
BEL-v150 Turbine
Installation & Operation Guide



A silent and robust vertical axis wind power for a range of off-grid applications...

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Warranty Registration

Please register your product with us so that we can administer your warranty entitlement.

Customers are required to keep an original copy of their invoice should questions arise requiring reference to purchase information.

Read this first

1. Don't connect the wind turbine in the wrong polarity

Make sure you connect the +ve of the turbine to the +ve of the battery (red to red) and the -ve of the turbine to the -ve of the battery (black to black). Failing to do so will damage the equipment and invalidate your warranty.

2. Don't connect the Diversion Charge Controller in series with the turbine

If you choose to install a diversion charge controller (optional), always ensure that the turbine and the controller are connected to the battery separately.

3. Don't allow the turbine to run without being connected to the battery

Failing to do so will result in the turbine freewheeling causing premature wear and tear and unnatural blade noise.

Introduction

Please read this manual thoroughly before attempting to assemble, install or operate your BEL-v150 small wind turbine. This will assure optimum performance and safety.

The BEL-v150 turbine features an array of innovations and construction techniques as well as heavy-duty engineering to ensure optimum efficiency and a long operating life.

The BEL-v150 has been designed to be simple, economic, durable and yield excellent performance.

Specific BEL-v150 turbine features:

- Innovatively designed axial flux alternator, using neodymium iron boron magnets
- Bearing support at both ends of the savonius rotor to provide stability and longevity
- Maintenance-free, low friction bearings
- Silent operation
- Easy installation
- Simple design for low cost and durability
- Fully marinised using stainless steel fixings and anodised aluminium components
- Low mass to help reduce exerted forces and ensure easy installation.

BEL-v150 has been designed to for both land-based and marine environments. Thanks to its unique design, the BEL-v150 will suffer minimal corrosion in both normal and salt water operating conditions.

Applications include:

- Marine trickle charging
- Supplying power for DAQ and environmental monitoring
- Monitoring sites
- Telecommunications
- The Developing World.

Safety Precautions

Safety must always be your primary concern during the assembly, installation and operation of your *BEL-v150* turbine. Always be aware of the risks involved with mechanical and electrical installation work. If in doubt about any issue regarding your turbine, please seek further assistance before proceeding. Installation of the *BEL-v150* turbine should only be undertaken by suitably competent and qualified personnel.

Mechanical Safety Hazards

- The main rotor is the most obvious and serious mechanical safety risk. When the turbine is operating at its rated performance, the blades may be very difficult to see, due to the speed of rotation. Never approach the turbine whilst it is operating at speed. **Ensure that the turbine is installed in a suitable position where nobody can interfere with the rotor blades.**
- Working with tools of any kind can be dangerous. Your *BEL-v150* turbine requires some basic mechanical assembly with rudimentary hand tools. If you are in any doubt about how to use these tools correctly, please seek advice from a suitably experienced person.
- Your *BEL-v150* turbine will inevitably be installed upon a mast or tower or other support structure. This may mean working at height. Always ensure that all personnel in the immediate vicinity are aware of any lifting / hoisting operations that will be occurring. Check there are no loose components or tools likely to fall and cause injury during the lifting operation. Where possible, all assembly work should be completed at ground level.
- Ensure that the batteries are disconnected during the installation procedure.
- Twist the turbine output cables together (to create a short circuit) during the mechanical installation process. This will prevent the turbine from 'spinning up' during the installation.
- Never install the turbine upside down or in any orientation other than that depicted on the installation instructions.
- Install your turbine during a calm day.

Electrical Safety Hazards

- The *BEL-v150* generates rectified DC voltage. Even at these low voltages there are inherent risks. Caution should always be used when connecting the *BEL-v150* to the electrical system.
- Ensure that you have followed the cable-sizing chart to ensure that the correct size of transmission cable has been selected. If a cable of insufficient cross-sectional area is used, heat may build up in the cables causing a potential fire hazard. Using cables of insufficient cross-sectional area may also reduce the power transmission efficiency of the turbine.
- Battery systems can deliver a serious amount of current. A short circuit in the battery circuit can lead to hundreds of amps flowing through the battery cables. This will cause a heat build-up and ultimately an electrical fire. Batteries can explode when shorted. Always use insulated electrical tools when working on the battery's electrical connections.
- Batteries are very heavy. Do not attempt to move batteries by yourself. Always use manual handling tools and an assistant.
- Always keep lead-acid batteries the correct way up. Do not allow the acidic electrolyte to spill or come into contact with your skin or face. Always follow the manufacturer's safety instructions when handling lead-acid batteries.

Please use common sense when installing and operating your turbine!

Specifications

Turbine Name: BEL-v150 Turbine
Part Number: GA-LETU-013
Nominal Voltage: 12 / 24V DC

Rotor Diameter: 270 mm
Rated Wind Velocity: 8 m/s
Rated Output: 24 Watts
Start-up Wind Velocity: 4 m/s
Total weight: 13 Kg
Tower mount: see below
Chassis Construction: Aluminium
Rotor Blades (3-off): Aluminium

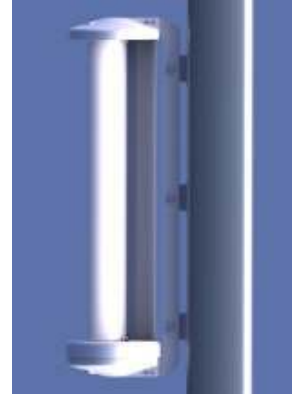


Fig-1: Side View

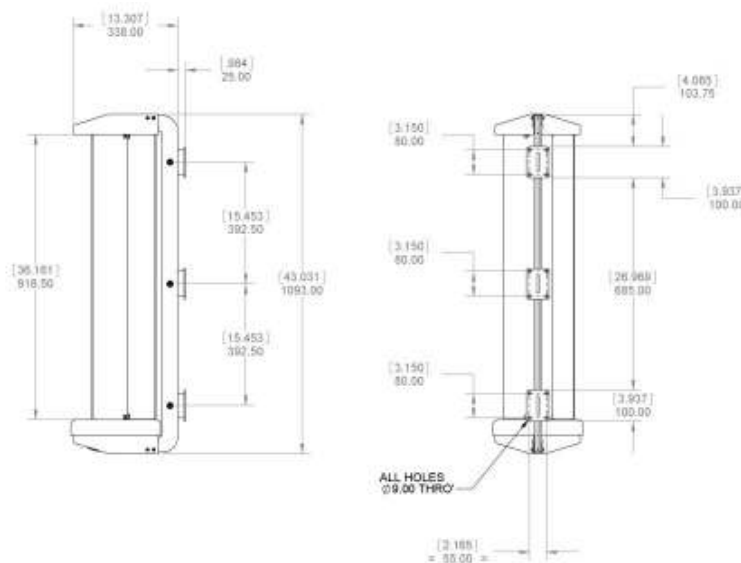


Fig-2: Operating Envelope

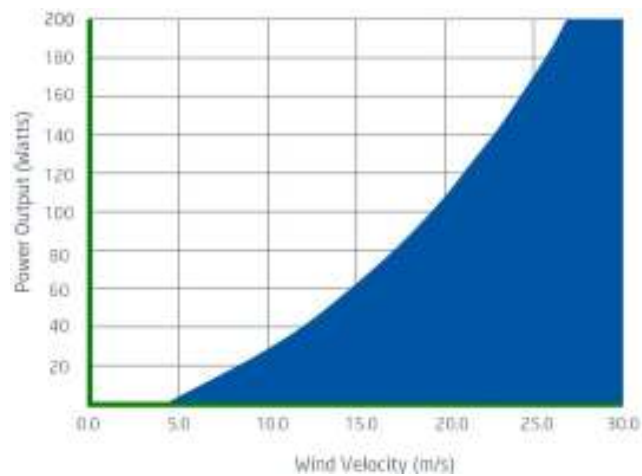


Fig-3: Energy Conversion

Package Contents

Your BEL-v150 turbine will arrive containing the components shown below. If any of the components are missing or damaged, please contact your dealer immediately.



BEL-v150 Turbine: Qty 1



User Manual: Qty 1

Tools Required For Assembly

You will require the following tools to assemble your BEL-v150 turbine:

- 13 mm A/F spanner & 13 mm ratchet (one of each required)
- 8mm A/F spanner or ratchet
- A set of Metric Standard Hexagon Keys
- Electrical screw drivers
- Power drill
- 8.5 mm diameter twist drill bit, suitable for drilling through steel (if standard mount brackets are being used)
- Digital multi-meter capable of measuring DC Volts

Mechanical Assembly Procedure

- 1) **Unpacking** - Inspect the contents of the box and ensure that all items are present and free from damage. If any of the components are missing or damaged, please contact your dealer immediately.
- 2) **Check Main Rotor & Continuity** - Ensure that the main rotor is free turning and does not scrape or rub as it rotates - see Fig 4. As the turbine is shipped in a horizontal orientation, it may be the case that the upper or lower stub shafts or cowlings have shifted during transit.

If the turbine blades feel stiff and do not rotate freely, follow the below steps to reset the stub shaft positions:

- A) Remove the M5 cowling fixings and then the cowlings themselves.
- B) Slightly slacken the M5 fixings on the upper and lower stub shafts.
- C) Hold the turbine **vertically** and rotate the main rotor blades.
- D) The stub shafts will now reposition themselves and the turbine will rotate freely.
- E) Retighten the upper and lower stub shaft fixings and check that the turbine still rotates freely.
- F) Reposition and fix the cowlings ensuring that they do not rub upon each other..

The bearing units used in the magnet rotor assembly are factory lubricated and sealed for life. It will take approximately 100 hours of normal operation for the seals to 'bed-in' and the lubrication to be distributed correctly around the bearing raceways and ball cages. During this period you may notice a reduced performance caused by the additional friction of the bearing seals. In operating temperatures of -10 degrees Centigrade or lower, this 'bedding-in' period will be extended by a further 50 hours of normal operation.

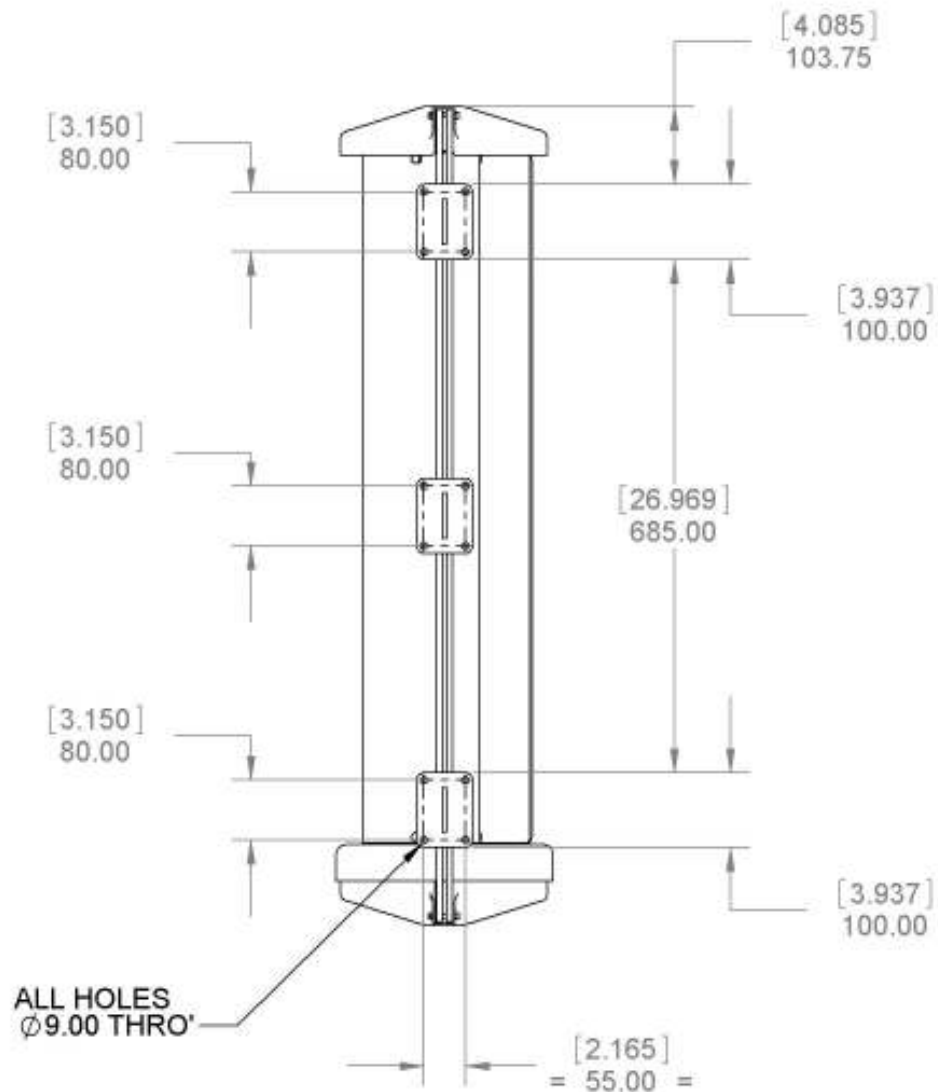
Connect a digital multi-meter to the positive (red) and negative (black) output leads extending from the rear of the turbine. With the multi-meter set to detect DC Volts (0-20V), a voltage should be displayed when the main rotor is spun by hand. This voltage will vary with the speed of rotation. If no voltage is detected whilst turning the rotor, please contact your dealer immediately.



Fig-4: Checking main rotor rotation and voltage output

- 3) **Remove the turbine from the transit packing** – Use a pair of 13mm A/F spanner and or ratchet to remove the M8 fixings from the transit base board.
- 4) **Fix the turbine in its mounting Position** – With the turbine removed from the baseboard, it can now be fitted in its intended position. The BEL-v150 is supplied as standard with three universal flat mounting brackets. Dimensions of the brackets can be found below in fig 5. Alternative mounting brackets are available from Leading Edge Turbines.

Ensure that the turbine is mounted vertically and on a flat and smooth surface. Incorrectly mounting the turbine may cause the main spine to distort which may result in the turbine not rotating freely.



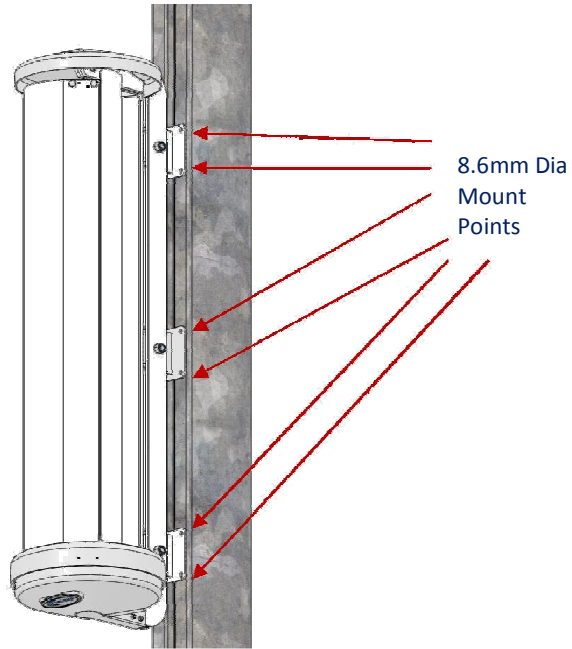


Fig-5: Mount the turbine in position

- 5) **Install the Transmission Cables-** Follow the table below to select the correct wire size (cross-sectional area). This will vary depending on your nominal battery voltage and the distance that the cables will be run. Careful selection of the cable size is required. It will not only affect the safety of the system, but also the overall efficiency. A cable of insufficient cable size will cause a voltage drop, wasting the power that has been generated. The cable sizes listed below have been selected with efficiency and cost in mind, as it is unlikely that your turbine will be running at full capacity 100% of the time. If in doubt, consult your local electrical supplier. The cable should be installed in accordance with local electrical regulations and guidelines. If in doubt, use a local electrical contractor to complete the cable installation. Once the transmission cable installed, it can be connected to the BEL-v150.

Warning: If a cable of insufficient cross-sectional area is used, heat will build up in the cables causing a potential fire hazard. Cable capacities quoted below are based upon 'Tri-Rated' cables (BS6231).

BEL-v150 Nominal Output Voltage	Transmission Distance		
	10 Metres (30 Feet)	30 Metres (90 Feet)	100 Metres (300 Feet)
12 Volts	1.5 mm ²	4 mm ²	Not Recommended
24 Volts	1.5 mm ²	2.5 mm ²	10 mm ²

Electrical Installation

Please refer to Figs 6 for appropriate generic wiring diagrams. In a battery charging renewable energy system there may be different ways of wiring small wind turbines, photovoltaic panels, charge controllers and batteries together. This type of system will often expand 'organically', but the following guidelines should be followed:

- **Follow the appropriate electrical code** - The electrical wiring of your **BEL-v150** turbine and associated electrical systems must be done in accordance with national and local electrical codes and regulations.
- **Do not connect the turbine or batteries during the installation** - Ensure that the turbine is not running or connected to the batteries during the installation or wiring process. Connect the output cables of the turbine together to prevent the rotor from starting up.
- **Galvanic corrosion of electrical joints** - Try to avoid connections between dissimilar metals. For example, connecting copper and aluminium together will result in galvanic corrosion of the connection. This will increase the electrical resistance of the connection (wasting energy), and reduce the mechanical integrity of the joint. Where possible, use a fluxed solder to make electrical joints.
- **Protect the cables** - The power transmission cables must be protected from mechanical damage and fatigue. Run the cables through an approved conduit / trunking.
- **Cable strain relief** - Prevent mechanical strain on the transmission cables running down the tower from the turbine. Clip the cables to the inside of the tower. Failure to do this will result in excessive mechanical strain on the cable joints within the slip-ring assembly and may cause a failure. Cable ties or cable glands are a good way to prevent mechanical strain on the cables.
- **'Earth' the System** - The turbine tower should have its own separate earth point. The negative terminal of the battery bank should also be earthed. This provides protection against the build-up of static and lightning strikes. The tower should be earthed separately with its own ground rod if there is a long transmission distance between the tower and batteries. An appropriate surge arrester could also be used to help prevent damage to the battery charging system during a lightning strike. Ensure that the earth cables are of the same rating as the positive and negative cables.
- **Cable Selection** - The cable size table should be used to select the minimum sized cable for a given transmission distance. Voltage drop in the cable will be improved if a larger cable is used.
- **Fuses** - The turbine and charging circuit should be protected with a suitably rated 'slow-blow' DC fuse or DC circuit breaker. Please refer to the table below for the correct rating. The fuse or breaker should be positioned between the turbine and batteries (on the positive cable). If a stop switch is used (recommended) the fuse should be positioned between the switch and the batteries.

<i>BEL-v150 Nominal Output Voltage</i>	<i>DC Fuse / DC Circuit Breaker Rating</i>
<i>12V</i>	<i>20 Amp</i>
<i>24V</i>	<i>10 Amp</i>

-
- **Run / Stop Switch** - A simple switch arrangement can provide a safe and easy way of stopping the turbine during high winds, or for maintenance. *BEL* turbines can supply a switch which is best for this purpose. As the switch is thrown, the batteries are disconnected and the turbine is 'shorted' reducing the rotor to a slow rotation. Refer to the generic wiring diagrams. A run / stop switch is optional on the BEL-v150 turbine. See Appendix for more information.
 - **Charge Controllers** – We recommend that the BEL-v150 is used with our BEL-300 diversion charge controller. A diversion charge controller works as an 'overflow' for your batteries and protects them against becoming overcharged. A diversion charge controller is a separate electrical entity and is wired directly onto the battery bank in parallel with the turbine. When the BEL-v150 is to be used in a hybrid system with multiple power sources such as solar PV, we recommend that you use our 45A diversion charge controller and separate dump load - This provides a flexible system that is able to accommodate different charging systems.
We do not recommend that any other type of charge controller is used with the BEL-v150 turbine - This may cause damage to the turbine or the charge controller.

Please refer to the following wiring diagrams as a guide.

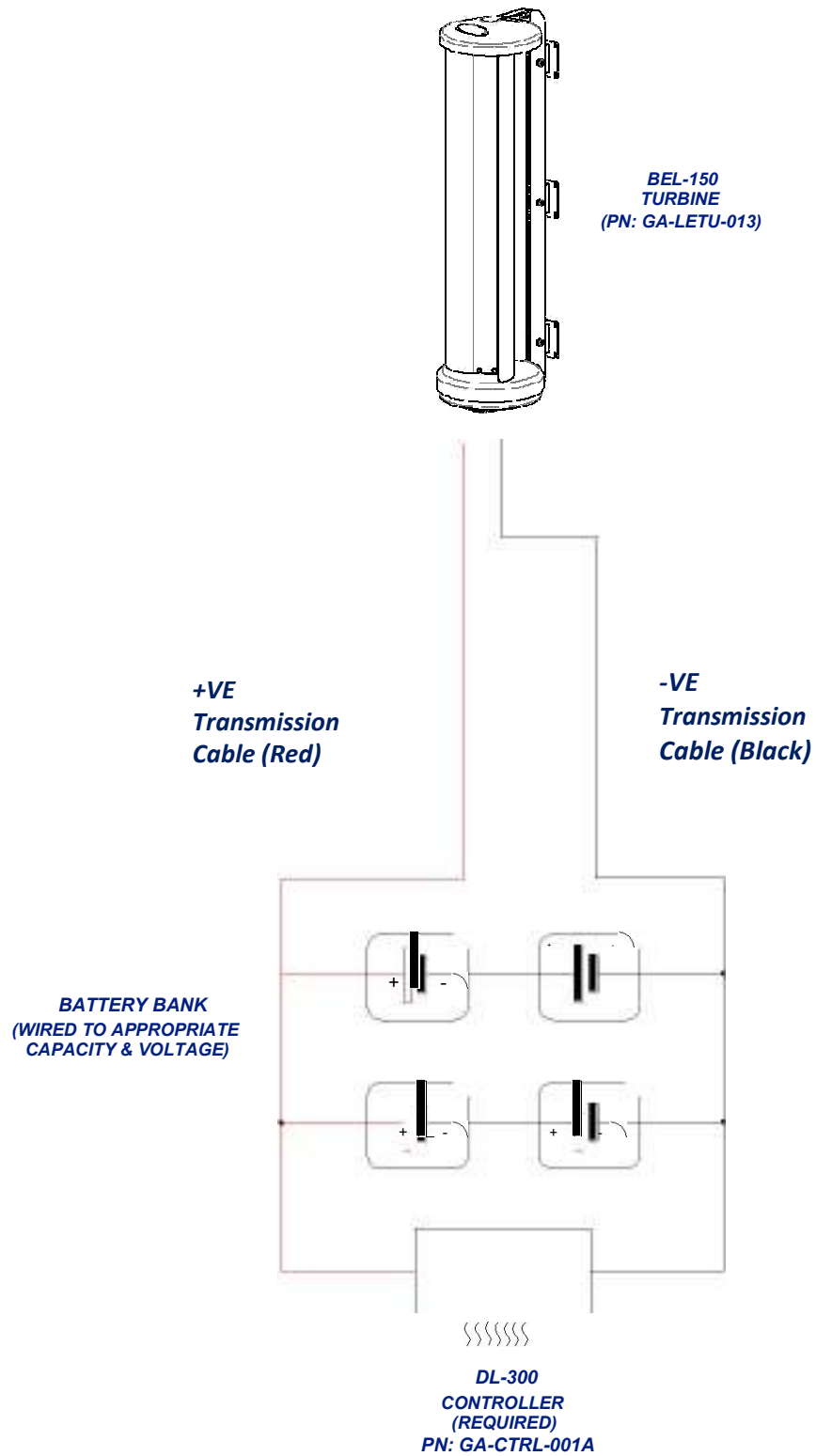


Fig-6: Simple 'Stand-Alone' battery-charging wiring diagram

Turbine Operation

The *BEL-v150* turbine is based on a simple design for ease of installation and reliable operation. You may notice the following behaviour during normal operation:

- **Cut-in** - The turbine will not begin to charge the batteries until the rotor is spinning at approximately 120 RPM. Whilst operating below this speed, the turbine will be 'off-load' and freewheeling. Once the turbine output voltage becomes equal to the nominal battery voltage (at around 120 RPM), the turbine will come 'on-load' and begin to deliver current to the batteries. During the off-load stages of rotation, the rotor blades rotate very freely. This allows the rotor to build up speed and allows aerodynamic lift to be generated by the blades.
- **Normal Operation** - Once the rotor is spinning at 120 RPM, current will be delivered to the batteries. As the rotor speed increases, so too will the current and voltage.
- **Shut Down (If Run / Stop switch is fitted)** - A run / stop switch is not required with the *BEL-v150* turbine but one can be installed if desired (see appendix 2). By activating the stop switch, the output cables of the turbine are 'shorted' together. This effectively puts an infinite load on the generator causing the turbine to stall. When the stop switch is activated the turbine may still rotate slowly during high winds, but the rotor blades will not be able to build up any significant speed. It is not recommended that the stop switch is activated whilst the rotor is spinning at high speed. This sudden braking action will stress the blades and other components. Only activate the stop switch during a 'lull' when the rotor is not spinning excessively fast.
- **High Winds** - Every effort has been taken to ensure that the *BEL-v150* will withstand the forces exerted by strong winds. The turbine will continue to generate power whilst surviving the immense forces that are exerted by high winds.

Maintenance

Please follow the preventive maintenance programme listed below. This will ensure that the turbine operates reliably and safely with good efficiency.

Always shut down the turbine before attempting to carry out maintenance.

Post-Installation Checks (to be carried out one month after installation):

- Check that the turbine mount fixings are secure and has not worked loose. Adjust if required.
- Ensure that the rotor blades rotate freely.
- Ensure that all electrical connections are sound.

Annual Maintenance:

- Inspect the turbine & support structure.
- Ensure that the bearings are smooth and free running.
- Inspect the rotor blades for damage such as dents or chips. The blades will become unbalanced if they are damaged. This will cause vibration, noise and poor performance. If many dents have occurred along the edges of the blades, a new set of rotor blades should be fitted (part numbers available in the Spares section).
- Remove any build-up of dirt and debris from the rotor blades using a mild detergent and warm water.
- Check the blade fixings for tightness.
- Check that all electrical connections are sound and free from corrosion.
- Generally ensure that the turbine is in good working condition and is safe for continued use.

After five years of normal operation:

- We recommend that the rotor bearings should be replaced after five years of continuous operation. This will ensure that the turbine's performance and safety is not compromised.

Other Considerations:

- The equipment used in the charging system (batteries, charge controller, PV panels, invertors, etc.) should be maintained according to the instructions published by the relevant manufacturer.
- Where lead-acid batteries are used, it is especially important that they are maintained carefully. Failure to do so will result in the batteries being rendered useless within a short period of time.