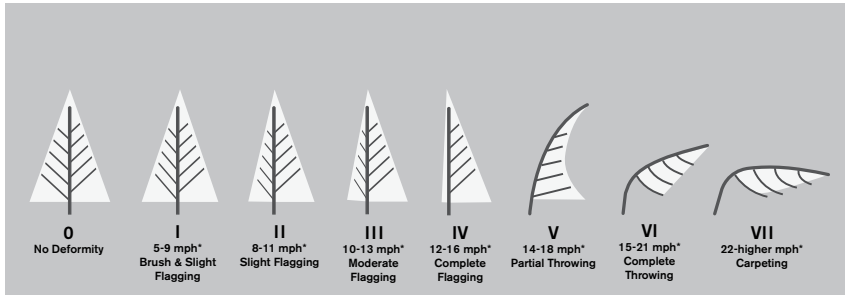


PRIOR TO INSTALLATION

Siting Tips

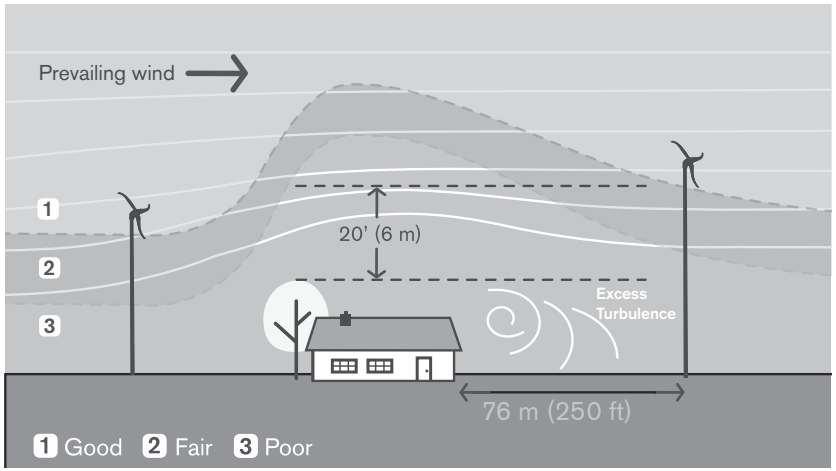
PROPER SITING = Better Performance & Increased Longevity

Look at vegitation deformation to determine best area and prevailling wind direction.



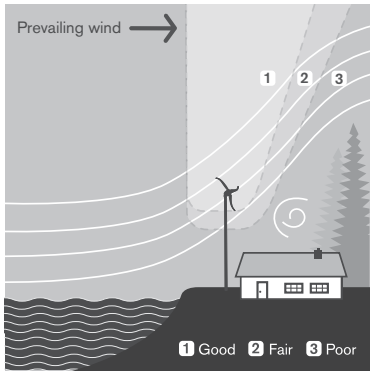
Griggs-Putnam Index. *Probable mean annual windspeed. Data prepared by E.W. Hewson, J.E. Wade, and R.W. Baker of Oregon State University

EXCESSIVE TURBULENCE = Fatigue Damage & Shorter Turbine Life



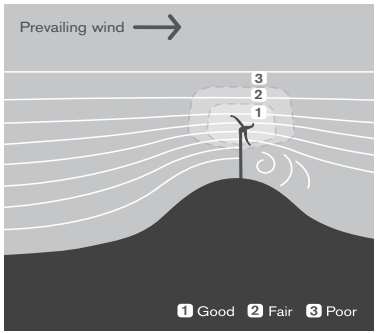
Turbine should be a minimum of 76m (250 ft) away from and 6m (20 ft) above obstacles.

ATYPICAL SITING CONSIDERATIONS



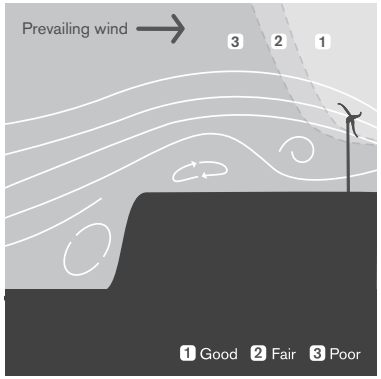
Coastal or Lakeside

Trees and taller structures can be down-wind.



Ridge Tops

Wind compresses as it blows over the top of a hill, increasing the wind speed.



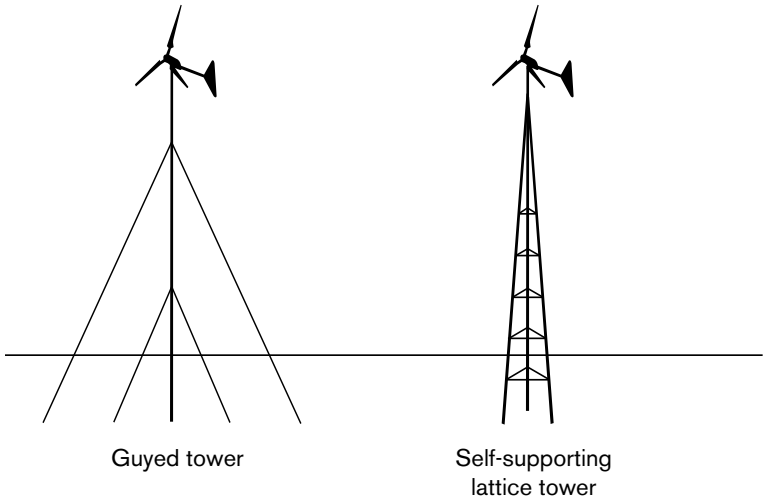
Plateau/Mesa

Site the generator far enough from the cliff to avoid turbulent wind.

Tower Selection and Installation

Tower Selection

Guyed Towers	Lattice Towers
Less-expensive	More-expensive
Larger Footprint (radius is 1/2 - 3/4 of tower height)	Smaller Footprint

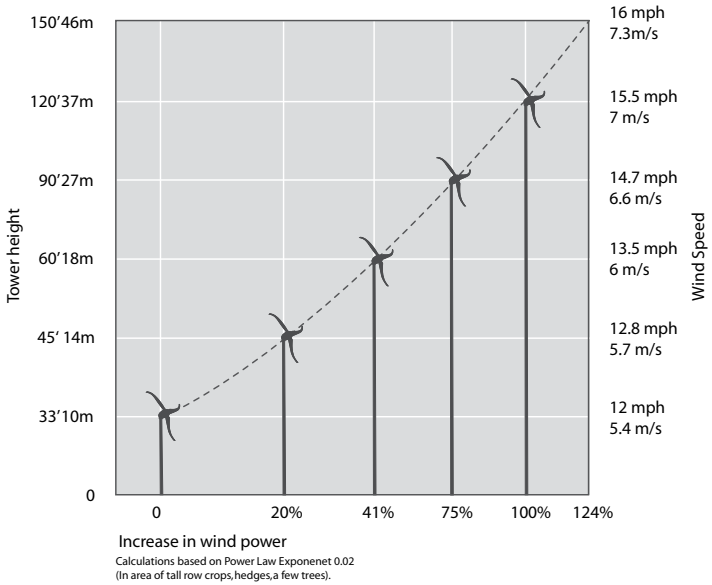


Guyed tower

Self-supporting lattice tower

Soil and wind conditions vary; towers and tower foundations must be designed for your specific location.

Wind speed increases with height. Higher towers also raise generators above the air turbulence that can exist close to the ground.

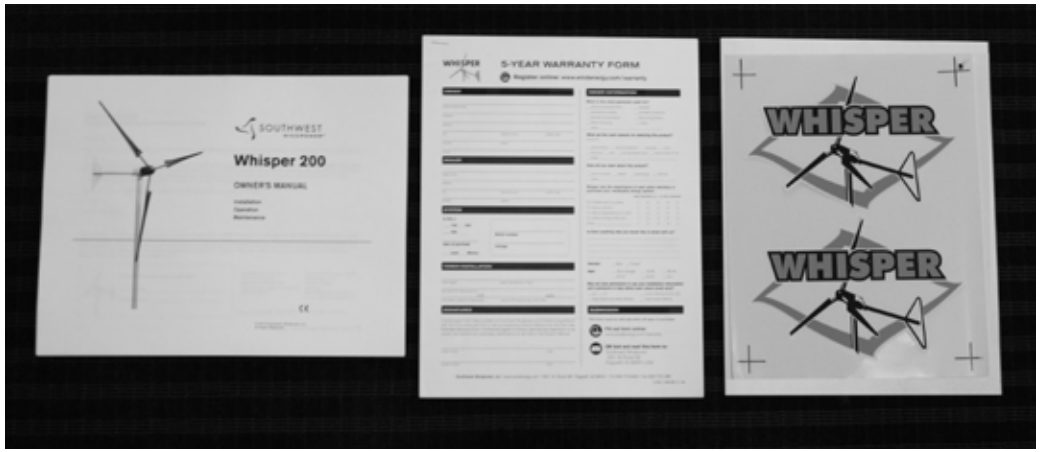


Prevent tower climbing by unauthorized persons or children. Never climb without proper safety equipment.

Always stop the blades before climbing the tower. Both falling from the tower and contact with the spinning blades can be lethal.

Arrival Kit

User's Packet



IMPORTANT: Properly complete the warranty registration card; failure to complete and return the card may affect your warranty.

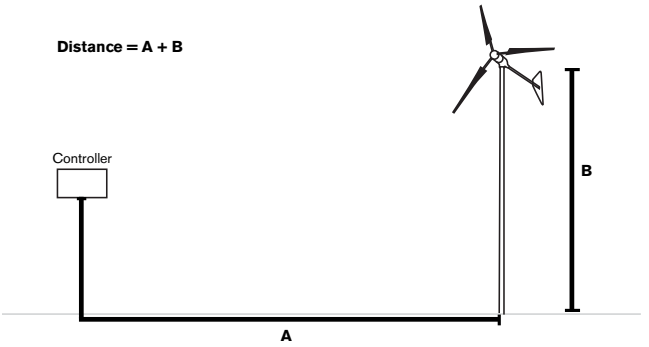
System Wiring

Batteries may emit explosive and irritating gas while charging. Use protective gloves and safety glasses.

Never make any electrical connection, light a match or make a spark near a recently-charged battery.

Turn off all loads, and look away when making a final battery connection.

TIP: See the Whisper Controller installation section for complete wiring details.



Wire size from wind generator to controller based on voltage configuration and distance (Distance = A + B)

Size	12 V	24 V	48 V
mm^2	Distance*	Distance*	Distance*
4 mm^2 (12 AWG)	–	–	66 m (216 ft)
6 mm^2 (10 AWG)	–	–	106 m (346 ft)
10 mm^2 (8 AWG)	–	42 m (138 ft)	168 m (552 ft)
16 mm^2 (6 AWG)	–	66 m (218 ft)	266 m (872 ft)
25 mm^2 (4 AWG)	26 m (84 ft)	103 m (339 ft)	414 m (1356 ft)
27 mm^2 (3 AWG)	42 m (136 ft)	165 m (542 ft)	660 m (2168 ft)
34 mm^2 (2 AWG)	52 m (170 ft)	208 m (682 ft)	832 m (2728 ft)
42 mm^2 (1 AWG)	66 m (216 ft)	262 m (860 ft)	1048 m (3440 ft)
54 mm^2 (0 AWG)	82 m (274 ft)	335 m (1098 ft)	1338 m (4390 ft)
67 mm^2 (2/0 AWG)	104 m (342 ft)	416 m (1364 ft)	1662 m (5454 ft)
85 mm^2 (3/0 AWG)	132 m (434 ft)	528 m (1730 ft)	2110 m (6924 ft)
107 mm^2 (4/0 AWG)	166 m (546 ft)	664 m (2177 ft)	2654 m (8710 ft)

*If using aluminum wire, multiply the distances in the table by 0.65.
Distances are one way from the turbine connection to Whisper Controller terminals.

Simple Tips for Deep Cycle Battery Bank Sizing

In preparation for battery sizing, know:

ELECTRICAL USAGE - the amount of energy consumed 1 day in Watt-hours (Wh)

DAYS OF AUTONOMY - days of battery back-up required if unable to charge the batteries by any means.

DEPTH OF DISCHARGE - limit of energy withdrawal to which you will subject the deep cycle battery bank.

*Deeper discharge = Shortened battery life.

- *Recommeded: never discharge a deep cycle battery below 50% of its capacity.*
- *Off-grid applications, a 25% DoD will extend battery life significantly.*

TEMPERATURE - Standard for most battery rating is 25 ° C (77 ° F).

Cold temperatures = reduced battery capacity
High temperatures = shortened battery life

RECOMMENDATION - Keep the number of parallel strings of batteries to three or fewer. More than three strings of batteries, risks shortening battery life due to uneven charging.

- *Batteries in Series = Voltage is Additive*
- *Batteries in Parallel = Ah is Additive*

*Example: 2 12V 100Ah Battery Bank

Series	24V	100 Ah
Parallel	12V	200 Ah

CALCULATIONS - calculate battery bank size, use example below:

- *A system load of 6,000 Watt-hours per day*
- *3 Days of Autonomy (back-up) needed*
- *Planned Depth of Discharge (DoD): 40%*
- *Battery bank ambient average low 15.6 °C (60 ° F)*
- *A 48V system*

STEPS:	EXAMPLE:
1.) Identify total daily use in Watt-hours (Wh)	***6,000** Wh/day*
2.) Identify Days of Autonomy (back-up days); multiply Wh/day by this factor.	***3** days of Autonomy: 6,000 x 3 = 18,000 Wh*
3.) Identify Depth of Discharge (DoD) and convert to a decimal value. Divide result of step 2 by this value.	***40%** DoD: 18,000 / 0.4 = **45,000 Wh***
*4.) Select the multiplier corresponding to the lowest average temperature your batteries will be exposed to. Multiply result from Step 3 by this factor. *Result is minimum Wh capacity of battery bank:*	*15.6 ° C (60 ° F) = 1.11* *45,000 x 1.11 = 49,950 Wh*
*5.) Divide result from Step 4 by system voltage. Result is the **minimum Amp-hour (Ah)** capacity of your battery bank.*	*49,950 / **48 = 1,040 Ah***

Temp in degrees

°C	° F	Factor
26.7	80 +	1.00
21.2	70	1.04
15.6	60	1.11
10	50	1.19
4.4	40	1.30
1.1	30	1.40
-6.7	20	1.59

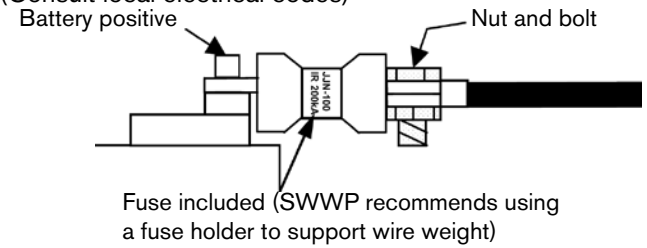
Battery Configuration and Location

RECOMMENDED:

- Locate battery in moderately stable room temperature, dry unoccupied building.
- If battery is in an occupied building, an enclosure with vent to outside is required. Follow code.
- Batter enclosure:
  - Allow 5 cm (2 in) on all sides for ventilation.
  - Allow 60 cm (2 ft) vertical clearance for maintenace access.
- To minimize the possibility of EMI (electromagnetic interference), the line from the battery to the Whisper Controller should be less than 10 feet (3 m).

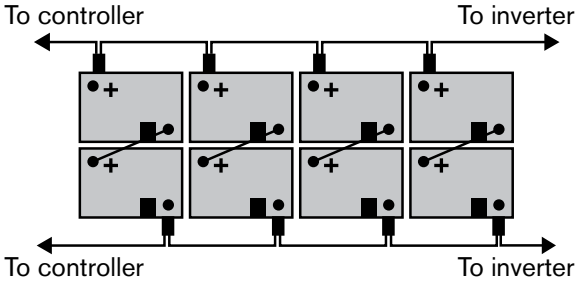
Battery Fuse Installation

(Consult local electrical codes)

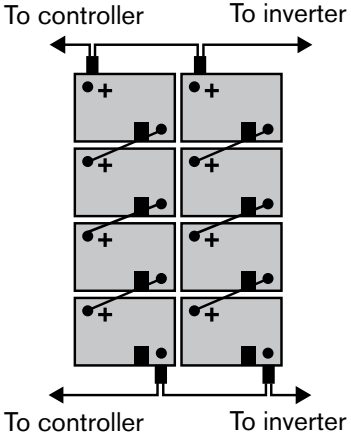


Use the diagrams below to determine the series/parallel arrangement for your system voltage. Please note: based on 6V batteries.

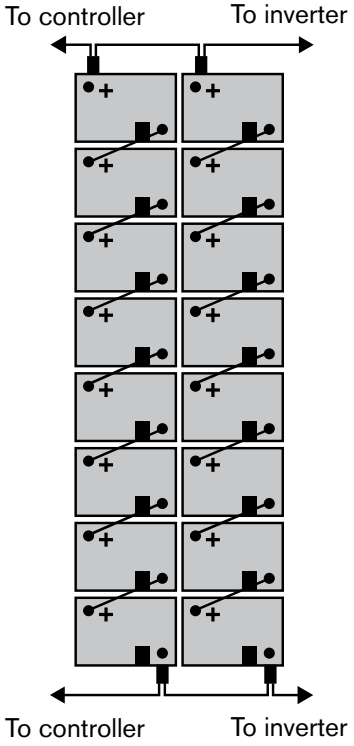
12 Volt Configuration



24 Volt Configuration



48 Volt Configuration



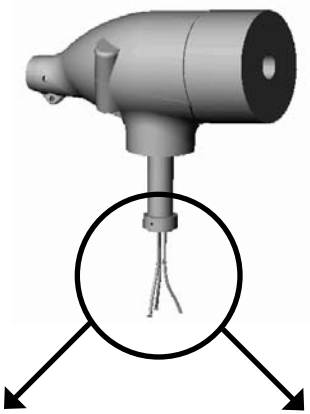
Wind Turbine Electrical Tests

Complete these tests before mounting blades to rotor. These tests confirm the wind generator is ready to install on the tower.

Ground Test

Check resistance to ground on any wire. Resistance must exceed 10,000 ohms; on many digital meters this will show a reading of “OL”.

Open Circuit Test



When the wires are unconnected the wind generator rotor should spin freely.

Short Circuit Test

When all the wires are shorted together the alternator should turn hard.

Phase to Phase Test

When **any two wires** are shorted together the alternator should turn lumpy as though there are smooth and bumpy portions of the rotor.

INSTALLATION SECTION

This section of the manual includes pages 15-29. The pages cover:

If it is necessary to print installation instructions, these are the primary pages you will need.

INSTALLATION

Set Wind Turbine Voltage

The Whisper 200 wind turbine and controller must be configured for the correct system voltage - 12, 24, or 48 volts.

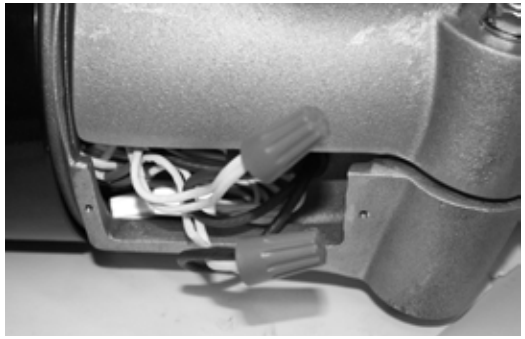
- Whisper controllers are shipped from the factory configured for 24 volt operation.
- The correct turbine voltage is set by altering the 12 stator wire and 3 brush wire connections.

IMPORTANT: The stator wires are coated with varnish that MUST be removed to make a good connection. Remove varnish by scraping with sharp edge or lightly sandpapering the wire.

- Access wires by removing the “Multi Voltage” cover on the turbine housing.
- The brush wires are interchangeable and not labeled. The brush wires are the larger multi-strand wires; 10AWG.
- The stator wires are numbered and color coded with a wire sleeve. For example stator wire “Red 3” has a red sleeve with the number “3” printed on it. Wire “Red - “ has a red sleeve with no number. The “-” indicates there is no number.

*Refer to table on next page for specific stator and brush wire connections.

- Cut off the twisted ends of the stator wires and strip off approximately 25 mm (1 inch) of insulation.
- Hold stripped ends of the wires parallel to each other and twist together clockwise direction before installing the wire nut.



- Trim wires and twist on the appropriate color wire nut (indicated in the table). Push hard on the wire nut while twisting clockwise.
- Coat wire nuts and terminal strip connections with dielectric grease to protect wires against corrosion.

**36V configuration has been removed from this manual. Contact Southwest Windpower technical support for 36V configuration.*

Voltage Configuration Wiring Table

Reference the following table to determine the correct brush and stator wire connections for your voltage configuration.

	Red Wire Nuts		
12 V	Brush Wire	Brush Wire	Brush Wire
	White 1	White –	Red 1
	White 3	White 2	Red 3
	Black 2	Red 2	Black 1
	Black –	Red –	Black 3

	Red Wire Nuts			**Yellow Wire Nuts**	
24* V	Brush Wire	Brush Wire	Brush Wire	White –	White 2
	White 1	Red 2	Black 1	Red 3	Red 1
	White 3	Red –	Black 3	Black –	Black 2

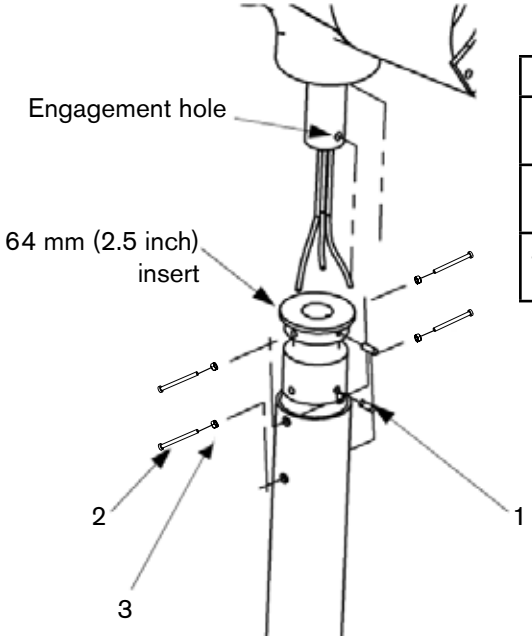
	Red Wire Nuts			**Yellow Wire Nuts**			
48* V	Brush Wire	Brush Wire	Brush Wire	White –	White 2	Red 2	Black 2
	White 1	Red –	Black 1	Red 1 Black –	White 3	Red 3	Black 3

*For high voltage Whisper, use the 24V configuration for a 120V HV Stator, and the 48V configuration for the 240V HV Stator.

Mount Turbine On Tower

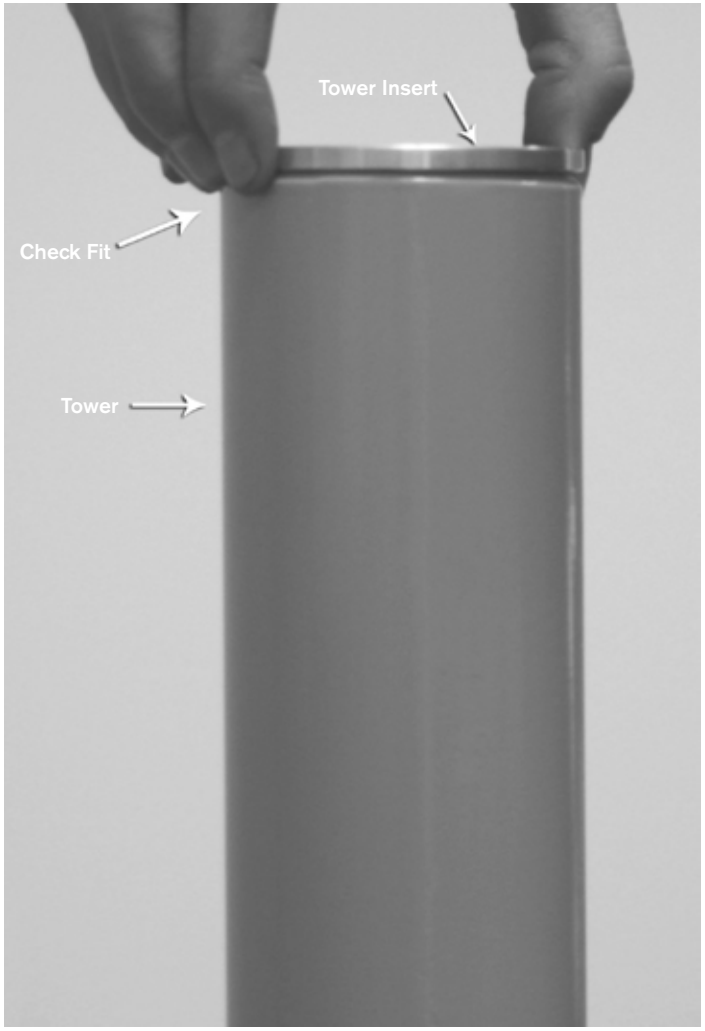
TIP: Use medium-strength thread locking compound on all fasteners.

Tower Insert Kit
For 64 mm insert (2.5 inch Schedule 40 Pipe –2.875 O.D. x .20in Wall)

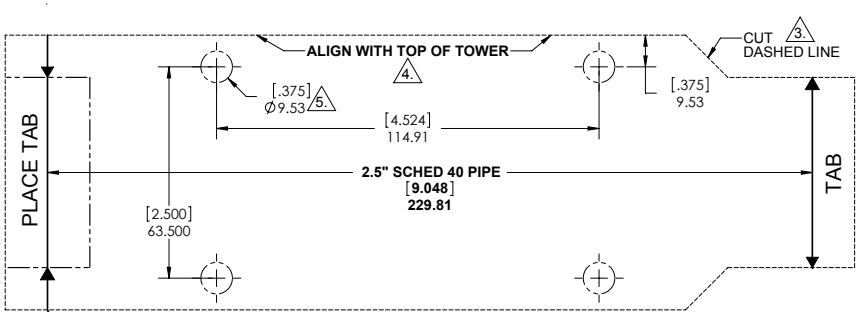


Item	Description	Qty:
1	Set Screw (M6 X 20)	2
2	Set Screw M8 X 35	4
3	M8 SS Nylock Nut	4

MARINE: If you are installing your Whisper in a corrosive environment, use a marinized Whisper and apply Tef-Gel to all threaded holes to prevent screws from becoming permanently seized into place.



Tower Preparation



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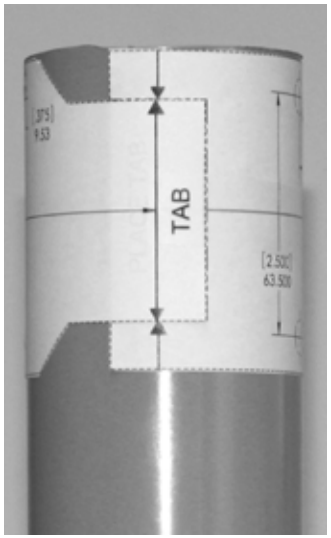
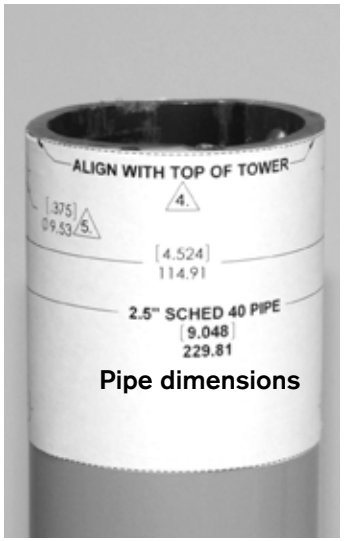


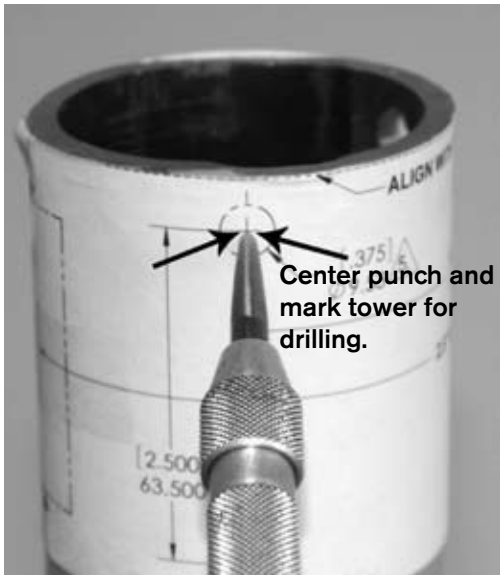
- Align with top of tower
- Wrap template around tower until tab arrows line up.
- Secure template with tape

2)



Pipe dimensions

3)



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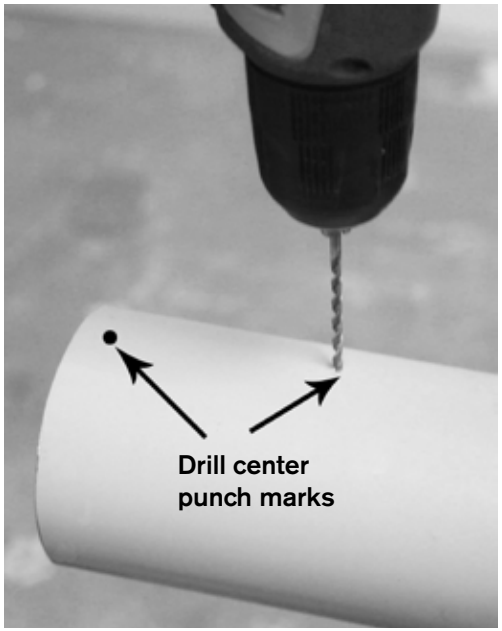
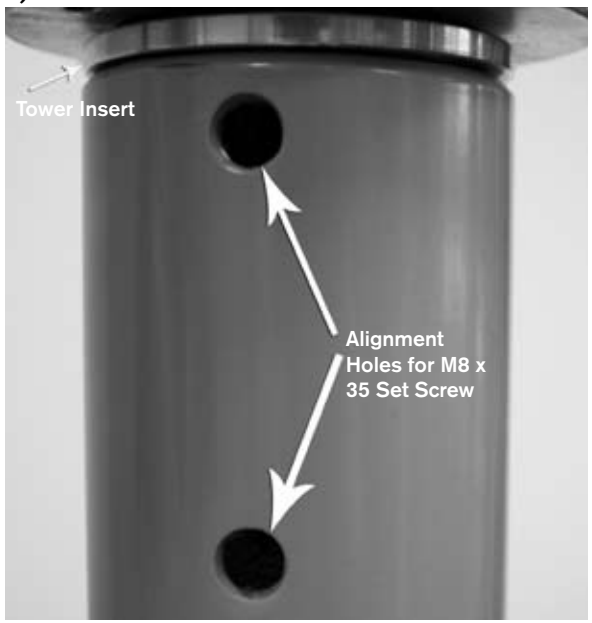


Recommended:
Begin drilling with small bit & work up to 10MM (3/8") metal cutting drill bit.

Install Tower Insert

1)



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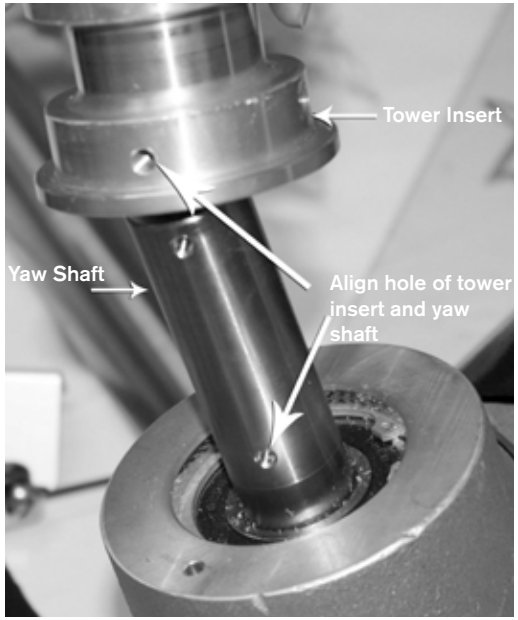

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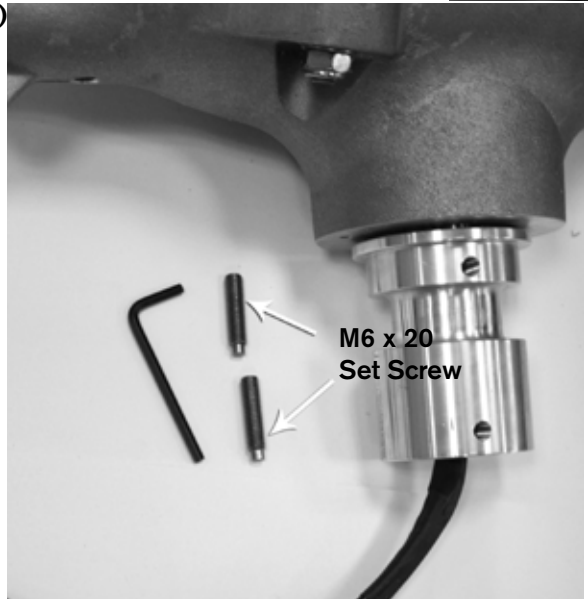

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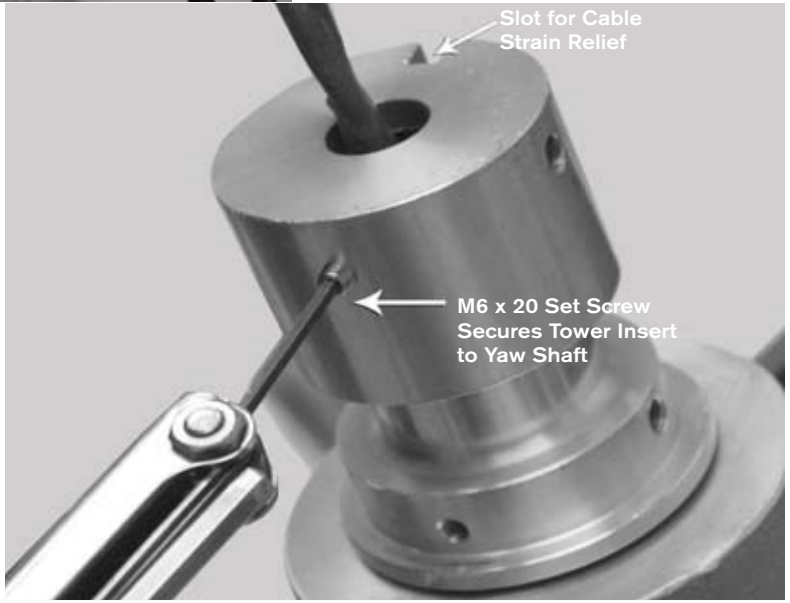
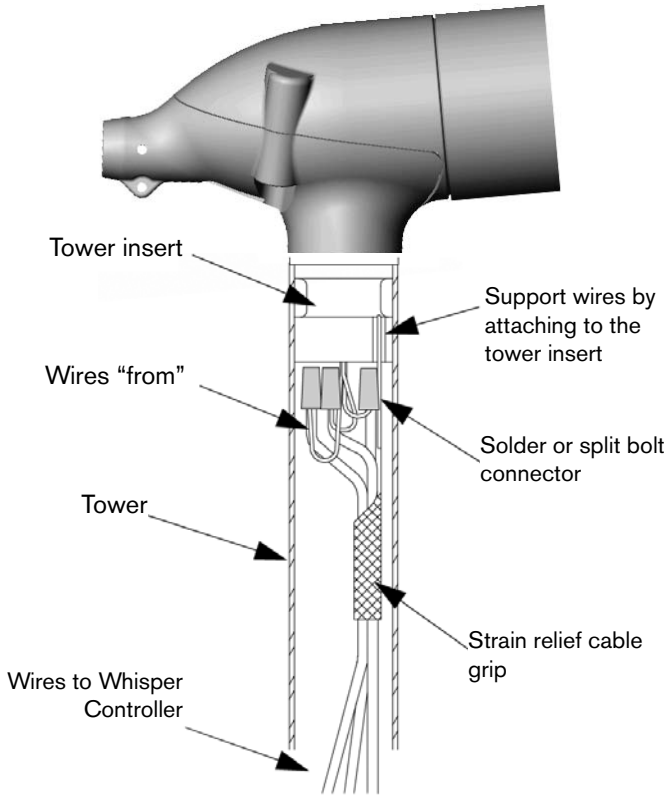
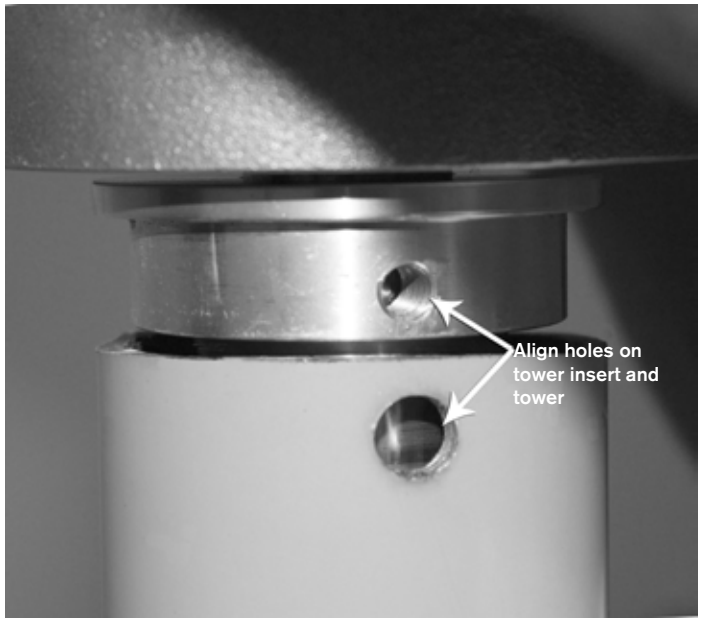
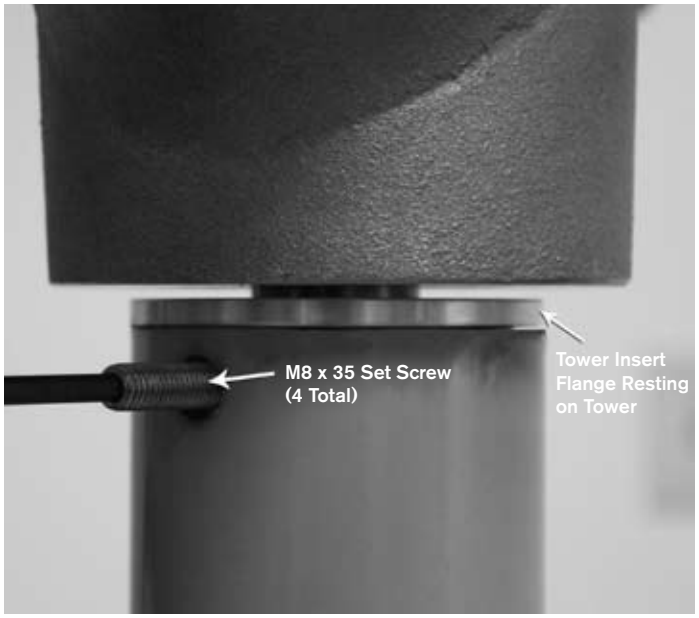


Mount Turbine to Tower







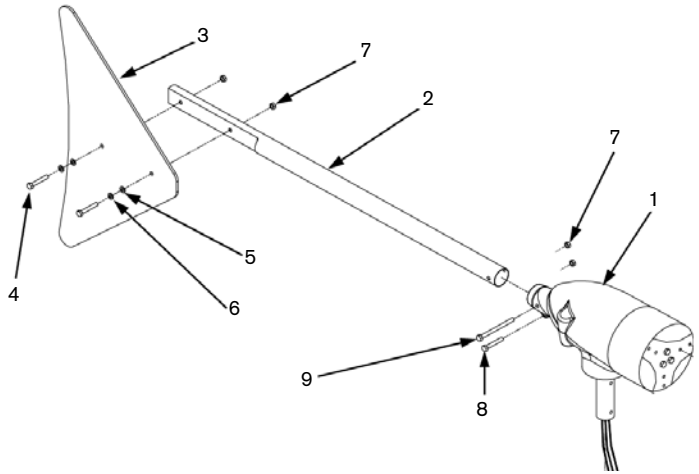
1) Solder or use split bolts to make electrical connections.

2) Wrap connections thoroughly with electrical tape to prevent shorts to tower.

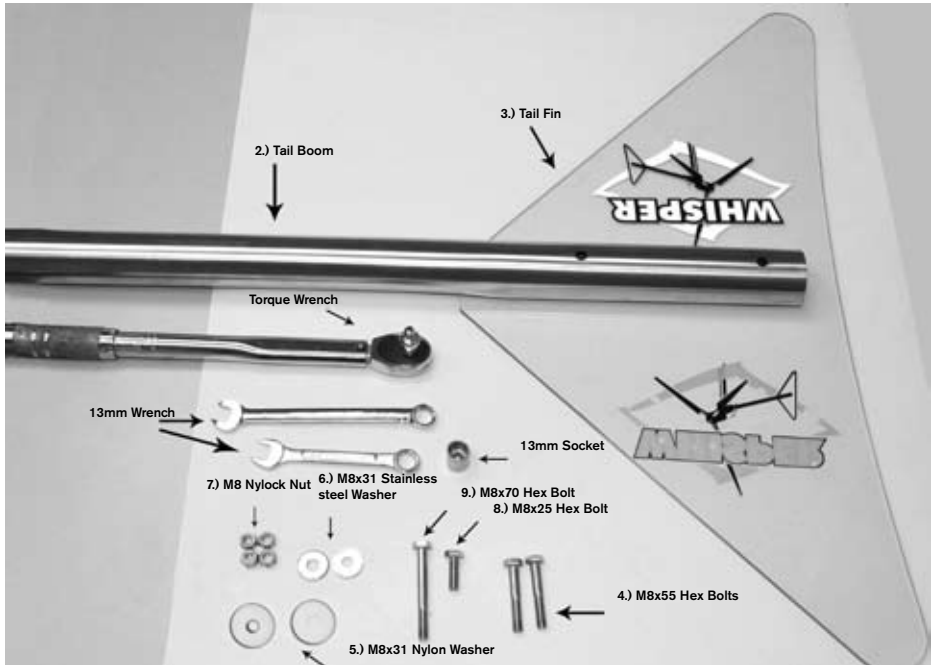
3) Support wires to avoid weight on slip ring wires and wire connections.

Tail Installation

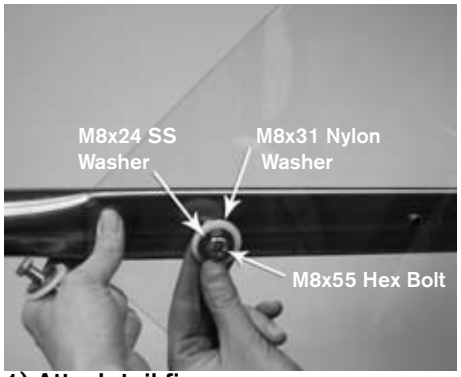
Item	Description	Quantity
1	Assembled Generator	1
2	Tail Boom	1
3	Tail Fin	1
4	Hex Bolts, M8 x 55	2
5	Nylon Washer, M8 x 31	2
6	SSTL Washer, M8 x 24	2
7	Nylock Nut, M8	4
8	Hex Bolt, M8 x 25	1
9	Hex Bolt, M8 x 70	1



Tail Installation Kit



Assemble Whisper Tail Fin

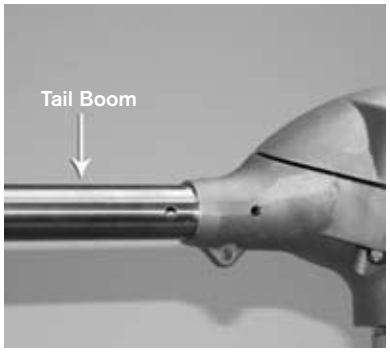


1) Attach tail fin.
Not shown: M8 Nylock Nut

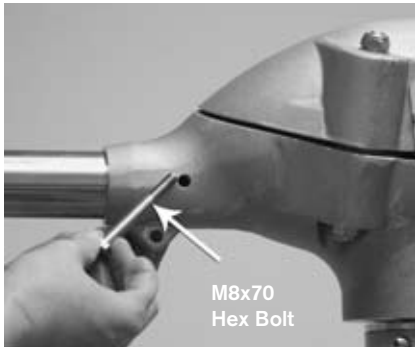
2) Apply Whisper sticker to top and bottom of fin.

3) Complete tailfin assembly.

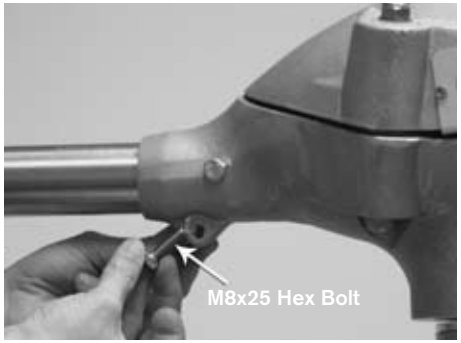
Mounting Tail Boom



4) Align holes when pushing tailboom into casting.

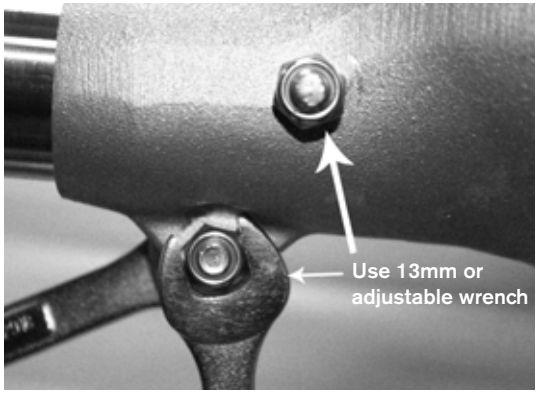


5) Secure tail boom anchor.



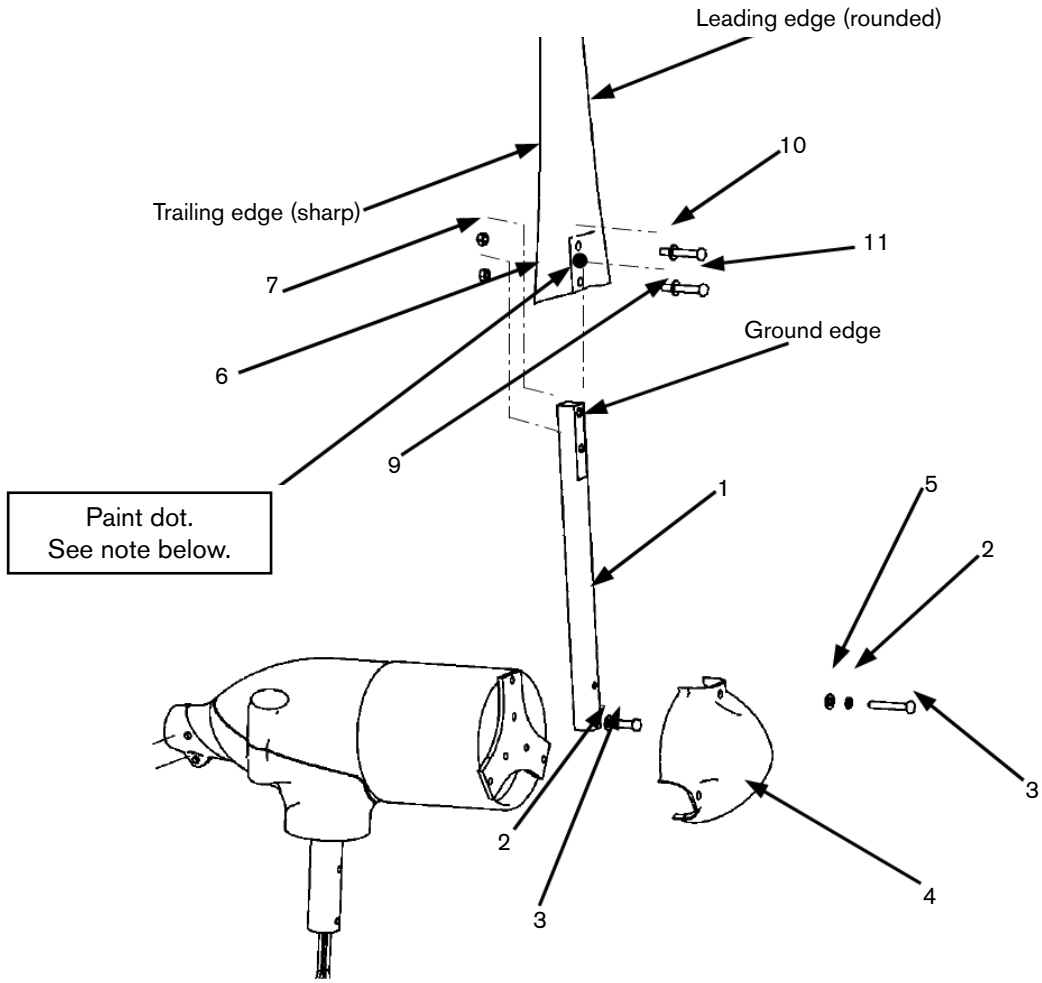
6) Tighten casting to secure tail boom.

7) Secure M8 nylock nuts



Whisper 200 Blade Installation

- **Make sure diversion switch is in the "stop" position.**
- Flat (non-ground) end of blade extension attaches to rotor.
- Ground edge of blade extension face toward blade.
- Use thread locking compound (Loctite 242 or equivalent) on all bolts.
- Torque all bolts to 24 N·m (18 lb-ft). Do not overtighten.



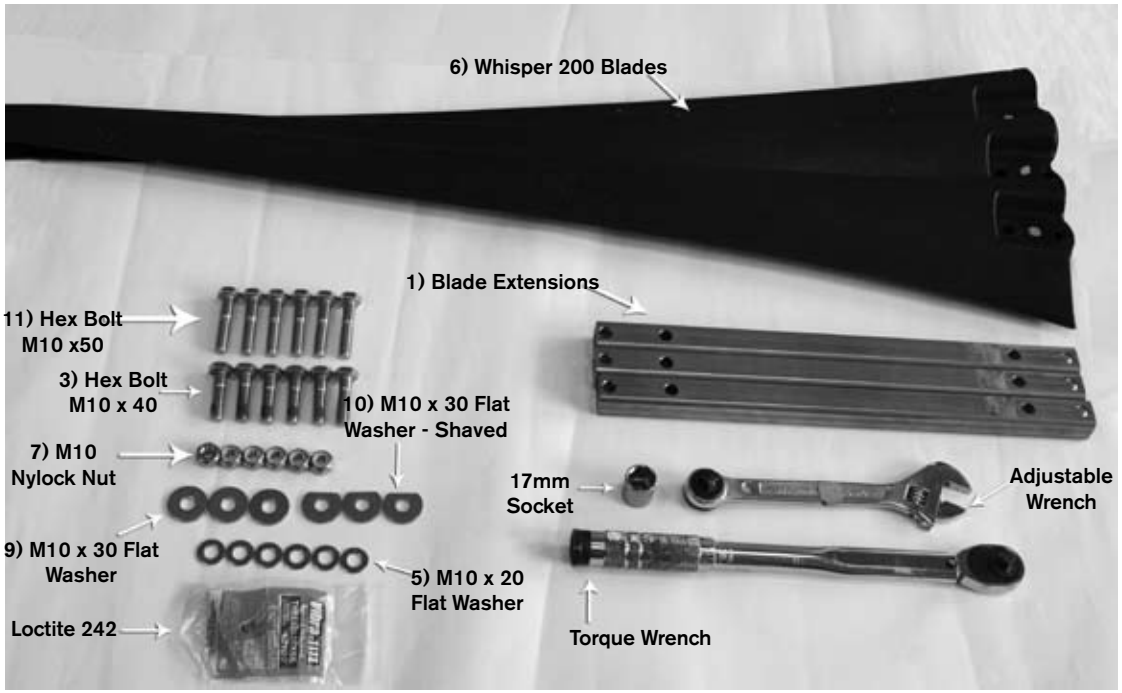
IMPORTANT for MARINE units: The enclosed packet of Tef-Gel should be used in threaded holes to prevent corrosion and screws becoming permanently seized into place.

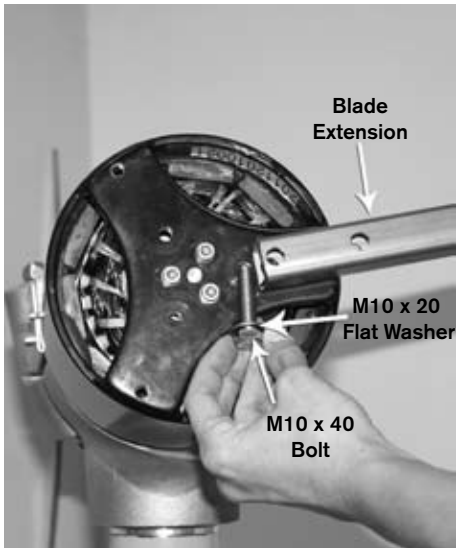
IMPORTANT: Each turbine blade has a paint dot on the "front " of the blade between the blade mounting holes. The blades should be bolted to the ground end of the blade extensions so that the paint dot is VISIBLE after the blades are mounted.

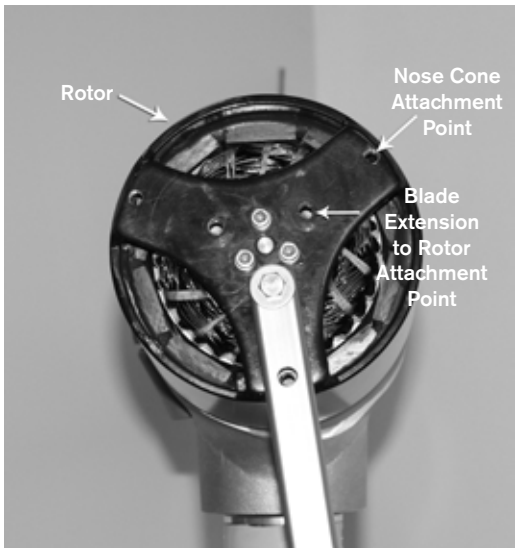
Item	Description	Quantity
1	SS Blade Extension	3
2	SS Lock Washer, M10	6
3	SS Hex Bolt M10 x 40	6
4	Nose Cone	1
5	SS Flat Washer M10 x 20 (Thin)	3

Item	Description	Quantity
6	Blade	3
7	SS Nylock Nut M10	6
9	SS Flat Washer M10 x 30 (Thick)	3
10	SS Shaved Washer M19 x 30	3
11	SS Hex Bolt M10 x 50	

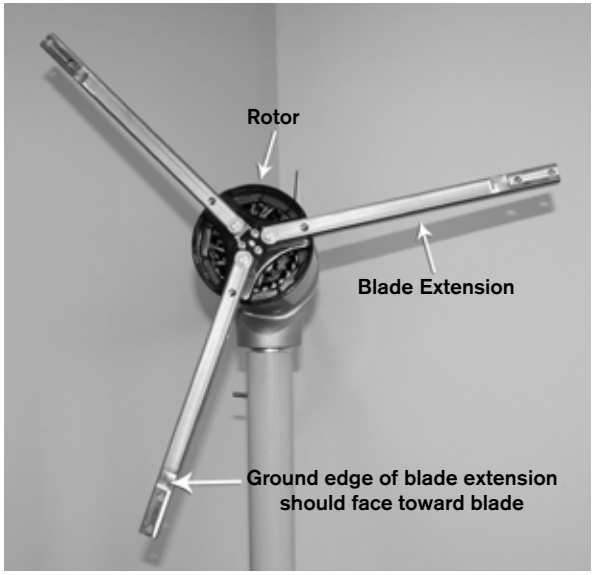
BLADE INSTALLATION



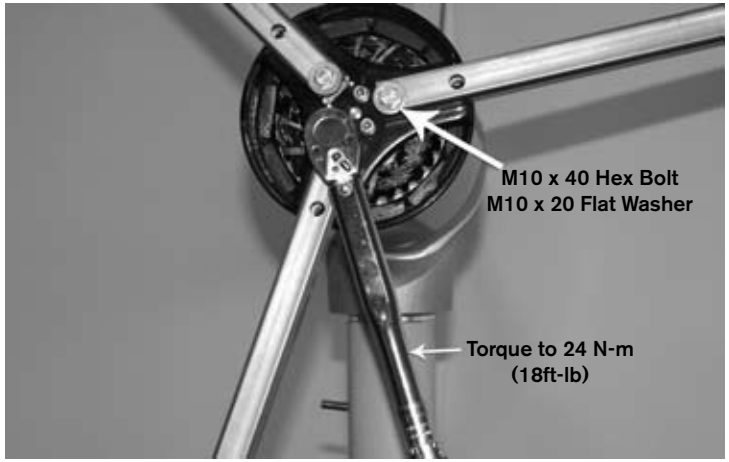




Attach blade extension to rotor.

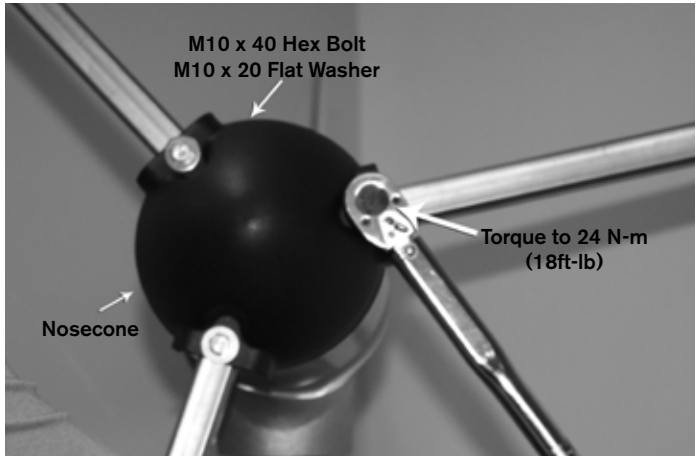


Ensure nose cone to rotor attachment hole lines up before tightening blade extensions.

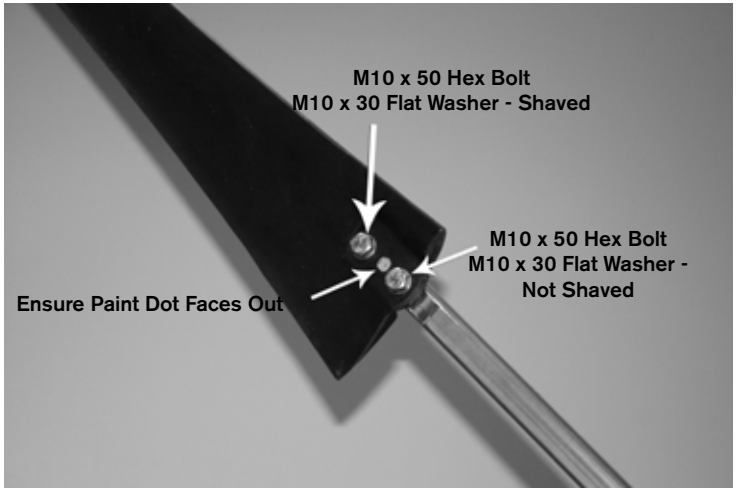


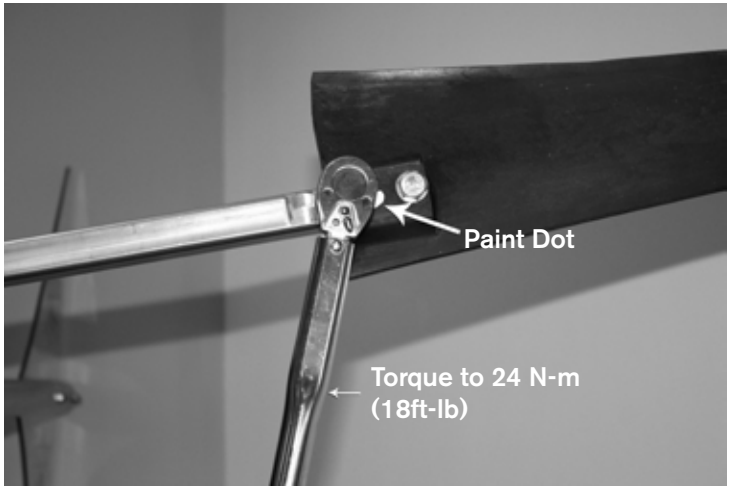
Any two tip distances should be equal distances apart to reduce vibration.

Attach nosecone to rotor.



Attach blades to blade extensions.



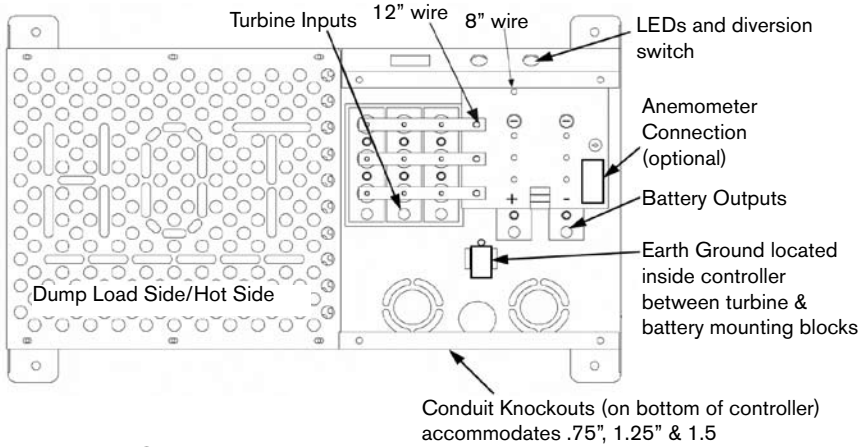


Final Assembly

Whisper Controller – Mounting

- When performing preliminary turbine to controller tests, temporarily mounting the controller close to wind turbine allows easy access while testing the turbine and controller functionality.
- Perform turbine to controller tests prior to mounting blades.
- Allow effective heat convection by mounting controller vertically against a wall.
- The dump load side of the controller gets very hot, DO NOT mount near flammable or heat sensitive materials.
- Controller is NOT rated for outside use and must be protected from the elements. Mount inside a protected building.

*Controller can be mounted as shown below, or rotated 90 degrees with dump load on top.



Whisper Controller – Wiring

Connecting

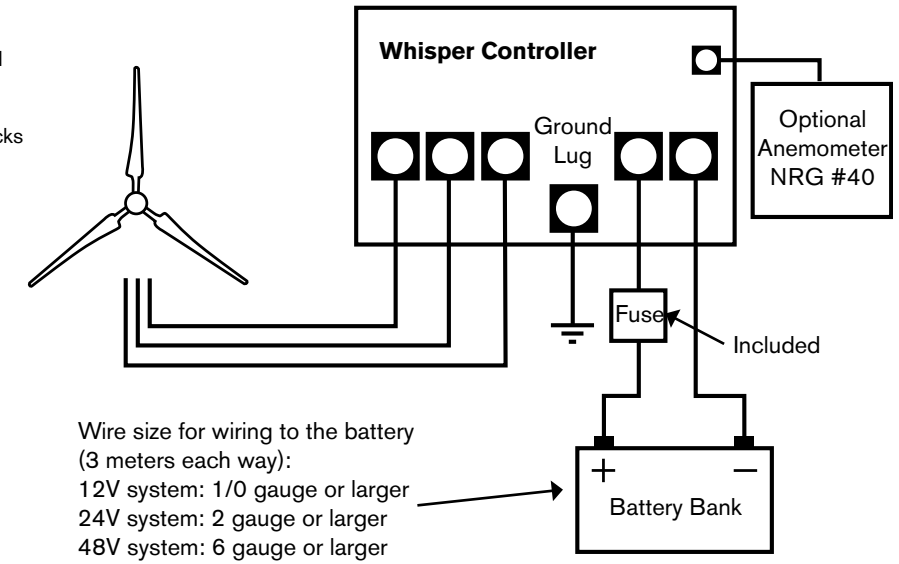
Remove the Controller electronic cover and connect the battery, turbine and ground wires as shown in the accompanying schematic.

Controller **MUST** be connected to the batteries **BEFORE** making the wind turbine connections.

Correct polarity **MUST** be observed when connecting battery cables.

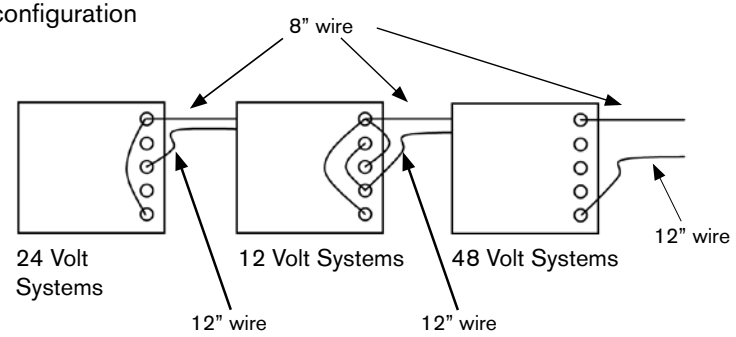
- Setting dip switch voltages before connecting to battery. See "Printed Circuit Board Switch Settings" section.
- Avoid shorting battery leads together when connecting the battery.
- Connect the battery to the controller. Confirm the microprocessor is energized by moving the diversion switch to the "stop" position; red LED should illuminate.
- If not, momentarily depress the "reset" switch on the controller PCB.
- Return the diversion switch to the battery position and observe the red LED to turn off.
- When connecting the battery do not allow the connection to power the microprocessor on and off quickly. This could cause the microprocessor to lock up.
- If the microprocessor locks up and reseting does not correct the problem, contact Southwest Windpower for instructions.
- After successful startup, cycle red LED by toggling the diversion switch then switch to "Stop"
- Connect turbine wires to controller (order is not important)

**When the red LED is on, the turbine will not spin as long as at least two of its wires are connected, except in strong winds.*



Dump Load Wiring

- Wire the resistive “dump” load for the correct system voltage
- Sufficient jumper wires are provided to achieve any system voltage configuration



Optional Anemometer Connection

- Whisper Controller is designed to accomodate a model #40 NRG anemometer (www.nrgsystems.com; Item Number 1900).
- Connect anemometer wires to labeled PCB terminal block.
- Anemometers require specific polarity; observe the labeling on the terminal block connections.
- If applicable, connect a grounding shield to the controller’s grounding terminal.
- Mount anemometer close to turbine without entering the turbine’s swept area (see manufacturer’s installation instructions).

Understanding Voltage Regulation:

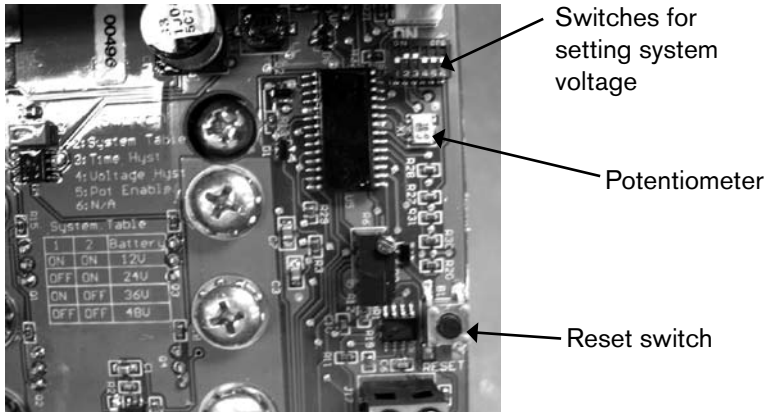
“Regulation-On”

- Controller is regulating battery voltage and diverting power to the dump load
- If the controller measures battery voltage **above** “regulation-on voltage” for more than 30-40 seconds, it begins diverting power

“Regulation-Off”

- Controller resumes battery charging
- If the controller measures battery voltage **below** “regulation-on voltage” for more than 30-40 seconds, it stops diverting power and begins battery charging

Whisper Controller - Printed Circuit Board Switches and Reset Button



- Six switches on the PCB are used to set operating system parameters.
- The default settings are suitable for most systems installations and should only be changed to alter system voltage.

Reset Switch:

- Whisper Controller operation is controlled by a microprocessor.
- The PCB reset switch resets the microprocessor. Depressing the reset switch has the same effect as disconnecting a battery cable.
- To reset momentarily press the reset button. If it is necessary to depress a second time, wait approximately 15 seconds.
- **Voltage regulation points set using the optional display setting will be lost if reset switch is depressed or a battery cable is disconnected; controller will revert to potentiometer set points.**

Printed Circuit Board Switch Settings

Switches 1 and 2, System Voltage
Select the correct system voltage by setting the position of switches 1 and 2 according to the following table.

System Voltage	Switch 1	Switch 2
12 Volt	ON	ON
24 Volt	OFF	ON
48 Volt	OFF	OFF

After changing the system voltage depress the reset switch to “read and save” the new voltage setting.

Switch 3 , Time Hysteresis, Default Setting “ON”

ON	30-40 second delay for controller to start or stop charging when regulation set point is reached
OFF	No-delay – charging will stop or start immediately when regulation set point is reached

It is not necessary to depress the Reset Switch after changing the switch setting.
Southwest Windpower STRONGLY recommends Switch 3 remain in ON position

Switch 4, Voltage Hysteresis, Default Setting “OFF”

OFF	Controller starts or stops charging at the voltage regulation points set through optional display or by the PCB potentiometer
ON	Voltage regulation-on point (battery stops charging) set using potentiometer increases by: - 1.0 volts for 12V systems - 2.0 volts for 24V systems - 4.0 volts for 48V systems Votage regulation-off point (battery charging resumes) is not affected Voltage hysteresis switch does not increase the regulation on and off set points using the optional display

Switch 5, Potentiometer Enable, Default Setting “OFF”

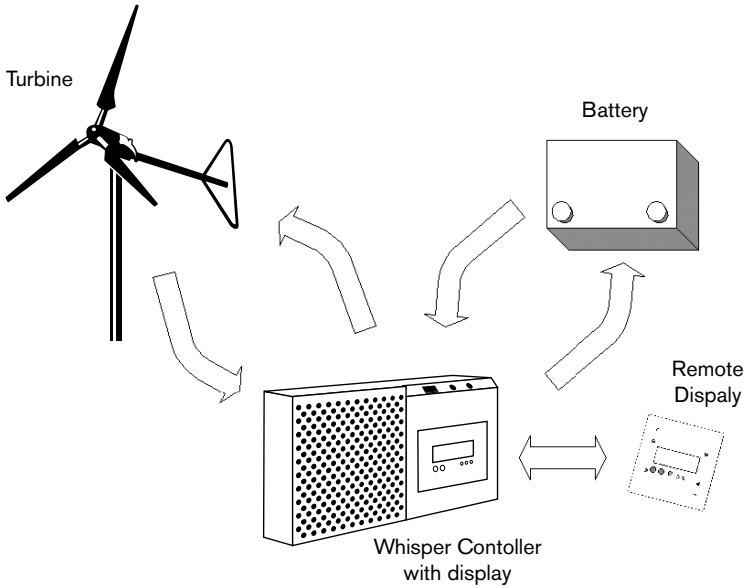
ON	Enables reading potentiometer voltage in real time. Resolution limits are: - 0.2 volts for 12V systems - 0.4 volts for 24V systems - 0.8 volts for 48V systems Voltage regulation points must be set using potentiometer not optional display
OFF	Prevents changing the voltage regulation point using the potentiometer

It is not necessary to Reset after changing the switch 4 & 5 settings.

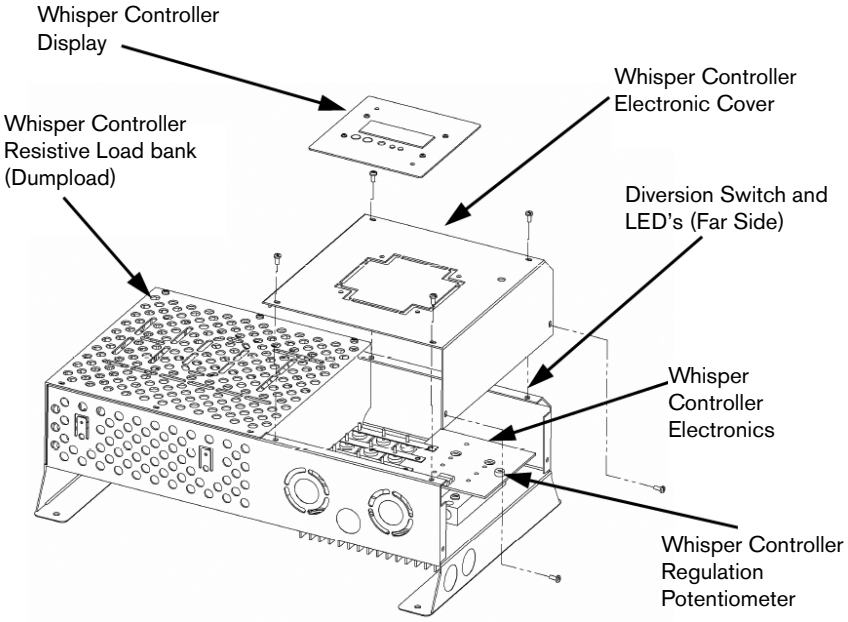
Before adjusting the Voltage Regulation-On set-point understand that increasing the voltage will not increase the turbine’s output voltage or current. This set-point only adjusts the “shut-down” voltage for battery charging. Overcharging will significantly reduce a battery’s life expectancy.

Switch 6, Default Setting “OFF”
There is no function presently associated with this switch. SWWP recommends leaving the switch in the OFF position.

OPERATION AND ADJUSTMENTS



Whisper Controller Components



Operation of the Whisper Controller

1) Overview

– Controls and converts turbine power. Functions:
- Rectifies power from wild AC to DC voltage
- Contains diversion load & controls voltage regulation
- Monitors voltage, current, energy production and wind speed (if equipped)

– Optional LCD Display:
- Offers instant access to operational parameters and performance measurements; voltage, current, power, energy, charge, peak power and wind speed (if equipped)
- Display LEDs function same as controller LED

2) Normal Operation

– Interface mechanisms: LED, diversion switch, voltage regulation adjustment, PCB configuration switches and LCD display (if equipped)

– Interface allows setting regulation voltage, monitoring system

3) Diversion Switch

– Diverts power from batteries to dump load to avoid battery overcharging

– Considerations if activated:
- Will not stop a spinning turbine but will not allow a stopped turbine to start spinning
- If turbine blades are spinning, it is normal and safe

4) LED Operation

Red LED = Power diverted to dump load;
Green LED = Turbine is charging battery

LED INDICATORS		
RED	GREEN	INTERPRETATION
OFF	ON	Battery charging
BLINKING	OFF	Power to diversion load to regulate battery voltage
ON	OFF	Power to diversion load by operator request (via Diversion Switch or remote Display).

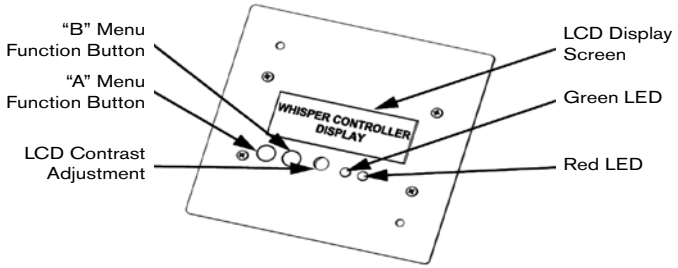
5) Setting Regulation Voltage (without Display) *See page 22 - Switch 5

- Turning the potentiometer clockwise (CW) increases the voltage set points. Use following chart for approximate potentiometer set points.

Note: Determine the initial potentiometer position by turning fully counter clockwise (CCW). Count and record the number of turns.

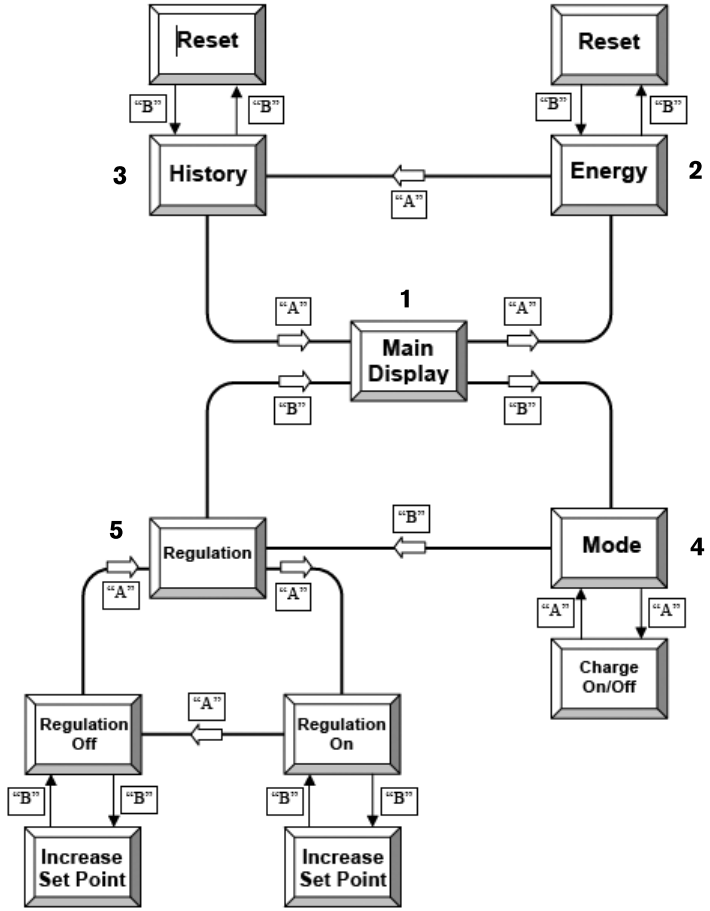
Pot Position	Regulation Off Voltage	Regulation On Voltage
Fully CCW	12.0V 24.0v 36.0v 48.0v	13.0V 26.0v 39.0v 52.0v
1/4 Turns CCW	13.0V 26.0v 39.0v 52.0v	14.0V 28.0v 42.0v 56.0v
Factory Preset	13.4V 26.8v 40.2v 53.6v	14.4V 28.8v 43.2v 57.6v
1/2 Turns CW	14.0V 28.0v 42.0v 56.0v	15.0V 30.0v 45.0v 60.0v
3/4 Turns CW	14.0V 28.0v 42.0v 56.0v	16.0V 32.0v 48.0v 64.0v
Fully CW (18 turns)	14.0V 28.0v 42.0v 56.0v	17.0V 34.0v 51.0v 68.0v

6.) Whisper Controller Display (Optional)



- Designed to mount on:
  - Whisper controller base unit (a short CAT5 Ethernet cable is provided) or 4" wall type switch receptacle
- If mounted on controller, connect CAT5 to jack closest to diversion switch to disable controller LED
- Mounting on Whisper Controller
  - Remove electronics cover
  - Remove sheet metal insert where display will mount
  - Use hardware provided to mount display to electronics cover
  - Hardware: 8-32 x 3/8" black oxide SS screws and 8-32 nuts with captive star washers
- If mounted remotely, the display can be mounted up to 300 m (1,000 ft) from controller; longer CAT5 cable must be purchased by user.
- Verify display function: text should appear on LCD display after display and batteries are connected to controller.
- It may be necessary to adjust LCD contrast:
  - Locate small hole between buttons and LEDs
  - Insert small screwdriver through display cover
    - Turn clockwise to lighten
    - Turn counter-clockwise to darken
- If text is still not visible, disconnect & reconnect cable to display to reset.

Display Menu Ring Structure



Display Menu Functions

Ref #	Page	Display			Menu Select	Effect
1	Main	On or Off		00.0 mph	"A"	go to A ring
		11.3V	00.0A	000W	"B"	go to B ring
			A Ring			
2	Energy	KWh	0000	000.00	"B"	go to reset menu
		kAh	0000	000.00		
	Reset Menu	Reset kWh?	A: RESET	B: CANCEL	"A"	reset power
					"B"	return to reset menu
3	History	Mph: pow:	00.0a 00.0a	00.0p 00.0p	"B"	go to reset menu
	Reset Menu	Reset Page?	A: RESET	B: CANCEL	"A"	reset readings
					"B"	return to reset menu
			B Ring			
4	Mode	Mode:	On		"A"	batteries charging
		A: OFF_REM	B: SKIP		"B"	go to regulation set menu
		Mode:	Off		"A"	batteries diverted
		A: ON_REM	B: SKIP		"B"	go to regulation set menu
5	Regulation Set	REGULATION SET:			"A"	change regulation point
		A: CHANGE	B: SKIP		"B"	return to Main Menu
	Regulation On	Regulation ON voltage:			"A"	go to regulation off menu
		15.8v			"B"	Increase ON set voltage
	Regulation Off	Regulation OFF voltage:			"A"	go to regulation set menu
		12.8V			"B"	Increase OFF set voltage

1) Main Page

- Displays controller's measurements: battery charging status, voltage, and current and turbine power and windspeed (if equipped)
- Main display leads to four sub-pages by selecting "A" or "B" functions
  - "A" – Energy and History menu pages
  - "B" – Mode and Regulation menu pages

2) Energy Page

- Displays accumulated kWh and kAh since last reset
- Accumulated data can be reset by selecting menu option "B"
- Menu option "A" goes to the History page

3) History Page

- Displays average and peak windspeed and turbine power since reset
  Note: windspeed is only available if anemometer is installed
- Reset accumulation data by selecting menu option "B"
- Menu option "A" goes to the Main Display page

4) Mode Page

- Displays current charge mode
  - If "ON" is displayed the battery can be charged; turbine will spin in adequate wind
  - If "OFF" is displayed turbine power produced is diverted to dump load; turbine will not spin in light winds
  - "A" menu button toggles the mode
  - "B" menu button returns to Regulation Set page
- Controller can switch to "OFF" mode in the following conditions"
  - "OFF_REM" - turbine power is diverted to dump load via request from remote display
  - "OFF_MAN" - turbine power is diverted to dump load when diversion switch is moved to "Stop" position
  - "OFF_REG" - turbine power is diverted to dump load via automatc regulation at present voltage

**Diversion switch set to "OFF" overrides Remote Display "ON" function*

5) Regulation Page

Digitally set "regulation on" and "regulation off" voltages using the Regulation Setpage Menu

- Select "A: CHANGE" for "Regulation ON" subpage for voltage changes
  - "B" menu button increases voltage to 17V maximum. At 17V, if pressed again, the voltage rolls back to 13V
  - "A" menu button brings up "Regulation OFF" subpage
    - "B" menu button increases voltage to a maximum of one volt lower than "Regulation ON" voltage. At maximum, if pressed again, the voltage rolls back to 12V
    - "A" menu button returns to Regulation Set page
- Select "B:SKIP" to return to Main Display Page

*Regulation Off voltage cannot be specified above Regulation On voltage

MAINTENANCE AND REPAIR

Maintenance – Monthly

1) Test Diversion Control (check electrical wiring)
- Divert the load by setting the diversion switch to “stop” in a moderate wind (charging but not furling)
- No unusual difficulty or noise should be experienced in stopping the blade rotor
- A noise during diversion can indicate a disconnected wire

2) Check Mechanical Condition
- Watch and listen from the tower base. There should be no mechanical noise, rattle or vibration and the blades and tail must not wobble
- If you hear mechanical noise, rattle or vibration, or see blade or tail wobble, lower the tower for inspection
- If you experience any of these conditions, refer to Troubleshooting and Repair

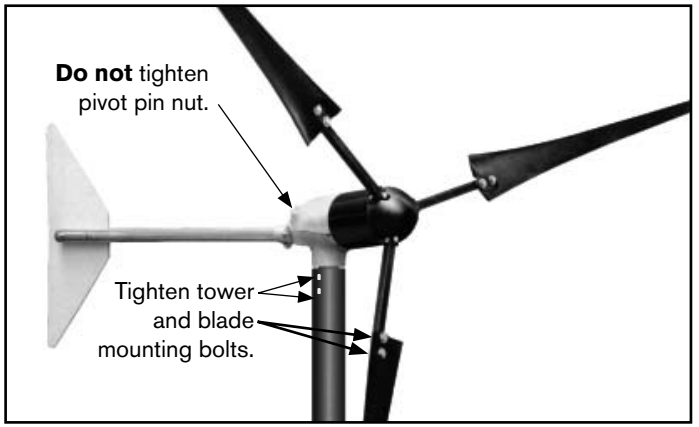
3) Inspect the Tower
- Follow all inspection and maintenance requirements of the tower manufacturer
- Tighten all nuts and bolts, especially wire clips
- Check for cracks and bent/broken parts at the anchors and base
- Check for broken strands and tighten wires

4) Check the Battery
- Consult your battery manufacturer maintenance guide
- Tighten battery connections
- Remove corrosion and protect terminals

Maintenance - Annual

Lower the tower and give wind generator a complete inspection. Fix or replace any warn or loose parts.

a) Check tightness of all tower and blade nuts and bolts
b) Check all bearings
c) Clean the blades with a mild detergent to remove all dirt and debris. Replace blades if they are cracked or damaged
d) Check the pivot bushing and bore. Lay the turbine down while it is completely unfurled (the normal operating position), and see if you can wobble the lower half. If it wobbles significantly (noticeable play), then the bushing and/or bore is ovalized. Replace the bushing first and retest it. If it still wobbles then the castings need to be replaced.



Maintenance Log
Observe monthly and annual inspection requirements. Record all maintenance and repair work.

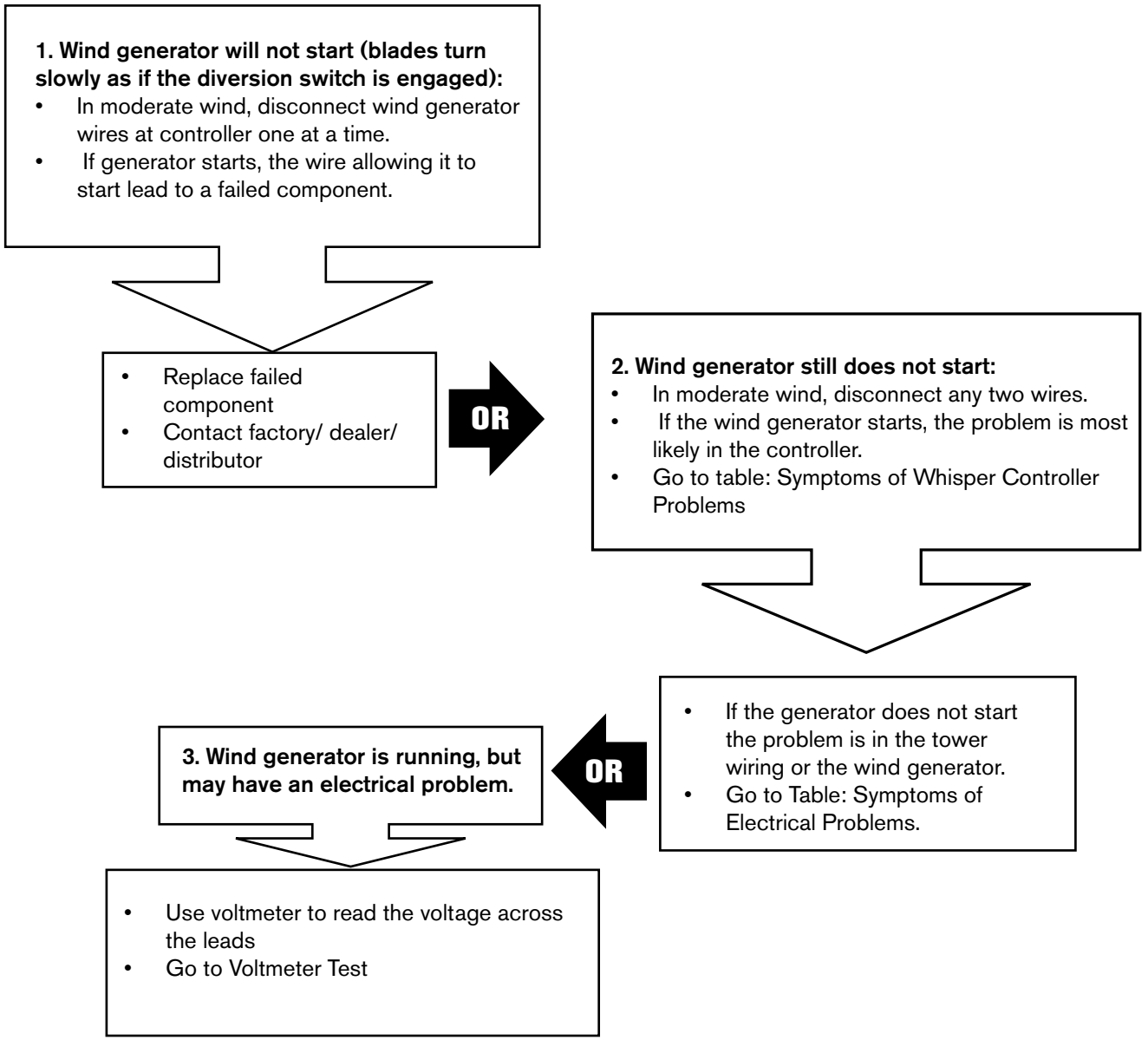
Date	Problem/Observation	Action Taken

Troubleshooting and Repair

Table: Symptoms of Mechanical Problems

Symptom	Probable Cause	Correction
Blade rotor is stationary, even in high winds	a) Ice in generator, or on blades	a) Wait for warm weather. Leave running unless vibration is substantial
	b) Debris between rotor and stator	b) Turn blades gently by hand and use thin material to dislodge debris
	c) Loose, broken or rubbing magnet	c) Remove rotor and re-glue magnets – contact factory/ dealer/ distributor
	d) Bad or worn bearing	d) Contact factory or distributor
Blade rotor will not turn at all except in high wind, scraping or rubbing sound at low rpm, always stops at same blade position	a) Same as above, except more likely to be high magnet or bad bearing.	a) Same as above
Blade rotor is hard to start, output is lower & there is more blade noise than usual; appears out of balance.	a) Ice on blades	a) Wait for warm weather. Leave running unless vibration is substantial
	b) Dirty blades	b) Clean with mild detergent
	c) Damaged blade(s)	c) Replace damaged blade – contact factory/ dealer/ distributor
	d) Blade(s) on backwards	d) See blade installation
Blade rotor turns slowly, never spins rapidly	a) Blades on backwards.	a) See blade installation
Tail, generator and tower vibrate or shake excessively at all or some wind speeds	a) Blade out of balance	a) Replace blade – contact factory/ dealer/ distributor
	b) Blade not tracking	b) Contact factory/ dealer/ distributor
SAFETY FIRST - shut down turbine until a physical inspection can be performed.	c) Rotor out of balance	c) Contact factory/ dealer/ distributor
	d) Shorted alternator or wiring	d) Perform phase-to-phase testing
Rattle or clunking from generator	a) Generator loose in tower. Rotor loose on shaft, loose tail, missing rubber bumper, wires slapping inside of mast, governor pivot bolt loose	a) Inspect for damage and repair as required Retighten mounting hardware, use Loctite or equivalent thread-locking compound.
	b) Worn bearings	b) Replace bearings – contact factory/ dealer/ distributor
SAFETY FIRST - shut down turbine until a physical inspection can be performed.	c) Shaft broken	c) Replace shaft – contact factory/ dealer/ distributor

Electrical Diagnosis - Determining the Type of Electrical Problem



Voltmeter Test

Test	What it tells you
1. Voltage increases and decreases slowly relative to wind speed across all combinations of paired wires	• Everything is OK.
2. No voltage across one set of two wires	• One wire from the wind generator is not carrying power. Check the tower wiring and controller connections to ensure proper wiring. • If the wiring is correct contact authorized factory/ dealer/ distributor for further assistance.
3. Voltage significantly higher across one set of two wires than the others	• Possibly a shorted diode. Contact factory/ dealer/ distributor.
4. Voltage significantly lower across one set of two wires than the others	• There is a bad connection at wind turbine voltage connections or faulty stator winding. Contact factory/ dealer/ distributor.

Should these results appear inconclusive in determining the problem proceed directly to Table: Symptoms of Electrical Problems or see Table: Symptoms of Whisper Controller Problems below.

Table: Symptoms of Whisper Controller Problems

Symptom	Probable Cause	Correction
Blade rotor turns slowly, even in strong wind	a) Brake switch ON b) Shorted diode c) Dead or disconnected battery d) Short in wiring to turbine	a) Move switch to “OFF” b) Contact factory/ dealer/ distributor c) Ensure battery voltage at controller terminals is at least 10v, 20v, 32v, or 44v depending on turbine model d) See Table of Electrical Problems
Doesn’t regulate, red LED off and dump load is cold	a) Battery volts below setting b) Bad circuit board	a) Check battery with voltmeter (see Voltmeter Test). Adjust voltage setting b) Contact factory/ dealer/ distributor
Doesn’t regulate, red LED on and dump load is cold	a) Dump load burned out, disconnected or wired incorrectly b) Bad connection from circuit board to power block	a) Contact factory/ dealer/ distributor b) Contact factory/ dealer/ distributor
Dumpload always on, red LED on	a) Wrong battery voltage setting b) Bad circuit board c) Diversion switch set to “Stop” or disconnected	a) Check battery with voltmeter (see Voltmeter Test) Adjust voltage setting b) Contact factory/ dealer/ distributor c) Move diverson switch to “Start”. Check and restore connection, if needed

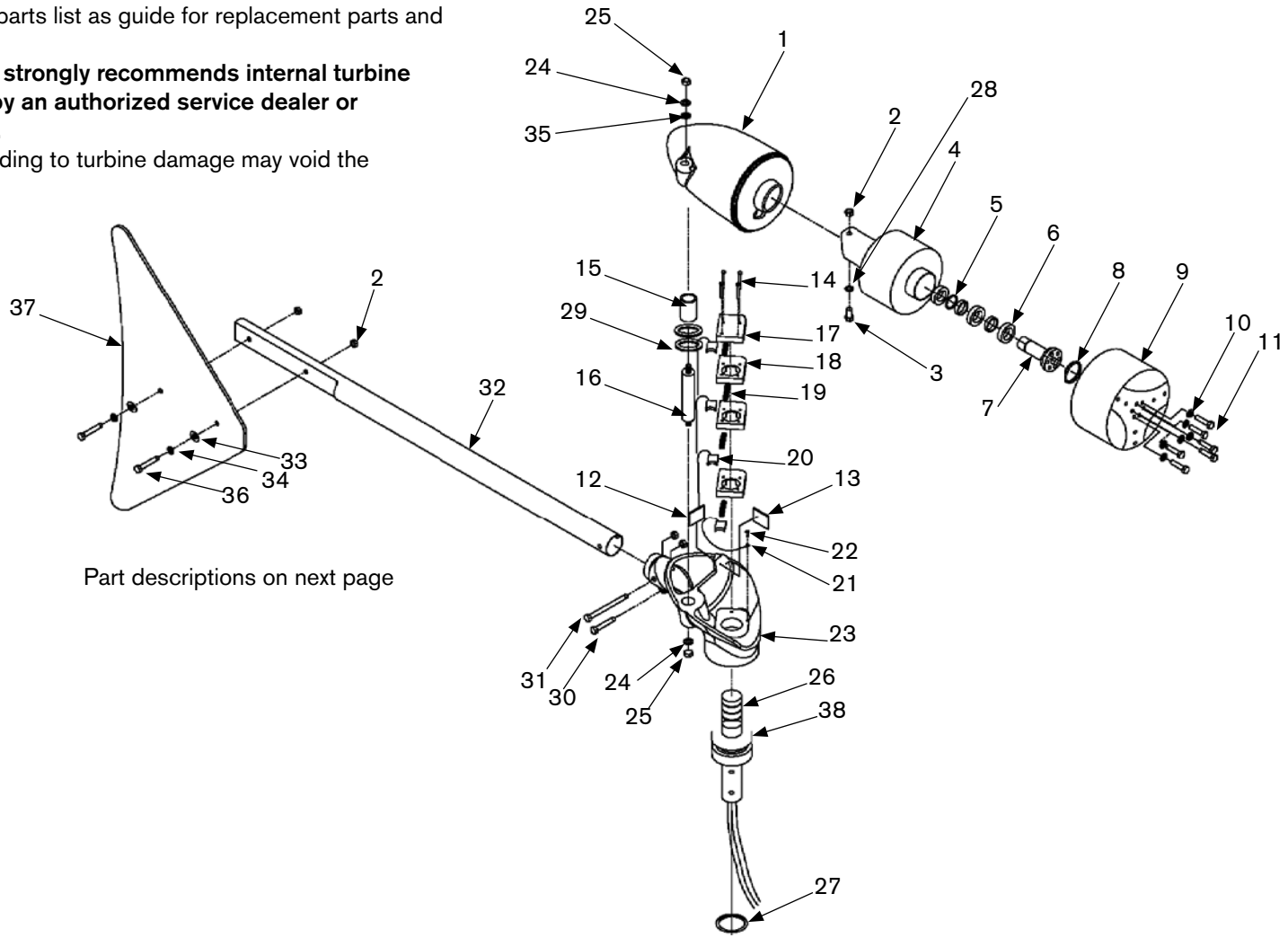
Table: Symptoms of Electrical Problems

Symptom	Probable Cause	Correction
Blade rotor will not turn or turns slowly, even in high wind	a) Diversion switch is ON. b) Battery is dead (voltage less than 1/2 nominal) c) Incorrect turbine wiring. d) Short circuit in wiring from generator to controller e) Failed component in controller f) Short circuit in brush card or slip ring assembly g) Short circut in turbine	a) Turn Diversion switch to Battery position b) Disconnect load and /or battery from generator until it starts; charge battery c) Rewire d) Check wiring from generator to controller e) See Voltmeter Test f) Contact factory/ dealer/ distributor g) Contact factory/ dealer/ distributor
Blade rotor runs too fast, may whistle; no output, no unusual mechanical noise	a) Two or three wires open between turbine and controller b) Controller diodes open or wire is disconnected at diode terminal c) Battery voltage over 50% d) Turbine may be in regulation, but wind is too high for turbine to stop e) Load or battery disconnected	a) See Voltmeter Test b) See Voltmeter Test c) Examine battery specifications and regulation set point. Replace improperly sized battery if necessary d) Wait for calmer conditions. Engage diversion switch to determine proper operation e) Check all connections
Blade rotor runs too fast, may whistle, output less than 50% for wind speed, growling , buzzing or vibration felt by hand or mast	a) Disconnect wire between turbine and controller b) One open or disconnect diode c) One slip ring or brush not making good contact	a) See Voltmeter Test b) See Voltmeter Test c) Contact factory/ dealer/ distributor
Blade rotor runs too slowly, low output, no unusual mechanical noise	a) Battery voltage low or dead battery b) Incorrect turbine wiring	a) Disconnect loads and let battery charge b) Check turbine wiring connections or rewire
Green charge light comes on momentarily during wind gusts or only comes on in very high wind conditions	a) The turbine and controller voltage settings may be set to different voltage configurations	a) Verify the turbine output wiring, the diversion load and the controller DIP switch are configured to the same voltage

Whisper 200 Exploded View

Mechanical Repairs and Parts Replacement

- Use exploded view and parts list as guide for replacement parts and troubleshooting.
- **Southwest Windpower strongly recommends internal turbine repairs be performed by an authorized service dealer or Southwest Windpower.**
- Unauthorized repairs leading to turbine damage may void the warranty.



Part descriptions on next page

Do not attempt repairs on top of the tower. Perform repairs only after tower has been lowered.

Whisper 200 Exploded View Parts List

No.	Description	Qty.	Part No.
1	Casting-Upper-Machined-100/200-Land Casting-Upper-Machined-100/200-Marine	1	3-CMBP-1225-02 3-CMBP-1225-04
2	Nylock Nut, M8	1	3-HDNT-201-02
3	Hex Head Cap Screw M8 x25	1	3-HDBT-2004-69
4	Stator-200-Land-LV Stator-200-Marine-LV Stator-200-Land-HV Stator-200-Marine-HV	1	3-CMBP-1199-01 3-CMBP-1199-02 3-CMBP-1199-03 3-CMBP-1199-04
5	Snap Ring-20mm-Zinc	1	3-CAOT-1064
6	Bearing-6204-Sealed Bearing-6204-Shielded	2 2	3-CABR-1003 3-CABR-1007
7	Spindle-100/200	1	3-CMBP-1139
8	Snap Ring-49mm-Zinc	1	3-CAOT-1066
9	Rotor-200	1	3-CMBP-1128-02
10	Washer M6, SS	6	3-HDWA-200-07
11	Socket Head M6 x 16	6	3-HDBT-2000-035
12	Stop Bumper	1	3-CMBP-1177
13	Stop Bumper	1	3-CMBP-1177
14	Screw-PPH-M5 x 60	4	3-HDBT-2001-027
15	Bushing-Bronze	1	3-CAOT-1052
16	Pivot Shaft-100/200	1	3-CMBP-1122
17	Cover-Brush Card	1	3-CMBP-1055
18	Brush Card Holder	1	3-CMBP-1056
19	Brush-Spring 1”	3	3-CAOT-1050
20	Brush-Transmission-No Sonic Weld	2	3-CMBP-1054-05
21	Brush-Ground	1	3-CMBP-1054-02
22	Ground Screw M5 x 10	1	3-HDBT-2001-017
23	Casting-Lower-Machined-100/200-Land Casting-Lower-Machined-100/200-Marine	1	3-CMBP-1226-02 3-CMBP-1226-04
24	Washer, M8 x 16	1	3-HDWA-102-10
25	Nylock Nut, M10	2	3-HDNT-201-03
26	Yaw Shaft Assembly-100/200	1	3-CMBP-1194

No.	Description	Qty.	Part No.
27	Snap Ring-69mm-Zinc	1	3-CAOT-1067
28	Washer-Bronze-1” x 1-1/2” x 1/16”	3	3-HDWA-904
29	Hex Bolt, M8 x 25 SS	1	3-HDNT-2004-069
30	Hex Bolt, M8 x 70 SS	1	3-HDBT-2006-077
31	Tail Boom-200	1	3-CMBP-1181
32	Washer-Flat-Nylon-1.235” x .365” x 1.1”	2	3-HDWA-905
33	Washer-Flat-Metric-SS-A2-M8 x 24	2	3-HDWA-201-09
34	Washer-Nylon-#10	1	3-HDWA-920
35	Screw-HHCS-M8 x 55-SS-A2	2	3-HDBT-2006-074
36	Tail Fin-200	1	3-CMBP-1143
37	Bearing-6206-Sealed	2	3-CABR-1004

Whisper Wind Turbine Warranty Agreement

Hardware Warranty

Southwest Windpower, Inc., ("Southwest Windpower") will repair or replace free of charge any part or parts of the Southwest Windpower Whisper™ Wind Turbine determined by Southwest Windpower to be defective in materials and/or workmanship under normal authorized use consistent with product instructions for a period of five years from the date the original purchaser ("Customer") receives the Wind Turbine ("Start Date"). This warranty extends only to the original purchaser. The Customer's sole and exclusive remedy and the entire liability of Southwest Windpower, its suppliers and affiliates under the warranty is, at Southwest Windpower's option, either (i) to replace the Wind Turbine with new or reconditioned Wind Turbine, (ii) to correct the reported problem, or (iii) to refund the purchase price of the Wind Turbine. Repaired or replaced products are warranted for the remainder of the original warranty period.

Restrictions

Problems with the Wind Turbine Products can be due to improper use, lack of maintenance, non-Southwest Windpower additions or modifications or other problems not due to defects in Southwest Windpower's workmanship or materials. No warranty will apply if the Wind Turbine (i) has been altered or modified except by Southwest Windpower, (ii) has not been installed, operated, repaired, or maintained in accordance with instructions supplied by Southwest Windpower, (iii) has been exposed to winds exceeding 120 mph (54 m/s), (iv) or has been subjected to abnormal physical, thermal or electrical stress, misuse, negligence, or accident. If Southwest Windpower's repair facility determines that the problem with the Wind Turbine is not due to a defect in Southwest Windpower's workmanship or materials, then the party requesting warranty service will be responsible for the costs of all necessary repairs and expenses incurred by Southwest Windpower.

Warranty Claims & Return Procedures

In order to be eligible for service under this warranty the Customer MUST return the warranty registration card included with this Warranty Agreement within 60 days of purchasing the Wind Turbine. Additionally, the Customer must submit a service request for Wind Turbine covered by this warranty within the warranty period by contacting Southwest Windpower in writing or via telephone and obtaining a Return Authorization ("RA") number. This RA must be obtained before returning any product under this warranty.

Notification must include a description of the alleged defect, the manner in which the Wind Turbine was used, the serial number, and the original purchase date in addition to the name, address, and telephone number of the party requesting warranty service. Within 3 business days of the date of notification, Southwest Windpower will provide the Customer with a RA number and the location to which the Customer must return the defective Wind Turbine. Any Wind Turbine requiring warranty repair shall be transported at the expense and risk of the party requiring warranty service, including but not limited to proper packaging of the Product. The Customer must return the entire Wind Turbine kit within 30 days after issuance of the RA number. Southwest Windpower will be under no obligation to accept any returned Wind Turbine that does not have a valid RA number. Customer's failure to return the Wind Turbine within 60 days of its receipt of a RA number may result in cancellation of the RA. All parts that Southwest Windpower replaces shall become Southwest Windpower's property on the date Southwest Windpower ships the repaired Wind Turbine or part back to the Customer. Southwest Windpower will use all reasonable efforts within five days of receipt of the defective Wind Turbine to repair or replace such Wind Turbine. If a warranty claim is invalid for any reason, the Customer will be charged at Southwest Windpower's then-current rates for services performed and will be charged for all necessary repairs and expense incurred by Southwest Windpower.

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