Installation and Owner’s Manual

LAKOTA Turbine - Land, Marine, and M1 Models

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AEROMAG CORPORATION Version 2.42

WARNING

The LAKOTA Wind Turbine can be easily damaged by incorrect handling, assembly, installation, or use. Furthermore, installation, erection, and maintenance of the LAKOTA Wind Turbine involves work with towers and electrical components, both of which can be extremely hazardous. Prior to assembly, installation, erection or maintenance of the LAKOTA Wind Turbine, individuals must read and understand the information contained in this Owner’s Manual as well as information provided by the manufacturers of other system components. Furthermore, designers and installers must be conversant with rules, regulations, and bylaws applicable to the installation.

Failure to comply with this Owner’s Manual will void the LAKOTA Warranty.

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It is the responsibility of the user to ensure that the LAKOTA Wind Turbine and all associated equipment are suitable for the intended purpose and installed in accordance with all applicable rules, regulations, bylaws, and codes. Policies governing the installation of wind turbines may vary dramatically from one jurisdiction to another and are beyond the control of AEROMAG Corporation. The entire risk for the use of, or results from, this document remains with the user.

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AEROMAG is continually striving to improve this Manual and greatly appreciates feedback from LAKOTA users. Please forward your comments, questions and criticisms to info@aeromag.com or contact our office directly at 928-775-0085 or 1-888-407-WIND.

A copy of this Manual is available in a digital version on CD for $8.00 including GST. To order a CD, please contact AEROMAX, 928-775-0085 or 1-888-407-WIND or info@aeromag.com.
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LAKOTA - OWNER’S MANUAL

Introduction

The LAKOTA Wind Turbine is a state-of-the-art small wind turbine designed for use in wind, solar or hybrid, stand-alone or grid-tied applications. This turbine features remarkably quiet AEROMAG Stealth-Acoustic™ carbon-fiber blades, a three-phase permanent magnet alternator, and a Controller-Rectifier Panel which incorporates a ‘Brake Switch,’ a rectifier module, and a load diversion regulator. The rectifier converts the alternating current (AC) output of the alternator to 12, 24, or 48 volts direct current (DC) depending on the model selected. The load diversion regulator (LDR) diverts excess power to a resistive load when the wind is strong, the demand for energy is low and the batteries are fully charged. The light-weight, low-inertia design ensures excellent low-wind-speed and gust performance, and also allows for effective electromagnetic braking of the rotor in moderate wind conditions using the ‘Brake Switch’ on the controller-rectifier. The turbine has a rated power output of 900 watts at 28.8 mph and a peak power output in excess of 1300-1500 watts in high winds. It is designed to auto-furl by tilting horizontally in high winds but will maintain its full power output when furled. The LAKOTA MARINE features a durable white titanium-dioxide, polyurethane aircraft coating to help protect metal surfaces, particularly for marine applications and severe Canadian climates. Both models feature sealed bearings and a sealed alternator unit that does not need greasing or to be opened during annual inspections.

Specifications and Features

- Rotor Diameter – 2.09 meters (82.3 inches)
- Swept Area – 3.43 square meters (36.9 square feet)
- Weight – 16 kilograms (35 pounds)
- Rated Power Output – 900 watts at 12.9 meters/second (46.4 kph) (28.8 mph)
- Peak Power Output – 1500 watts at 17.0 Meters/second (61+ kph) (38+ mph)
- Start-up wind speed – 2.9 meters/sec (10.5 kph) (6.5 mph)
- Charging 1 ampere at 12 volts at 4.0 meters/sec (14.5 kph) (9 mph)
- Aerospace grade, uni-directional carbon fiber blades with optional helicopter tail rotor leading-edge protective tape for use in abrasive desert environments.
- Aluminum body with all stainless steel hardware
- 3 phase AC PMG alternator
- Rare earth neodymium iron boron permanent magnets
- Adjustable settings to match turbine performance to low, medium/low, medium/high, and high wind regimes
- LAKOTA MARINE has a UV stabilized titanium-dioxide, linear-polyurethane aircraft coating that provides additional protection in harsh, marine, arctic or corrosive environments.
Warnings, Cautions, and Notes

Installation, erection, and maintenance of the LAKOTA Wind Turbine involves the physical installation of the wind turbine on a suitable tower and work with various electrical systems and components, both of which can be extremely hazardous. Those who are unfamiliar with renewable energy systems or their installation should seek the assistance of professional tradesmen, most importantly a qualified Electrical Contractor, familiar with renewable energy systems and components. Specifically, installers must be familiar with battery management, high amperage DC circuitry, and local electrical codes. In all cases, prior to assembly, installation, erection, or maintenance of the LAKOTA Wind Turbine, individuals must read and understand the information contained in this Installation and Owner’s Manual as well as information provided by the manufacturers of other components that will be incorporated in the overall system. Furthermore, designers and installers must be conversant with rules, regulations, and bylaws applicable to the installation.

Throughout this manual, the terms WARNING, CAUTION, and NOTE are used to highlight hazards or unsafe practices or significant points worthy of emphasis. These terms are defined as follows:

**WARNING**
Hazards or unsafe practices that could cause serious injury or death.

**CAUTION**
Hazards or unsafe practices that could damage the wind turbine and system components.

**NOTE**
Notes that will make assembly or operation easier and less prone to error or may avoid poor performance due to improper installation or adjustment.

Safety Considerations – A Common Sense Approach

Common sense and caution should be used in assembling and installing the LAKOTA wind turbine. Some appropriate safety considerations are:

- Plan your work before doing it. Read this entire manual at least once first.
- Work systematically in the order recommended. Don’t rush.
- Keep your tools and equipment organized to avoid making mistakes.
- Wearing thin leather or rubber palm gloves may avoid minor cuts and pinches.
- Wear sturdy shoes or steel-toe work boots and construction hat in case something heavy falls.
- Test for voltage present on electrical connections with a multi-meter before touching or connecting them.
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Package Contents and Inventory

The following paragraphs provide a detailed list of components included with the LAKOTA Wind Turbine. Immediately upon receipt of the system, take a few moments to verify that all of the components were included in the shipment. In the unlikely event that one or more items was omitted, lost, or damaged during shipping, contact your Authorized LAKOTA Dealer. Have the model number, serial number, and original purchase receipt available. Refer to the Identification Section (write these key numbers on page _Ref67025072) for additional information regarding the model and serial numbers.

CAUTION

When removing the LAKOTA Wind Turbine from the packaging, do not lift the wind turbine by the “black rubber handle.” It is not a handle but rather an electrical conduit and is not designed to support the weight of the wind turbine. Lifting the wind turbine by the conduit can damage the internal wiring and cause the unit to malfunction. Always lift and carry the unit by grasping the main housing. Careful handling or lifting using one or both of the large furling springs is acceptable.

BOX 1 - LAKOTA Wind Turbine Body Assembly
(Approx. 15 kgs (33 lbs))

Documentation
• 1 LAKOTA Wind Turbine Owner’s Manual (this document)
• 1 Product Registration Card for the wind turbine head unit and blade array
• 1 Warranty Card - Must be returned for warranty validation

Alternator and Mounting Components
• 1 Wind turbine alternator assembly
• 2 Stainless Steel Metric Hex Head Cap Screws M10 x 25
• 1 Stainless Steel Yaw Shaft Clamp (should be attached to the base)
• 4 Heavy-Duty Wire Ties

Tail and Tail Fin Components
• 1 Left Tail Fin
• 1 Right Tail Fin
• 2 Rectangular 3 hole Metal Spacers
• 1 Cross Brace
• 2 Stainless Steel Metric Hex Bolts M6 x 16
• 3 Stainless Steel Metric Hex Bolts M6 x 45
• 10 Stainless Steel Metric Flat Washers for M6
• 5 Stainless Steel Metric Nylon Insert Lock Nuts for M6
• 1 Stainless Steel Metric Hex Bolt M10 x 70
• 2 Stainless Steel Metric Flat Washers for M10
• 1 Stainless Steel Metric Nylon Insert Lock Nut for M10
Hub Components
- 1 Stainless Steel Hub Back Plate
- 1 Stainless Steel Hub Front Plate
- 2 Neoprene Black Triangular Dampers
- 1 Stainless Steel Torque Ring (may be fastened to Hub Back Plate)
- 3 Stainless Steel Metric Flat Head Socket Cap Screws M6 x 12
- 2 Torque Keys (1 spare taped to the alternator drive shaft)
- 1 Stainless Steel Metric Flat Washer for M16
- 1 Stainless Steel Nylon Insert Metric Lock Nut for M16
- 1 Short Arm Allen Key (4mm) for Flat Head Socket Cap Screw M6 x 12

Blade Mounting Hardware
- 9 Stainless Steel Metric Hex Head Cap Screws, M6 x 55
- 18 Stainless Steel Metric Flat Washers for M6
- 9 Stainless Steel Nylon Insert Metric Lock Nuts for M6
- 1 Spinner (Black - LAND model or White - MARINE Model)

BOX 2 - Electrical Components
(Approx. 3.6 kgs (8 lbs))
- Controller-Rectifier Module with ‘Brake Switch’ 30 Amp Circuit Breaker

BOX 3 - LAKOTA Blades and Tail Boom
(Approx. 2.7 kgs (6 lbs))
- 3 Uni-Directional Carbon-Fiber Blades
  (Black-LAND model or White-MARINE Model)
- 1 Stainless Steel Tail Boom
Planning Your Project

Installation of the LAKOTA Wind Turbine is a substantial undertaking worthy of considerable planning prior to assembly or construction of towers. For both practical and economic reasons, it is important to carefully assess your specific requirements and to design and size your renewable energy system accordingly. The following paragraphs highlight some considerations when planning your project. Those who are unfamiliar with wind energy, should refer to published information available in books, magazines, and on the world wide web. For more hands-on training, check the AEROMAG website, www.aeromaxenergy.com for training workshop information. You can also explore the links available under the Knowledge section of the website.

A renewable energy system consists of three fundamental components – a generation capability that produces the power, a storage medium that stores energy for later use, and a conversion and distribution capability that converts the power to the required voltage and frequency and distributes it to the desired loads. Included with the generation capability are the components necessary to control the generator and convert the generator output to a suitable voltage and frequency. The following diagram illustrates the fundamental components and lists some of the common subcomponents. Not all components are used in all systems.

<table>
<thead>
<tr>
<th>Generation</th>
<th>Storage</th>
<th>Conversion and Distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind Generators</td>
<td>Battery Bank</td>
<td>DC and AC Loads</td>
</tr>
<tr>
<td>Towers</td>
<td>Capacitors</td>
<td>Circuit breaker/Fuses</td>
</tr>
<tr>
<td>Solar Arrays</td>
<td>Grid-tied (using the grid as a storage media)</td>
<td>Inverters</td>
</tr>
<tr>
<td>Hydro Generators</td>
<td>Water tank or pond</td>
<td>Circuit Breaker Panels</td>
</tr>
<tr>
<td>Gas/Diesel Generator</td>
<td></td>
<td>Shunts</td>
</tr>
<tr>
<td>Charge Controllers</td>
<td></td>
<td>Volt and Ammeters</td>
</tr>
<tr>
<td>Load Controllers</td>
<td></td>
<td>Watt meters</td>
</tr>
<tr>
<td>Diversion Loads</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

This manual focuses primarily on the generation component of the renewable energy system and specifically for the LAKOTA Wind Turbine. For a detailed discussion of other components, refer to documentation provided by the component manufacturers.

Site Selection and Tower Height

The power available from the wind is proportional to the speed of the wind cubed; therefore a relatively small increase in the average wind speed can make a dramatic increase in power production. Turbulence is also of concern because turbulent air robs the turbine of energy that would otherwise be available in smoother “laminar flow” air. With this in mind, the goal should be to site the wind turbine where the wind is the strongest but also where smooth laminar flow air can be assured, ideally in all wind directions. This is, of course, much easier in theory than in practice because the wind speed and direction at a particular site and a particular time are affected by both macro and micro environmental factors. Major weather patterns (the macro level) will determine prevailing winds and local topography, barriers (trees, buildings), and surface roughness can have a dramatic affect at the micro level. These local effects will also vary from season to season as the prevailing winds change. Since the wind speed increases and turbulence decrease with height, local effects can be best overcome, to some degree, by increasing the height of the tower. As a general rule, a wind turbine should be installed 9 meters (30 feet) above any object within 150 meters (500 feet) of the tower. To further complicate the problem, site selection and tower height must also consider the incremental cost of a taller tower.
increased line losses in the wire as the distance between the tower and the Controller-Rectifier Panel is increased, wiring costs, zoning bylaws, building codes, proximity to obstacles (particularly power lines), concerns of neighbors, and personal preferences. In the end, site selection is always a compromise of many factors. For a more in-depth discussion of site analysis and tower selection considerations, please refer to links on the AEROMAG web-site at www.aeromaxenergy.com (follow the “Knowledge” link) or contact your Authorized LAKOTA Dealer for further guidance.

Tower Selection

The LAKOTA Wind Turbine is designed for installation on a freestanding or guyed tower that can accommodate a two-inch diameter tubular mast riser and withstand a lateral thrust of 900 Newtons (200 pounds) at the masthead. A tower and mast riser are separate components and not part of the LAKOTA Wind Turbine; however, AEROMAG offers excellent, high quality, tilt-up, stainless coupler, tower kits suitable for most applications. For additional information regarding towers, please refer to the AEROMAG web-site at www.aeromaxenergy.com or contact your Authorized LAKOTA Dealer. For a detailed description the mast riser options refer to the Assembly Section on page _Ref67026282.

CAUTION

In a 160 kilometer per hour (100 mile per hour) wind, the lateral thrust imparted at the top of the tower by the LAKOTA LAND or MARINE Wind Turbine is approximately 360 newtons (80 pounds). To ensure an adequate margin, select a tower that is designed to withstand 900 newtons (200 pounds) of force at the masthead; this is more than twice the maximum design thrust of the LAKOTA Wind Turbine. Due to the upward furling design most of the “lateral thrust” at the top of the pole is actually directed vertically down the pole as the rotor tilts horizontally. Notwithstanding the tower safety margin, you should consider turning off the turbine or perhaps even lowering the tower, if the winds are forecast to exceed 160 kph (100 mph).

WARNING

Installation of towers can be extremely dangerous and must be conducted in accordance with the guidance provided by the tower manufacturer and with due consideration for safety. Consult a qualified mechanical engineer before designing your own tower or consult engineering stress analysis to see if a particular commercially available tower is suitable for the LAKOTA.

System Voltage

The LAKOTA Wind Turbine is available in 12, 24, or 48 volt models. Determining the appropriate voltage for a particular installation is a function of both technical and economic factors. Higher voltage systems require more batteries thus increasing the overall cost of the installation. Lower voltage systems are impacted more by line losses and the high current flow produced. For example, 12 volt systems are a poor choice when the wind turbine is located a significant distance (>100ft) from where the power will be used. An Authorized LAKOTA Dealer will be able to assist in selecting the appropriate voltage for your specific installation.
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Optimizing the Performance of the LAKOTA Wind Turbine

LAKOTA Wind Turbines are preset at the factory for use in a low to medium wind regime (Class 2 or Class 3) which is optimum for most locations. If your location has consistently stronger AVERAGE winds (Class 4 or higher), you may benefit from a higher MOD setting. As a general rule, higher MOD settings are only applicable to some marine, coastal, high altitude, or high latitude locations. Using a higher MOD setting in a low to medium wind regime will lower the overall energy production of the wind turbine. If you wish to change the MOD setting of your LAKOTA Wind Turbine, contact your Authorized LAKOTA Dealer or AEROMAG directly at 928-775-0085 or 1-888-407-WIND or via e-mail at info@aeromag.com.

The following chart can be used to decide if a different MOD setting or rotor selection may be appropriate. Note: The range of speeds and the boundaries of wind “Classes” vary from source to source. Treat wind classes as an approximation. The chart below refers to speeds in m/s and equivalent mph. LAKOTA is normally shipped in MOD 3, low to medium wind regimes.

<table>
<thead>
<tr>
<th>Wind Class</th>
<th>Annual Average Speed</th>
<th>LAKOTA MOD Setting</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Kph</td>
<td>Mph</td>
</tr>
<tr>
<td>1</td>
<td>16.3</td>
<td>10.1</td>
</tr>
<tr>
<td>2</td>
<td>21.6</td>
<td>13.4</td>
</tr>
<tr>
<td>3</td>
<td>24.2</td>
<td>15.0</td>
</tr>
<tr>
<td>4</td>
<td>26.1</td>
<td>16.2</td>
</tr>
<tr>
<td>5</td>
<td>27.9</td>
<td>17.3</td>
</tr>
<tr>
<td>6</td>
<td>30.3</td>
<td>18.8</td>
</tr>
<tr>
<td>7</td>
<td>35.9</td>
<td>22.3</td>
</tr>
</tbody>
</table>

The following chart can be used to decide if a different MOD setting or rotor selection may be appropriate. Note: The range of speeds and the boundaries of wind “Classes” vary from source to source. Treat wind classes as an approximation. The chart below refers to speeds in m/s and equivalent mph. LAKOTA is normally shipped in MOD 3, low to medium wind regimes.

### LAKOTA Site Specific Rotor Size and Wind Mod settings

<table>
<thead>
<tr>
<th>ROTOR</th>
<th>MOD</th>
<th>CLASS</th>
<th>W/SqM</th>
<th>Speed(b) at 10M (33ft)</th>
<th>W/SqM</th>
<th>Speed(b) at 50M (164ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>EAR</td>
<td>3</td>
<td>1</td>
<td>&lt;100</td>
<td>&lt;4.4</td>
<td>&lt;91.8</td>
<td>&lt;6.6</td>
</tr>
<tr>
<td>EAR</td>
<td>3</td>
<td>2</td>
<td>100-150</td>
<td>4.4-5.1</td>
<td>9.8-11.5</td>
<td>200-300</td>
</tr>
<tr>
<td>EAR</td>
<td>2</td>
<td>3</td>
<td>150-200</td>
<td>5.1-5.6</td>
<td>11.5-12.5</td>
<td>300-400</td>
</tr>
<tr>
<td>EAR</td>
<td>1</td>
<td>4</td>
<td>200-250</td>
<td>5.5-6.0</td>
<td>12.5-13.4</td>
<td>400-300</td>
</tr>
<tr>
<td>EARSAR</td>
<td>0</td>
<td>5</td>
<td>250-300</td>
<td>6.0-6.4</td>
<td>13.4-14.3</td>
<td>500-600</td>
</tr>
<tr>
<td>SAR</td>
<td>0</td>
<td>6</td>
<td>300-400</td>
<td>6.5-7.0</td>
<td>14.3-15.7</td>
<td>600-800</td>
</tr>
<tr>
<td>SAR</td>
<td>0</td>
<td>7</td>
<td>&gt;400</td>
<td>&gt;7.0</td>
<td>&gt;15.7</td>
<td>&gt;800</td>
</tr>
</tbody>
</table>

**CAUTION**

Performance MODs must be adjusted by a Certified LAKOTA Technician. Opening the LAKOTA alternator casing or failure to comply with this requirement WILL VOID the Standard and/or the Extended Warranty.
Diversion Load

As a general rule, renewable energy systems that use small wind turbines for power generation must also incorporate a diversion load designed to dump excess energy when the wind is strong, the demand for energy is low, and the batteries are fully charged. The diversion load must be able to continually dissipate all of the maximum instantaneous power produced by the wind turbine. Theoretically, a diversion load can be installed on either the DC side at the rectifier (before the inverter) or AC side (after the inverter) usually at 120v AC; however, an AC diversion load will not protect the wind turbine in the event of an inverter failure. AEROMAG recommends using the LDR series controller integrated with the LAKOTA rectifier/controller, coupled to an 1800 watt DC resistive heat load. This means 1800 watts of continuously available power dissipation capacity, for all LAKOTA installations.

The LAKOTA Wind Turbine requires at least 1800 watt diversion load to ensure an adequate margin of capacity in all possible operating conditions. The resistance (in ohms) of the diversion load is also critical and is a function of the maximum operating voltage; specifically, the voltage at which power will be diverted to the diversion load as determined by the setting of the of the Load Diversion Regulator (refer to pages _Ref76206361_). The following table outlines typical diversion load requirements for the LAKOTA Wind Turbine.

<table>
<thead>
<tr>
<th>Nominal Turbine Voltage (volts)</th>
<th>Maximum Operating Voltage (volts)</th>
<th>Maximum Power Output (watts)</th>
<th>Maximum Current $I = \frac{W}{E}$ (amps)</th>
<th>Recommended Resistance $R = \frac{E}{I}$ (ohms)</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>14.4</td>
<td>1800</td>
<td>125</td>
<td>0.12</td>
</tr>
<tr>
<td>24</td>
<td>28.8</td>
<td>1800</td>
<td>62.5</td>
<td>0.46</td>
</tr>
<tr>
<td>48</td>
<td>57.6</td>
<td>1800</td>
<td>31.25</td>
<td>1.84</td>
</tr>
</tbody>
</table>

We have found that an ideal diversion load is a pair of edge wound ceramic resistors mounted in a properly vented metal enclosure. Alternative low voltage devices such as, air or water, heating elements may be suitable diversion loads provided they are highly reliable and of the correct resistance and power dissipation. For additional information regarding diversion loads, contact your Authorized LAKOTA Dealer.

Battery Bank

A renewable energy system which uses the LAKOTA Wind Turbine as a source of power generation must also incorporate a battery bank of the same nominal voltage – 12, 24, or 48 volts. Besides storing the energy for later use, the battery bank also serves to condition the power as it is generated. As a general rule, deep-cycle, flooded lead-acid batteries are used due to their lower cost and recognized durability. They provide the best power density per dollar. Glass Matt (AGM) or Gel batteries require little or no maintenance but cost more per stored watt and generally store less energy per pound of battery. They are more convenient but less capable.

Sizing of the battery bank is a critical aspect of the renewable energy system design and warrants detailed consultation with your Authorized LAKOTA Dealer. Over sizing the battery bank...
results in unnecessary expense; under sizing the battery bank results in inadequate storage capacity and an inability to make optimum use of the power produced by the wind turbine.

**Power Conversion**

The LAKOTA Wind Turbine is an alternator based system which produces 12, 24 or 48 volt “Wild AC” power. Wild because its voltage, current and frequency changes dynamically as the wind changes. The AC power is rectified or “smoothed out” by the LAKOTA Controller-Rectifier and the DC output of the controller-rectifier is used to charge “pump energy” into a 12, 24, or 48 volt battery bank. Think of the battery bank as a gas tank and the turbine as a gas pump. The wind is an infinite source of energy but the turbine “gas pump” has a limited rate it can fill your battery tank. Energy can be drawn directly from the batteries to power low voltage DC loads or by using an inverter can be converted to 110/220 volt AC to power conventional household loads or feed power to the electrical grid in a grid-tied application. To continue the analogy, the inverter then is the “engine” of your system. It uses the stored electricity fuel to run your appliances and lights.

So the determining factor on what you can run with your turbine is not the turbine itself but rather the peak or continuous rated power of the inverter and the size of your battery bank. You may be able to run your whole house for some period when the wind is not even blowing. The question is how fast is your engine using the stored energy and how long will it take to empty the tank or refill it? A detailed discussion of power conversion options and the equipment available is beyond the scope of this manual. Consult with your Authorized LAKOTA Dealer to determine the size, type and options of the equipment most appropriate for your installation.

**Wiring**

Wiring requirements for the LAKOTA Wind Turbine are dictated by the voltage of the wind turbine, the distance between the wind turbine and the controller-rectifier panel (don’t forget to include the height of the tower), whether the cable run is over-head or buried, and of course, the requirements of the local electrical code. Wire insulation is designed for a wide variety of applications so it is important to ensure that the type of wire is appropriate for your specific installation – overhead or buried with or without conduit. Correct sizing of the cable is important to ensure that the line losses are within acceptable limits while at the same time minimizing the cost of material. Using to small a cable is like hooking up a garden hose to a fire truck. The high resistance created in the small wire could burn out either the wire or the turbine or both.

For the cable run between the wind turbine and the control panel, AEROMAG recommends the use of multi-strand copper wire of sufficient gauge to minimize line losses to less than 4% if possible. Losses over 4% may be acceptable depending on your application. Consult your Authorized LAKOTA Dealer or an electrical contractor who is familiar with your installation. Appendix A provides information regarding wire types and the maximum length of cable runs for various combinations of wind turbine voltage, wire gauge, and line loss.
Lightning Protection and Grounding

Lightning protection and grounding are of concern when dealing with towers and electrical components. Due to a tremendous variation in system design and local conditions it is impossible to be specific regarding lighting protection for all installations; however, some general guidelines are provided in the following paragraphs. Customers are advised to seek the guidance of their Authorized LAKOTA Dealer, the manufacturers of other system components, the designer of their overall system, and the requirements of the local electrical code for more detailed information regarding the need for, and installation of lightning protection in their area.

Basic principles of lightning protection include the installation of lightning arrestors and the provision of an easy path to ground to minimize the damage from a lightning strike. Lightning arrestors provide a path to ground when a greater than normal voltage exists in a conductor thus providing some protection to power lines and other electrical components. The above photo shows a three-phase lightning arrestor connected to the cable runs at the base of a tower.

If the ground is fairly moist or otherwise electrically conductive, once a lightning strike reaches the ground it will quickly dissipate into the conductive soil. In very dry, frozen, sandy or gravely soil, or on bare rock, special effort must be made to minimize the electrical resistance of the connection to the ground. Where possible, connection to the ground can be made by driving a copper or metal grounding rod or iron pipe approximately 2.5 metres (8 feet) into the ground. If there is a limited amount of soil, a ground net or a ring of conducting material such as non-insulated copper grounding wire, can be used to protect the tower, wind turbine, and surrounding structures.

To reduce the probability of damage from a lightning strike, everything in the system must be connected to the ground. Metal towers must be solidly grounded and wooden tower structures should have at least a #8 AWG wire running from the wind turbine riser down the outside of the tower to the grounding rod. On guyed towers, each individual guy wire must be grounded. Concrete is an insulator so towers that are mounted on concrete pads and guy wires that are anchored in concrete should each be electrically tied to individual grounding rods. The grounding rods should then be tied together with a buried ground wire. If there are nearby buildings that have lightning protection systems, connect the tower grounding system to the lightning protection system of the building.

When installing the lightning protection system, avoid sharp bends in the wiring. A sharp bend presents large electrical impedance to a lightning strike and may cause the lightning to arc out of the wire.
The LAKOTA Wind Turbine Controller-Rectifier Panel incorporates a ‘Brake Switch,’ a rectifier module, and a load diversion regulator (LDR). The ‘Brake Switch’ provides a means of stopping the rotor rotation by electrically short circuiting the wind turbine alternator windings. The rectifier module converts the variable frequency alternating current (AC) from the wind turbine to 12, 24, or 48 volt direct current (DC) which can be used for a variety of applications. The rectifier module also prevents power from a battery bank from feeding back into the wind turbine. The load diversion regulator (LDR) monitors the output voltage of the wind turbine and diverts excess energy that can not be used by the system to a diversion load when the wind is strong, the demand for energy is low, and the batteries are fully charged. The Controller-Rectifier Panel is intended for interior installation only.

In most applications, the LAKOTA Wind Turbine will be used in conjunction with a battery bank as part of a renewable energy system. When used to charge batteries, the LAKOTA Wind Turbine Control Panel must be configured with an automatic load diversion capability to ensure that the batteries cannot be overcharged and the energy produced in the turbine always has some where to go. The load diversion capability must be installed before the wind turbine is operated in order to protect the controller when the batteries are fully charged but the turbine is still producing power. Examples of an automatic and a manual load diversion installation are outlined in the following paragraphs. The configuration of these systems, in conjunction with the turbine and battery selection can vary considerable depending on the application. It is strongly recommended that customers who are not conversant with renewable energy systems and their associated components seek expert guidance and assistance to design and install their system.

CAUTION

Failure to install a proper load diversion capability prior to operating the wind turbine may void your warranty due to an "open circuit" condition being possible that can severely damage the electrical components of the wind turbine. The LAKOTA Wind Turbine is a permanent magnet alternator and must be presented a managed load at all times to avoid damage.

Manual Load Diversion can be done but is NOT RECOMMENDED unless the turbine is only operated under constant supervision due to the need to react to changing wind and load condition.
Assembly of the LAKOTA Wind Turbine

**CAUTION**

When assembling the LAKOTA Wind Turbine, it is essential that each step be completed and verified sequentially in accordance with these instructions. Due to the nature of the assembly, it is often impossible to verify previous steps because fasteners and connectors are no longer accessible. Complete each step in its entirety prior to proceeding to the next.

**Tools Required**

The following tools will be required to complete the system check, assemble, and install the LAKOTA Wind Turbine on the mast riser. This list does not include additional tools that may be required for assembly and erection of the tower or installation of system components provided by other manufacturers; please refer to your tower manual and information provided by the component manufacturers for additional requirements.

- 24 mm or 15/16” box wrench and socket
- 17 mm box wrench and socket
- 10 mm box wrench and socket
- 10 mm nut-driver, ¼ inch drive ratchet with a 10 mm socket
- 4 mm Allen key
- Torque wrench/ratchet with a range of approximately 5-30 newton-meters (4-20 foot-pounds) (50-250 inch-pounds).
- Thread locking compound medium strength, non-permanent (Locktite 242 or equivalent)
- Tape measure, 4 meters (12 feet) or longer
- Multi-meter (Ohm-meter)
- Semi-round metal file
- Medium slotted screwdriver
- Medium (No2) Phillips head screwdriver
- Rubber mallet or hammer and wooden block
- ½ inch heavy duty electrical tape
- Quality leather work gloves and a pair of thin rubber palm gloves for detailed work
- Safety glasses or goggles
- Hard hats or safety helmets for tower erection

**CAUTION**

When removing the LAKOTA Wind Turbine from the packaging, do not lift the wind turbine by the “black rubber handle.” It is not a handle but rather an electrical conduit and is not designed to support the weight of the wind turbine. Lifting the wind turbine by the conduit can damage the internal wiring and cause the unit to malfunction. Always lift and carry the unit by grasping the main housing. Careful handling using one or both of the large furling springs is acceptable.

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Pre-Assembly Tests

Prior to assembling the LAKOTA Wind Turbine, complete the following tests. These tests were conducted at the factory; however, to check for possible internal shipping damage, the tests should be completed again prior to assembling the wind turbine:

**Pre-Assembly Test One – Continuity and Stator Ohms MOD Check**

1. Set the multi-meter to read resistance (Ohms) and connect each lead to two different alternator output wires. Check for some small resistance, indicating there is continuity in the windings. Then check the actual resistance compared to the following chart to determine if it is wired correctly and which MOD state it is in.

**LAKOTA Stato Ohms Test**

<table>
<thead>
<tr>
<th>Stator</th>
<th>All readings plus or minus 0.2 Ohms</th>
<th>Annual Average Wind Regime ≤ 12mph</th>
<th>11-13mph</th>
<th>12-14mph</th>
<th>&gt;14mph</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Stator Unwired MOD1 Low MOD2 Med MOD1 High MOD2 Severe</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12v</td>
<td>0.2</td>
<td>0.7</td>
<td>0.7</td>
<td>0.2</td>
<td>0.2</td>
</tr>
<tr>
<td>24v</td>
<td>0.5</td>
<td>1.7</td>
<td>1.7</td>
<td>1.5</td>
<td>0.5</td>
</tr>
<tr>
<td>48v</td>
<td>2.0</td>
<td>7.9</td>
<td>4.9</td>
<td>4.9</td>
<td>2.0</td>
</tr>
</tbody>
</table>

2. Repeat steps two and three for output wires number two and three to ensure the turbine’s output will not be grounded to the case or tower when installed.

**Pre-Assembly Test Two – Static Performance Check**

1. Set the multi-meter to read AC voltage in the range of 1-50 volts.
2. Connect the multi-meter to any pair of alternator output wires (e.g. wires 1&2) and slowly turn the drive shaft of the generator assembly with a small box wrench. As you rotate the wrench, it should feel “bumpy” at low speed and the bumps should all feel the same around a complete slow rotation and smooth out as you rotate faster. If you encounter uneven or higher resistance, even on one part of the rotation, there may be a short or improperly wired configuration of the windings.
3. Turning at about 1 rev per second the multi-meter voltage should read 50-75% or more of the rated voltage of the turbine (e.g. 18-20v or more for a 24v system) that confirms general output is possible and wiring is likely correct.
4. Repeat steps two and three for the other wire pairs (e.g. wires 1&3, then wires 2&3).

**Pre-Assembly Test Three – Turbine Grounding Check**

5. Set the multi-meter to read resistance (Ohms).
6. Connect one of the multi-meter probes to one of the generator output wires and the other multi-meter probe to the aluminum housing.
7. The multi-meter should read a very high resistance (mega ohm or “OL” - over limit).
8. Repeat steps two and three for output wires number two and three to ensure the turbine’s output will not be grounded to the case or tower when installed.

If any of these tests are unsuccessful, contact your Authorized LAKOTA Dealer or AEROMAG.
Assembly Stand

To facilitate easier handling of the LAKOTA Wind Turbine during assembly, consider building a simple stand similar to the one shown in the adjacent photograph. This will allow the turbine to be oriented in the normal operating position during assembly which is often more convenient than trying to work on a large flat surface. A stand can be easily made using the mast riser (see the following paragraph) or a length of similar sized pipe mounted on a suitable metal or wooden base. If the stand is 107 cm (42 inches) high the wind turbine blades should clear both the floor and an 8 foot ceiling during assembly. Ensure that the base is large and heavy enough to provide a stable platform for working.

NOTE

The following assembly instructions assume that the LAKOTA Wind Turbine is being assembled an assembly stand similar to that described in the preceding paragraph and that it is oriented in the normal operating position. If an assembly stand is not being used, extra care should be taken to ensure the correct orientation of installed components.

Pre-Fitting the Wind Turbine to the Mast Riser

The mast riser is the top section of the tower that extends above the top guy wire connection point and is used to provide the standoff clearance between the wind turbine blades and the cables that support the tower. It may or may not be part of a tower kit because it depends on the turbine being installed. For a non-guyed tower, a short mast riser will likely be required to mate the wind turbine to the tower. The LAKOTA Wind Turbine is designed to fit a 2 inch (nominal) Schedule 40 iron or galvanized pipe with an outside diameter of 2.375 (2 and 3/8ths) inches and an inside diameter of 2.067 (2 and 1/16ths) inches. The mast riser should normally not extend more than 1.22 meters (4 feet) above the top of the tower due to the large leverage or bending moment produced by the length. The end of the mast riser that mates with the yaw shaft of the wind turbine should be machined to ensure a clean square end and must not be threaded. The inside of the pipe may need to be reamed to accurately preserve the 2.067 inside diameter. A clean square end on the mast riser and an accurate inside pipe diameter will enhance the structural bond between the yaw shaft and the mast riser and make for a quieter running machine. The lower end of the mast riser must fasten securely to the top of the tower and the nature of that coupling will depend on the tower design. Please contact the tower manufacturer or supplier for guidance.
CAUTION
The mast riser must not extend more than 1.22 metres (4 feet) above the top of the tower. A longer than required mast riser increases the risk of structural failure due to increased stress concentration at the bottom end of the mast riser.

A simple solution for an effective mast riser known as the “Rocket Riser” is shown below. The two bolts are threaded into the larger tower pipe and jam the riser to one side to assure a secure attachment. The rocket fins on the riser act as the upper tower guy wire attachment points.

CAUTION
The mast riser must be able to withstand a lateral thrust of 900 Newtons (200 pounds) at the mast head. All tower components and couplings must be sized accordingly.

Fitting of the wind turbine yaw shaft to the mast riser should be completed prior to mating of the mast riser and the tower. This can be accomplished on a bench or utilizing the Assembly Stand if the stand incorporates the actual mast riser. The inside diameter of the mast riser may need to be filed and cleaned to ensure a proper fit. The three fins on the yaw shaft of the turbine may also be filed carefully if necessary to facilitate a proper fit.

CAUTION
If it is necessary to file the fins on the turbine yaw shaft do so with care. Filing the top portion of the fins can be awkward and there is a natural tendency to remove too much material from the lower portion of the fins while trying to file the upper portion. If the fins are filed excessively, the integrity of the coupling will be compromised and the wind turbine could separate from the mast riser under certain conditions.
Assembling and Installing the Tail

When assembling and installing the tail, it is recommended that the fins be attached to the tail boom prior to attaching the tail boom to the wind turbine generator. To assemble the tail fins, attach the fins and the rectangular spacers to each side of the boom using three M6 x 45 bolts, six M6 flat washers and three M6 lock nuts. The spacers should be between the fins and the boom and the washers should be on the outside surface of the fins. Do not tighten the bolts. Install the cross brace between the longer fins using two M6 x 16 bolts, four M6 flat washers and two M6 lock nuts. When all five bolts have been installed, gradually tighten them sequentially to symmetrically position the fins and then torque to 11 Nm (8 ft lbs).

To install the tail boom, orient the boom with the longer fins pointing down and the hole in the boom lined up with the corresponding hole in the wind turbine housing. Insert the tail boom into the housing and when it is snugly seated with the holes aligned, secure with an M10 x 70 bolt, two flat washers (one on each side of the turbine housing) and an M10 nylock nut. Torque to 75 Nm (55 ft lbs). Put a drop of medium strength lock tight on each thread.

NOTE
The tail boom fits snugly in the wind turbine housing. Attempt to line up the mounting holes prior to seating the boom. If necessary, adjust or remove the boom using a light twisting force on the tail fins. Use caution to avoid bending or damaging the fins. Make sure the end of the boom tube does not have any sharp burrs that could gouge or jam on the inside of the housing and make it difficult to insert.

CAUTION

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- Page numbers -
If the tail fins are installed upside down (with the longer wing up), the blades of the wind turbine may contact the tail fins and damage the rotor blades as well when the machine tilts back in high wind conditions.

Assembling the Blade Array

Place the torque key and then the hub torque ring onto the wind turbine generator shaft ensuring that the hub torque ring is fully seated on the shaft.

Place the aft hub plate onto the wind turbine shaft, ensuring that the large hole in the centre seats beyond the shoulder of the shaft and carefully aligning the three inner holes of the aft hub plate with the three holes on the hub torque ring. Fasten the aft hub plate to the hub torque ring using three M6 x 12 cap screws with a few drops of permanent (red or green sometimes provided in a small vile) thread locking compound applied to the threads of each screw. Using the 4 mm Allen key (provided), tighten the screws evenly until the aft hub plate is securely fastened to the hub torque ring. Torque the screws to 16 Nm (12 ft lbs).

**CAUTION**

THIS IS A MAJOR SOURCE OF SYSTEM FAILURES DUE TO IMPROPER ASSEMBLY

If the back hub plate is mated to the torque ring before fitting to the drive shaft the aft hub plate can catch on the shoulder of the wind turbine shaft, and when you seat the assembled blade array you may hear a solid clunk as it seats and even be able to torque the hub nut fully. The torque ring however, is still not seated and the blades can work loose with serious damage within days. Always pre-fit the torque ring by itself first. Then add the back hub plate as described above.
Blade Array Assembly

Remove the aft hub plate and torque ring from the wind turbine shaft and place it on a large flat protected work surface, to facilitate blade installation.

**CAUTION**

Carbon fiber blades can be easily damaged by a hard work surface or improper tool use. It is recommended that the work surface be covered with a heavy blanket or quilted moving pad to protect the blades during assembly.

Insert nine M6 x 55 bolts with an M6 washer under the head of each through the nine holes in the hub plate. The head of the bolts and the washer should be on the back of the hub plate – the same side as the hub torque ring. Place one of the hub dampers over the nine bolts and onto the front of the aft hub plate. Note that the additional bolt holes, for the spinner, as shown in the picture at right, are no longer used. The spinner now uses only the apex bolt holes. Note the apex bolts in the right picture are in the wrong holes.
Place the root of three wind turbine blades over the bolts on the hub plate ensuring that the curved face (the lifting surface) of each blade will face the wind turbine generator (i.e. the aft hub plate). Using the following photographs, identify the trailing edge of the blades and ensure that the blades are mounted so that the trailing edge at the root or hub will be closest to the turbine casing when the blade array is installed. See photo lower right. There may also be a small printed sticker on the root of each blade identifying the windward or forward surface.

**CAUTION**

The orientation of the blades is critical. If one or more of the blades are installed backwards the wind turbine will not function properly.

Correct blade rotation is clockwise when viewed from in front of the wind turbine looking toward the tail. If the blades are not marked in an obvious way, examine the blade root to ensure that the thick leading edge of the blade is forward (toward the wind) and the thin trailing edge of the blade is aft (toward the alternator).

Place the second hub damper and the second hub plate over the wind turbine blade array. Install an M6 flat washer and an M6 nylon lock nut on each of the nine bolts but do not tighten. Again, the non-symmetrically placed bolt holes are no longer used. Snug up the inner two lock nuts on each blade but allow sufficient play to enable the blades to move.
“radially”. Just finger tighten the lock nuts on the bolts in the apex holes of the triangular hub plate; these bolts are primarily used to attach the spinner and will be tightened in a later step. Adjust the orientation of the blades to ensure that they are exactly 120 degrees apart. This is best accomplished by measuring the distance between the tips of adjacent blades as shown in the following photographs and adjusting the blades until all three measurements are equal. The blade tips are contoured so take special care to use the same points on the tip for each measurement.

After the blades have been accurately adjusted, tighten each of the six inner lock nuts in sequence to a final torque of the to 12 Nm (9 ft lbs). Be careful so as not to disturb the radial positioning of the blades. Do not tighten the apex nuts as they will have to be removed to install the spinner in a later step.

Place the assembled blade array onto the wind turbine shaft with the hub torque ring to the rear. Don’t forget to install the torque key. Ensure that the hub torque ring and the aft hub plate are properly seated beyond the shoulder of the wind turbine generator shaft. When properly seated, the narrow portion of the hub torque ring will be recessed into the front of the wind turbine alternator housing as shown in the previous and adjacent photos.

Once again, ensure that the blade orientation is correct as outlined in the preceding CAUTION and then secure the blade array with the M16 flat washer, and the M16 nylon lock nut. Tighten the drive shaft lock nut while preventing the blade array from turning by holding the route of the blades by hand. While firmly holding the body of the wind turbine, wiggle each of the blades fore and aft and then re-torque the drive shaft lock nut. Repeat this process until the hub
torque ring is firmly seated. Torque the drive shaft lock nut to 19 Nm (14 ft lbs). When tightened properly, two to three complete shaft threads should protrude past the drive shaft lock nut.

CAUTION
Ensure that the blade array is fully seated as outlined in the preceding paragraphs. If the blade array is not properly seated, it will loosen despite being correctly torqued and will result in irreparable shaft and hub damage.

To install the spinner, remove the three lock nuts that were loosely threaded onto the bolts in the apex holes of the triangular hub plate. Place the spinner over the three bolts and secure with the M6 flat washer and M6 lock nut. Gradually tighten the three nuts in sequence to a final torque of less than 8 Nm (6 ft lbs). Do not over-tighten, as this may put undue stress on the nose cone and it may crack or break under operating conditions. These nuts are only there to hold the nose cone. Over tightening these bolts can actually bend the tips of the front hub plate and result in bending the blade tips out of track by over an inch, resulting in blade vibration and unnecessary noise.

Cold weather installations (below -10 deg C) may require re-torquing after the machine has been outside and acclimated to the sub-zero temperatures. After the alternator and blades have been allowed to cool to ambient temperature (30-45 min), recheck the torques on the hub and blades and be very careful with the spinner nuts since the spinner becomes more brittle at sub-zero and does not tolerate bending well.
Installation of Interior Components

NOTE
Prior to final installation and erection of the LAKOTA Wind Turbine, the other components of the renewable energy system (controller, batteries, diversion loads, inverters etc.) must be installed and wired in accordance with the overall system design and component manufacturer’s guidance. As a minimum, the LAKOTA Wind Turbine Control Panel must be installed to ensure that there is a means of controlling (stopping) the wind turbine when it is first erected.

Mounting the LAKOTA Wind Turbine Controller/Rectifier Panel

The LAKOTA Wind Turbine Control Panel is designed for surface mounting and is intended for interior installation only. It should be mounted adjacent to the DC side of the inverter or the DC disconnect panel depending on the design of the installation and within reasonable proximity to the battery bank to minimize the length of the battery leads. The panel can be mounted in any orientation if necessary to simplify the wiring to adjacent components. Simply fasten the panel to the wall with four round-head wood screws using the holes at the top and bottom of the panel. A typical installation is shown in the adjacent photograph. Be sure to leave sufficient space around the panel to facilitate the connection of large gauge wires and to allow access to the cover fasteners.

Mounting the Diversion Load

A renewable energy system that uses a LAKOTA Wind Turbine must also incorporate a diversion load (refer to page _Ref76206118). The diversion load should be in mounted in reasonable proximity to the LAKOTA Controller-Rectifier Panel in a vented cabinet, as shown in the photograph below.
Wiring the LAKOTA Controller-Rectifier Panel

Connect the DC Output Terminals of the Control Panel to the DC Disconnect side of the renewable energy system (usually the batteries) and also to the “+ and –“ of the LDR controller that is mounted inside the Controller/Rectifier panel. The three phase wires from the turbine can be connected to any of the three terminal in the upper terminal block. Connect the ground wire to any point on the chassis. Both the diversion load and the battery connections should be through a suitable amperage circuit breaker that protects the wiring from major overloads.

**CAUTION**

Ensure that the circuit breaker used in both cases is much higher than the rated power of the turbine. ie for 24v use slow acting at least 60A (for 48v use at least 40A and for 12v use at least 125A) to ensure that it will not trip under normal high output circumstances. Should either of these breakers trip under normal operating conditions the turbine will become “unloaded” and can seriously over-speed causing major damage to the turbine. These breakers should only trip in response to a short circuit potential fire condition.

Setting the Load Diversion Regulator (LDR)

As a general rule, the LDR should be set at or above the battery bulk/absorption voltage and the circuit breaker for the diversion load should be opened when charging the batteries from a grid connected inverter charger or other gas/diesel generator, to prevent the unit from diverting energy during charging.

![Diagram](image)
Installation and Erection of the LAKOTA Wind Turbine

NOTE
This section provides recommended step-by-step instructions for installation of the LAKOTA Wind Turbine on a tilt-up tower. For installation on a non-tilting tower, assemble the tower and wind turbine together on the ground and use a small crane to erect the entire assembly or assemble the wind turbine on the ground and place it on the tower with a small crane. Take time to pre-fit the turbine yaw axis into the mast riser, before any phase wires are installed. This will make eventual mating of the turbine and tower much easier.

Prior to final installation and erection of the LAKOTA Wind Turbine the other components of the renewable energy system (controller, batteries, diversion loads, inverters etc.) must be installed and wired in accordance with the overall system design and manufacturer’s guidance. As a minimum, the LAKOTA Wind Turbine Control Panel must be mounted in a suitable location with the ‘Brake Switch’ selected ‘ON’ prior to installing the wind turbine on the riser or raising the tower.

CAUTION
The LAKOTA Wind Turbine must never be allowed to operate without being connected to the LAKOTA Wind Turbine Control Panel with either the ‘Brake Switch’ selected ‘ON’ or a suitable load connected to the Control Panel output. If the wind turbine ‘sees’ an open circuit, it can over speed, even in average wind, and severely damage the unit.

Tower Assembly and Test Lift

Ensure that the tilt-up tower is assembled, the Mast Riser installed, and the tower is test raised in accordance with the manufacturer’s instructions PRIOR to installing the LAKOTA Wind Turbine. Lower the tower and support it at suitable intervals so that the top of the tower is at least 1.2 metres (4 feet) off the ground to facilitate installation of the wind turbine. Place the wind turbine head on a bench or table near the top of the tower to facilitate the cable connections.
Installing the Cable Runs

The LAKOTA Wind Turbine must be connected to the LAKOTA Control Panel with three cable runs (phase wires) or a single cable with 3 conductors plus ground in weather proof casing. The size and type of wire is dictated by the voltage of the wind turbine, the distance between the wind turbine to the Controller-Rectifier Panel (including the height of the tower), the type of installation (overhead or underground cables), and the local electrical code. Appendix A provides some information regarding wire types and the length of cable runs for various combinations of wind turbine voltage, wire gauge, and line loss. It is the installer’s responsibility to ensure that the wire size and type is suitable for their particular installation and that it is installed in accordance with the local electrical code.

To ease the handling of large heavy cables, simplify the installation of the wind turbine on the tower by providing sufficient slack in the cables, it is recommended that a weather-proof junction box be installed at the base of the tower, either mounted on the tower itself or mounted near the base as shown in the adjacent photo. The connections in the junction box should not be made until the wind turbine is installed on the mast riser and the excess cable is pulled back down the tower.

Connecting the Cables to the Wind Turbine

At the wind turbine, the cables must be connected prior to the final installation of the wind turbine on the mast riser. Fish the three cables up or down the tower (which ever is most convenient) and leave sufficient cable exposed at the top of the tower (1 to 2 metres (3 to 6 feet)) to facilitate making the connections to the wind turbine. Securely connect the generator output wires to the cables using a substantial connector. The connector must be a minimum of #8 AWG to accommodate the generator output wires; however, a larger connector may be dictated by the size of the wire used for the cable runs. Ensure that the connections are electrically isolated from each other using heat shrink tubing, heavy-duty electrical tape or other materials designed to isolate heavy-duty electrical connections. To ensure the electrical integrity of the cable connections, complete the Pre-Assembly Tests (refer to page Ref65482564). In this case, for Test One the multi-meter will be connected to any pair of cables rather than directly to the generator output wires and for Test Two the multi-meter will be connected between the cable and the metal tower or a grounding wire that is common with the mast riser.
Securing/Suspending the Cables

For most towers, the weight of the cables suspended inside the tower can be significant and must be distributed to the wind turbine yaw shaft or to tower structure rather than borne by wires themselves. This is accomplished by attaching a suspension chain to a hole in the web of the yaw shaft as shown in the adjacent photo and securely fastening the cables to the chain with heavy-duty wire ties. Whether the cable is suspended from the yaw shaft or from the tower structure, it is essential that the weight of the cables is borne by the mechanical structure rather than the phase wires; there should be no tension on these wires.

Securing the LAKOTA Wind Turbine to the Mast Riser

When the cable runs have been connected to the wind turbine, feed the cables back into the mast riser and slide the wind turbine assembly onto the mast riser until the yaw shaft is fully seated. Simultaneously pulling the excess cable out the base of the tower will make it easier to mate the yaw shaft to the mast riser; however, do not apply excessive tension to the cables. When the yaw shaft is seated snugly, apply some medium thread locking compound to the two M10 x 25 bolts and secure the yaw shaft clamp. Torque the bolts to 58 Nm (43 ft lbs).

Completion of the Cable Runs

When the LAKOTA Wind Turbine has been securely installed on the mast riser, and before the tower is raised or the blades are allowed to move freely, complete the installation of the cable runs from the wind turbine to the LAKOTA Controller-Rectifier Panel. Prior to connecting the cables at the Controller-Rectifier Panel, it is recommended that Test Two outlined in Pre-Assembly Tests (refer to page _Ref65482564) be repeated to ensure the overall integrity of the cable runs. In this case, the multi-meter will be connected to any pair of cables rather than directly to the generator output wires.
LAKOTA - OWNER’S MANUAL

Once the test has been successfully completed connect the cables to the three terminals on the AC input side of the controller-rectifier. For a more detailed discussion regarding the wiring of the controller-rectifier refer to the section entitled ‘Wiring the LAKOTA Controller-Rectifier Panel’ on page _Ref76206201.

After the cables have been connected, ensure that the ‘Brake Switch’ is selected ‘ON’ and confirm that it is indeed ‘ON’ by giving the blades a light spin. If the brake is ‘ON’ the blades will immediately come to a stop. If the brake is ‘OFF’ the blades will coast to a stop.

CAUTION

The AC Phase wires from the wind turbine must be connected to the three terminals in LAKOTA Controller-Rectifier Panel. NEVER connect the AC wires from the turbine directly to the battery bank or the inverter.

CAUTION

Assembly of the LAKOTA Wind Turbine is now complete; however, the tower should not be raised nor the wind turbine be allowed to operate if installed on a fixed tower until all components of the renewable energy system have been assembled, installed, wired, and tested in accordance with the manufacturer’s guidance and the assembly of the wind turbine has been verified using the following Assembly and Installation Check-List.

☐ Thoroughly review the preceding instructions to ensure that all steps were completed in their entirety, in particular, to ensure that thread locking compound was applied where prescribed, fasteners were tightened to the prescribed torque, and wiring connections were secured and insulated.

☐ Re-verify that all exposed fasteners are tightened to the prescribed torque (except the nose cone attachment bolts) and that thread locking compound was applied where specified.

☐ Ensure that the wind turbine is securely fastened to the mast riser and that the yaw shaft clamp bolts have thread locking compound applied and are tightened to the prescribed torque.

☐ Closely examine the blades with reference to the photograph on page 22 to ensure that they are installed in the correct orientation.

☐ Ensure that there is no play in the hub torque plate by grasping the tip of a blade and gently rocking the blade array longitudinally to the drive shaft.

☐ Visually re-inspect the wind turbine, particularly the leading and trailing edges of the blades, to ensure that it was not damaged during assembly.

☐ Ensure that the ‘Pre-Assembly Tests’ were completed at the alternator output wires and at the base of the tower and/or the Controller-Rectifier Panel (refer to pages 14, 25 and 26).

☐ Ensure that the cable runs are securely connected at the Controller-Rectifier Panel and in the tower junction box if applicable. Check the LDR controller and diversion load is wired correctly. (see pages 25, 26)
Ensure that the ‘Brake Switch’ is selected ‘ON’ and confirm that the brake is indeed ‘ON’ by giving the blades a light spin. They should not be able to rotate more than 1/3 to ½ a turn with the brake ON when given a slight spin by hand.

Ensure that all components of the renewable energy system have been assembled, installed, wired, adjusted and tested in accordance with the manufacturer’s guidance.

If using a tilt-up tower, ensure that the tower has been assembled and installed in accordance with the manufacturer’s instructions and test lifted without the wind turbine installed. In lieu of specific guidance from the tower manufacturer, a tilt-up tower with a LAKOTA Wind Turbine installed should ideally be erected when the wind is calm and never when the wind is greater than 10mph.

The LAKOTA Wind Turbine is now ready for operation. If it is installed on a fixed tower, start the machine in accordance with the instructions outlined in the following section entitled ‘Normal Operation of the LAKOTA Wind Turbine;’

Normal Operation of the LAKOTA Wind Turbine

WARNING
This section deals only with the operation of the LAKOTA Wind Turbine. Operation of the overall renewable energy system will depend on the design of the system and the specific components installed. To ensure safe and effective operation of the overall system, compliance with the guidance provided by all of the component manufacturers and the local electrical authorities is essential.

CAUTION
The LAKOTA Wind Turbine must always be presented with a suitable load during operation. Prior to starting the wind turbine, ensure that all components of the renewable energy system have been assembled, installed, wired and tested in accordance with the manufacturers’ guidance. Presenting the wind turbine with an open circuit will cause irreparable damage to the alternator and/or the controller-rectifier. Presenting the wind turbine with an overload demand for power or a short circuit will stall it or prevent it from starting. MOD 3 setting will start in wind around 6mph and lower MOD settings like MOD 0 may not start up until 12 mph. Once started however, the LAKOTA should continue to fly down to 2-3mph if the wind is steady.

Setting the Load Diversion Regulator (LDR) Diversion Voltage

Prior to operating the LAKOTA Wind Turbine, the Load Diversion Regulator (LDR) must be adjusted. Refer to the photo on page 25 and note the range of adjustment voltage for your voltage turbine. Normally you will set the diversion voltage to be in the high end of that range near or above the float voltage the batteries will be operating at (ie set 29v when the float voltage is 28v) This will ensure the LDR will not divert any energy until the batteries reach at least 1 volt above Float. You can quickly check the operation of the LDR if the battery bank is full by turning the
blue and white rheostat counter clockwise until the small green LDE lights up. You may hear a high frequency hissing sound (approx 14kHz) as the diversion begins. Edge wound ceramic resistors may also make a slight buzzing as they dissipate energy. This is normal.

Starting the LAKOTA Wind Turbine

Prior to starting the LAKOTA Wind Turbine, set the controls of the renewable energy system to ensure that the alternator is presented with a suitable load. As well, ensure that a diversion load is available to divert any excess power generated by the wind turbine. If a Load Diversion Regulator is installed, ensure that the diversion voltage is set as described above.

To start the LAKOTA Wind Turbine, select the ‘Brake Switch’ on the LAKOTA Wind Turbine Controller-Rectifier Panel to ‘OFF’. If the wind is approximately 10 kph (6 mph), the blades should begin to rotate. If the wind is in excess of approximately 12 kph (8 mph), they will quickly gain speed to the point where the wind turbine is delivering power to the load. Once started, the blades will continue to rotate in very light winds below the starting wind speed but the wind turbine will not deliver any significant amount of power because there is simply very little energy per square meter of blade area. (In a 6.7mph wind there is only 16 watts per square meter of energy available in that wind and the theoretical maximum you could hope to extract is only less than 10 watts). Practically speaking you can harvest only 5 or 6 watts per square meter at 6mph. Operations at 20 mph will gather 80-100 times that amount of energy due to the cubed energy formula of wind speed. Put another way, you can get more energy from 1 hour of operation at 20 mph than you can from 30 hours of operation at 6mph.

Stopping the LAKOTA Wind Turbine

To stop the blades from turning, select the ‘Brake Switch’ ‘ON.’ The blades should quickly come to a stop, although they may continue to turn very slowly in a moderate to high wind. In strong winds just below the tilt up governing speed and in very high winds, the braking system may not stop the wind turbine, but it will keep the turbine safely turning slowly if it already was stopped when the brake was turned ON. If, after 5-10 seconds of attempted braking, the rotor cannot be stopped, select the ‘Brake Switch’ ‘OFF’ and wait for the wind to die down. You can try this 3-4 times and perhaps wait to “catch it” just as a gust dies down as it decelerates. If this fails to work then it is fine to leave the brake OFF and just let it run. Check to make sure the LDR is diverting energy if you are not using it. Turning on useful loads will assist the batteries in shedding load and allow the turbine to not have to work too hard to replace it.

CAUTION

Leaving the ‘Brake Switch’ ‘ON’ in high winds with the blades turning at high speed can destroy the alternator. Only select the ‘Brake Switch’ ‘ON’ in light to moderate winds below about 30mph (50kph) to ensure that the wind turbine can be safely stopped without damaging the alternator.

With the wind turbine stopped and the ‘Brake Switch’ selected ‘ON’, the blades may turn very slowly but well below airfoil operational speeds, even in hurricane force winds. This is the correct way of placing the wind turbine in a safe non-operational status.

Initial In-Service Tests

When the LAKOTA Wind Turbine is first put into service or after periodic maintenance, various tests will be required to confirm that it is operating correctly. The specific tests required will be
dictated by the overall design of the renewable energy system; however, the following will confirm the operation of the LAKOTA Wind Turbine and the controller-rectifier.

### CAUTION

The tests on the following page must be done with the wind turbine in operation and should be conducted by a qualified electrician.

---

**In-Service Test One – AC Voltage Check**

To complete this test, the LAKOTA Wind Turbine must be operating in a reasonable wind – 20 kph (12.5 mph) should be sufficient.

1. Set the multi-meter to read AC voltage in a range appropriate to the rating of the wind turbine.
2. Measure the voltage between any two phases on the input side of the controller-rectifier panel. The voltage will be dependant on the wind speed and MOD setting but the nominal value should be comparable to the rating of the wind turbine. (18-22v for a 24v turbine)
9. Repeat step three for the other wire pairs. The three voltages should be essentially equal in MOD 3 and MOD 0 but unequal on MOD 1 or MOD2

**In-Service Test Two – DC Voltage Check**

1. The DC voltage across the DC output of the LAKOTA Controller/Rectifier and “battery” side of the LDR should both read the same as the voltage of the battery bank. The voltage at the sensing terminals of the LDR should also be the same.
2. In gusty wind conditions with a small battery bank the voltage can vary 2-3 volts or more depending on the state of charge. The larger the AH rating and the fuller the battery bank the less variation there should be in voltage under gusty conditions.

**In-Service Test Three – Load Diversion Regulator Test**

1. This test is only applicable if a Load Diversion Regulator (LDR) has been incorporated in the Controller-Rectifier Panel.
2. To complete this test, the LAKOTA Wind Turbine should be operating in a reasonable wind (20 to 25 kph (12 to 16 mph)).
3. With a small insulated screw driver, lower the diversion voltage setting to the minimum value by turning the adjustment fully counter clockwise. The light on the LDR will indicate that power is being diverted to the diversion load and if there is sufficient power being diverted, the temperature of the diversion load will increase noticeably within a minute or so. Touching the ceramic resistors will not cause a shock hazard but be careful not to allow jewelry or tools to come in contact with
terminals or resistor connections or you may cause a short or spark. In light winds, it may be necessary to measure the voltage across the diversion load to confirm that power is indeed being diverted.

4. Note the voltage across the battery terminals of the LDR controller as the LED lights up. This will give you a better sense of the voltage range of the board in this configuration. Now turn it back full clockwise and then back maybe a quarter turn. This should be close to the correct setting for most systems. The next time there is good wind and you have a full battery bank you can recheck this high end setting under actual conditions. You want the LED to come on and the power to be diverted just above the normal float voltage of the battery bank. Note that when diverting, the LDR modulates at around 14 kHz and so the voltage read off the Load side of the board will read less than true voltage since it is oscillating but the resistors will get hot and current through them will read higher than actual.

5. After completing the test, re-adjust the diversion voltage setting to the desired value.

Periodic Maintenance of the LAKOTA Wind Turbine

The LAKOTA Wind Turbine requires minimal periodic maintenance; however, maintenance requirements of the overall renewable energy system will be a function of the various components incorporated in the system and must be conducted in accordance with the guidelines provided by the various manufacturers.

In-Service Monitoring

When the LAKOTA Wind Turbine is first placed into service, monitor it closely for any indications of abnormal performance and any signs of loose fittings or components; pay particular attention to tower guy wires ensuring that they are all secure and the tensions are correct. Monitor the wind turbine to ensure that it yaws smoothly and aligns itself with the wind; keep in mind that the wind velocity (direction and speed) can vary significantly between ground level and the top of the tower. Listen for abnormal noises or excessive vibration that could be an indication of loose fittings or components. Using a pair of binoculars, inspect the furling springs and ensure that the guy-wire connections are secure. Normally once in service the LAKOTA does not need more than an annual inspection. If convenient, however, after approximately one month of service, the LAKOTA Wind Turbine should be thoroughly inspected as per the ‘Annual Inspection’ outlined in the following paragraph.

Annual Inspection

Annually, or more frequently if installed in a particularly harsh, corrosive or abrasive environment, the LAKOTA Wind Turbine must be thoroughly inspected either by lowering a tilt-up tower or by accessing the wind turbine by other means. The following items should be inspected:

**CAUTION**

Prior to lowering a tilt-up tower or approaching the wind turbine in it operating position, ensure that the system is completely shut down. Refer to Stopping the LAKOTA Wind Turbine (page Ref76206264). Other components of the renewable energy system should be shut down or isolated in accordance with the applicable manufacturers’ instructions.
• Inspect all fittings and components to ensure that they are secure and are not showing signs of wear. If necessary re-tighten in accordance with the assembly instructions.
• Clean the unit using a clean damp cloth and a mild detergent.
• Remove the spinner and verify the torque on the drive shaft lock nut. If the torque is less than 19 Nm (14 ft lbs), re-torque the drive shaft lock nut in accordance with the procedure and then reinstall the spinner.
• Check for play in the alternator rotor shaft and the hub attachment by grasping the tip of a blade and applying a fore and aft pressure. If there is excessive play, re-verify that the drive shaft lock nut has been tightened to 19 Nm (14 ft lbs). If the problem persists, contact your Authorized LAKOTA Dealer.
• Inspect the furling mechanism to ensure that the eye-bolts are secure and that the eye-bolts and the springs are not exhibiting signs of excessive or abnormal wear.
• Inspect the alternator casing for signs of damage. If operating an MARINE model in a corrosive or harsh environment, inspect the protective polyurethane coating for signs of corrosion and touch up the exposed surfaces using the touch-up paint provided by the manufacturer or a good quality, polyurethane paint.
• Inspect the blades for nicks, cracks, or pitting. Minor nicks can be touched up using a good quality, polyurethane paint. Any significant blade damage should be brought to the attention of your Authorized LAKOTA Dealer.

Unattended Operation and Extended Dormancy

The LAKOTA Wind Turbine is an ideal power source for remote locations and seasonal dwellings. It can be operated unattended for extended periods provided that the overall renewable energy system is robust and failsafe. The system must be able to utilize or divert the energy produced by the wind turbine on a continual basis and in the event of a component failure the system must continue to divert the energy to the diversion load. Obviously, the physical installation must be able to withstand the full range of wind speeds that will occur during the period of unattended operation.

CAUTION

During operation, the LAKOTA Wind Turbine must always be presented with a suitable load and can be severely damaged if the alternator is presented with an open circuit. Due to the reduced opportunity for operator intervention in the event of a component failure that results in an open circuit, there is some increased risk associated with unattended operation.

For unattended operation, provisions must be made to complete the LAKOTA Wind Turbine annual inspection outlined in the previous paragraph and to lower the wind turbine if the winds are forecast to exceed 160 kph (100 mph) with a 32 kph (20 mph) gust factor (refer to the Caution on page _Ref76206304). Please note that other system components may require more frequent inspection and/or periodic maintenance – refer to the applicable manufacturers’ guidance.

The LAKOTA Wind Turbine can be shut down and left dormant for an indefinite period. Simply select the ‘Brake Switch’ ‘ON’ so that the alternator can turn but is not allowed to “Fly” and shut down other system components in accordance with the applicable manufacturers’ guidance. Although not necessary, to avoid unnecessary wear and tear during periods of extended
dormancy, the LAKOTA Wind Turbine can be removed from the tower and stored in a clean, dry environment.

For remote operations the turbine may be left running continuously as long as it has and assured storage medium and the correct LDR controller and diversion load. LAKOTA turbines currently under test in Ontario, Canada run continuously with only the LDR controller and a small capacitor bank instead of a battery. With no battery and no inverter and no other loads all energy is consumed by the resistors and the turbine flies under control at all times with no attention or other control. This confirms that with the proper load control, even if all other systems fail, the turbine can be safely operated for extended periods without supervision.
Appendix A – Wire Types and Sizing

The following Table provides information regarding the maximum amperage capacity of insulated conductors according to the United States National Electric Code. The Canadian equivalent designations are similar and available on the web.

<table>
<thead>
<tr>
<th>Size</th>
<th>60°C (142°F)</th>
<th>75°C (167°F)</th>
<th>90°C (194°F)</th>
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<tr>
<td>AWG</td>
<td>Types: TW, UF</td>
<td>Types: FEPW, RH, RHW, THHW, THW, THWN, XHHW, USE, ZW</td>
<td>Types: TBS, SA, SIS, FEP, FEPB, MI, RHH, RHW-2, THHN, THHW, THW-2, THWN-2, USE-2, XHH, XHHW, XHHW-2, ZW-2</td>
</tr>
<tr>
<td>or kcmil</td>
<td>Copper Conductors/System Wires (Amps)</td>
<td>Copper Conductors/System Wires (Amps)</td>
<td>Copper Conductors/System Wires (Amps)</td>
</tr>
<tr>
<td>18</td>
<td>-</td>
<td>-</td>
<td>14</td>
</tr>
<tr>
<td>16</td>
<td>-</td>
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Cable Selection For Various Wind Turbine System Voltages

Line Loss For LAKOTA Wind Turbine Generator 12V, 24V, and 48V System Voltages At 1300 Watts Of Power

<table>
<thead>
<tr>
<th>12 Volts</th>
<th>24 Volts</th>
<th>48 Volts</th>
<th>Multi-strand Wire</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distance up to, 2% loss</td>
<td>Distance up to, 4% loss</td>
<td>Distance up to, 2% loss</td>
<td>Distance up to, 4% loss</td>
</tr>
<tr>
<td>2.5 m</td>
<td>5.1 m</td>
<td>10.2 m</td>
<td>20.4 m</td>
</tr>
<tr>
<td>4.0 m</td>
<td>8.0 m</td>
<td>16.1 m</td>
<td>32.3 m</td>
</tr>
<tr>
<td>5.0 m</td>
<td>10.1 m</td>
<td>20.3 m</td>
<td>40.6 m</td>
</tr>
<tr>
<td>6.4 m</td>
<td>12.8 m</td>
<td>25.7 m</td>
<td>51.4 m</td>
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<tr>
<td>8.04 m</td>
<td>16.08 m</td>
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<td>64.3 m</td>
</tr>
</tbody>
</table>

Line Loss For LAKOTA Wind Turbine Generator 12V, 24V, and 48V System Voltages At 500 Watts Of Median Power

<table>
<thead>
<tr>
<th>12 Volts</th>
<th>24 Volts</th>
<th>48 Volts</th>
<th>Multi-strand Wire</th>
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<tbody>
<tr>
<td>Distance up to, 2% loss</td>
<td>Distance up to, 4% loss</td>
<td>Distance up to, 2% loss</td>
<td>Distance up to, 4% loss</td>
</tr>
<tr>
<td>6.6 m</td>
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<td>83.6 m</td>
<td>167.2 m</td>
</tr>
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</table>
Appendix B – LAKOTA Checklist and Installation Overview

CAUTION
Please consult with a knowledgeable Dealer/Installer or electrical contractor before purchasing components, attempting system design or layout of components and particularly before installing or connecting the tower or electrical components such as inverters and batteries. Failure to do so can result in destroyed components that are not covered by the warranty and possible injury to yourself or others.

WARNING
DO NOT connect electrical components based strictly on this manual. Consult a qualified electrician of systems design expert before attempting to install towers and especially high voltage (120/220v) electrical components such as inverters and grid connected systems. Failure to do so could cause serious injury or death.

Install LAKOTA Turbine Head Assembly (Final Checklist)
✓ Power cables connected and shrink-wrapped
✓ Continuity checked at base and/or at Controller-Rectifier
✓ Strain relief attached, secure and is adjusted shorter than the electrical cables
✓ Head Assembly “C-Clamp” is secure, with added rubber gasket and/or set screw through the C-clamp and mast riser. Lots of lock tight in appropriate places
✓ Hub nut blade array and tail assembly nylock nuts, all have been torqued properly. Spinner nuts not too tight
✓ No hub play (by gently moving the blade tip back and forth)
✓ Visually inspect the blades and alternator casing one last time, for damage that may have happened during installation or improper (backward) blade installation.
✓ Blade spin test confirms free movement to rotate, as well as brake is working and is ON
✓ Wind less than 5-10 mph or preferably calm for tower lifting
✓ READY to LIFT TOWER or POWER UP if in position and there is sufficient wind.

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- Page numbers -
LAKOTA Wind Turbine is not working and/or the Blades are not turning!

Are you sure the Blades are mounted correctly?

Is enough wind at your tower site? Estimating wind speed at higher altitudes is difficult and you may have to compare your wind speed with tree tops or equivalent at the same height. Refer to your tower manual as needed.

Repeat Wind Turbine System Checks Test 1 and Test 2 without the 3 power cables from your wind turbine connected to the Controller-Rectifier.

Verify Test 2 with one lead of the Multi-meter connected to the power cable of the wind turbine and the other end to the tower structure itself.

Check that the ‘Brake Switch’ is in the OFF position

Disconnect the Wind Turbine input wires from your Controller-Rectifier for a few seconds and see if the turbine starts rotating.

If your LAKOTA Wind Turbine is configured for low wind speed performance or higher system voltage configuration and you performed the modification yourself, re-check to determine that no errors in wiring were made.

You may have a failed rectifier diode. Contact AEROMAG technical support for how to bench test your Controller-Rectifier and/or replace a faulty diode or take you controller to an authorized LAKOTA Service Centre to have checked.

Done
Appendix D - LAKOTA Wind Turbine Warranty Notes

The Standard and Optional 3 Year Extended Warranties do not cover:

1. Damage resulting from negligence, accident, misuse, abuse, or neglect.
2. Damage resulting from failure to follow instructions supplied with the product.
3. Damage resulting from repairs or the substitution of assembly parts by anyone not authorized by AEROMAG.
4. Damage occurring during shipment of the product.
5. Damage to any unit which has been altered or on which the serial number and/or model number has been altered or removed.
6. Damage to or deterioration of the external housings due to excessive, severe, atmospheric degradation from extreme and unusual environments that require exceptional maintenance and refinishing service.
7. Damage caused by neglect and or failure to service when the required annual inspections is due as required by the unit’s Owner’s Manual.
8. Damaged if improperly connected to the equipment of other manufacturers.
9. Voltage or MOD adjustments to the product as outlined by the Owner’s Manual.
10. Cost incurred for de-installation, re-installation and shipping of the product for service.
11. Products damaged by or due to improper or inadequate packaging when returned for warranty service or repair.

The Standard and Optional Extended Warranties are void if the product is:

1. Damaged as a result of incorrect assembly, misuse, abuse or accident.
2. Utilized in an unauthorized commercial or rental application.
3. Modified or repaired by anyone not authorized by AEROMAG.
4. Damaged caused by improper use with or connection to the equipment of other fabricators, manufacturers or unqualified installers.

Return Authorization and Carry-In Service

If you experience a problem with your LAKOTA turbine at any time during the STANDARD WARRANTY period, contact your nearest Authorized LAKOTA Dealer or the AEROMAG Service Centre directly, at (928) 775-0085 or 1-888-407-WIND or info@aeromag.com to determine the nature of the problem. AEROMAG Service Centre will issue a Return Authorization (RA) number to return the turbine or send you the necessary replacement parts. This warranty is VOID if this warranty card is not returned to AEROMAG within 90 days from the date of purchase, together with a readable copy of the original purchase receipt. If you did not receive a warranty card with your LAKOTA please request one as soon as practical.

Note: The customer must identify the installer of the turbine or this warranty card will be annotated as “Customer Installed” and the customer thereby accepts responsibility for any and all handling damage or errors in installation. Handling damage or failures caused by improper installation, reconfiguration or customer maintenance of the LAKOTA are NOT covered by this warranty.

You are encouraged to retain and use the original shipping container in case of warranty return in order to ensure the unit is not damaged in shipment.
Identification and Markings for Warranty Registration

This is key information you may need in the future.

All LAKOTA Wind Turbines sold in Canada are identified by a Model Number and a Serial Number, both of which are stamped on an identification plate located on the main housing of the machine as shown in the adjacent photo. These numbers will be required in the event that there is a need to return the unit for warranty work. For convenient reference, the numbers and purchase information should be recorded below in the same way they are recorded on the Warranty Registration Cards packaged with the unit. The original bill of sale will also be required and can be attached to this page for safe keeping.

<table>
<thead>
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<th>Model Number</th>
<th>Serial Number</th>
<th>Blade Serial Number</th>
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<td>C - 3</td>
<td>C - AQF - - A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>C - AQF - - B</td>
</tr>
<tr>
<td></td>
<td></td>
<td>C - AQF - - C</td>
</tr>
</tbody>
</table>

Purchase Date: _____________________
Purchased From: _________________________________________________________
Address: _______________________________________________________________
City: _________________________ Province: _______ Postal Code: ______________
Phone: _______________________  Email: ___________________________________
Installation Date: ________________________
Installed Location: Address: ____________________________________________
City: _________________________ Province: ________ Postal Code: _____________
Installed By: ____________________________________________________________
Address: _______________________________________________________________
City: _________________________ Province: ________ Postal Code: _____________
Phone: _______________________  Email: ___________________________________
Extended Warranty Purchase Date: ____________________________

AEROMAG – Prescott, AZ Service Center   (928) 775-0085 or 1-888-407-WIND
**Torsion Settings - Quick Reference:**

<table>
<thead>
<tr>
<th>Pounds</th>
<th>Newton Metres</th>
<th>Foot Pounds</th>
<th>Inch</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main Hub Nut</td>
<td>19</td>
<td>14</td>
<td>168</td>
</tr>
<tr>
<td>Torque ring screws</td>
<td>16</td>
<td>12</td>
<td>144</td>
</tr>
<tr>
<td>Blade Array Inner Nuts</td>
<td>12</td>
<td>9</td>
<td>108</td>
</tr>
<tr>
<td>Blade Array Spinner Nuts</td>
<td>&lt;8</td>
<td>&lt;6</td>
<td>&lt;72</td>
</tr>
<tr>
<td>Yaw Shaft C-Clamp</td>
<td>58</td>
<td>43</td>
<td>516</td>
</tr>
<tr>
<td>Tail Fins</td>
<td>11</td>
<td>8</td>
<td>96</td>
</tr>
<tr>
<td>Tail Boom</td>
<td>75</td>
<td>55</td>
<td>660</td>
</tr>
</tbody>
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**NOTES:**