

Kestrel e400nb

250Vdc, Type 1112-3500-250 (3.5kW 250Vdc)

110Vdc, Type 1112-3500-110 (3.5kW 110Vdc)

048Vdc, Type 1112-3500-048 (3.5kW 048Vdc)

With Conditional Five Year Warranty



Important Note: Only the e400nb 3.5kW 250V grid tie version when installed with the Power One Aurora 3.6 Inverter is MCS and SWCC certified.

Warranty Registration (Failure to return may render the warranty to be void)

Please complete and return this page within three months after the product delivery date or within one month following the commissioning date. Attach a picture of your installation

Name of Product: _____
Product Serial Number _____ Pitch Control Serial Number _____ Blade Serial No. (1) _____ (2) _____ (3) _____
Delivery Date _____ or Commissioning Date _____
<i>Name and Address of Owner</i> _____ _____ _____
Telephone: _____ Email: _____
<i>Installation / Site Address (GPS co-ordinates are appreciated)</i> _____ _____

Commissioning Check List

Section	Operation / Procedure	Verified
4.2	All tail assembly M6 fasteners torqued to 10Nm (7.5ft lb)	
4.3	Tail boom weld assembly 2 x M12 to 50Nm (36ft lb)	
4.3	Tail boom weld assembly 8 x M10 to 50Nm (36ft lb)	
4.4	Generator electrical connection secure and insulated	
4.4	Generator fitted to the tower 8 x M16 to 120Nm (88ft lb)	
4.5	Tail assembly to the boom 2 x M10 to 35Nm (25ft lb)	
4.6	Blades properly installed (serial number forward)	
4.6	Blade bolts 6 x stainless M16 torqued to 90Nm (65ft lb)	
4.8	Nacelle 2 x M6 nuts + 4 x M5 screws stainless to 3Nm (3ft lb)	
4.8	Nosecone to stiffener ring 6 x M6 stainless to 4Nm (3ft lb)	
4.8	Nosecone to posts 3 x M8 stainless to 10Nm (7.5ft lb)	

Type of Tower	Installation Engineer	Comissioned Date

GENERAL COMMENTS:

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Send to: Kestrel Wind Turbines, P.O. Box 3191, North End, Port Elizabeth, 6056, Eastern Cape, South Africa Or email to: kestrel.admin@eveready.co.za OR Fax: +27 41 394 8183

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Revision History

Revision	Date	Comments	Author
1.8	06/13	Add SWCC Logo, technical specification and Annexure 6	J. Carpy
1.7	12/12	Revised technical specification	B.Singh
1.6	11/12	Blade fitment guide improved, brake fitment added	J. Carpy
1.5	09/12	MCS Logos added, blade bolts reversed, brake cable turns	J. Carpy
1.4	07/12	Add sect. 1.2 Operating procedures, revise maintenance	J. Carpy

Disclaimer

Kestrel Wind Turbines makes every effort to give accurate information in this manual and is in no way liable for any error or omission. The user of this manual assumes full responsibility and risk

Please carefully read and apply the safety notes. Consult a professional engineer and take advice if you are unsure.

Note: The Kestrel e400nb has a mechanical brake and the Kestrel e400n is supplied without this mechanical brake.

1.0 Safety and Warning Notes

Accidents can easily occur and there are always inherent dangers associated with any type of machine. Tower installations pose their own dangers. Always work carefully and have an assistant wherever possible. All installation work should be completed at ground level wherever possible. Be very aware of the blades during installation. Consult a civil engineer or reputable builder if you are unsure.

Use caution when working with this wind turbine. Use good handling methods and take precautions to avoid physical injury. The Kestrel e400nb output voltage can become dangerous and even lethal when running on open circuit. Always short the output wires together when the turbine is disconnected. Do not work on the system when the turbine is running or when lightning is possible.

Disconnecting any wire may result in a spark. The presence of explosive hydrogen from battery charging is always a possibility. Adequate ventilation must be provided for battery installations. Wire sizes must be correct for the powers supplied. Fire can result from shorts created on a battery. Consult a qualified electrician if you are unsure.

Slack bolts, poor workmanship and loose electrical connections must be avoided. The turbine blades are dangerous therefore exercise caution. Always shut the turbine down before approaching by operating the brake switch on the controller or the mechanical safety brake. Preventative maintenance is always the best. Checks are best carried out in calm weather conditions. Avoid any maintenance or inspection during windy weather.

1.1 Safety Symbols

The symbols shown are used throughout this manual to highlight safety points

General caution warning



Danger of hand injury



Danger of electrical shock



Injury from blades



Work Instructions

✱ Asterisk denotes a special instruction or reminder.

► Arrow head denotes an assembly/build instruction.

1.2 Turbine Operating Procedures

A standard start and stop procedure is included in this product manual (Annexure 4). It is recommended that a label showing this procedure be visible adjacent to the wind turbine tower.

A “T” bar is supplied to operate the tower brake. This “T” bar should be stored in a safe but accessible location and never left in position on the tower.

Standard Operating Procedure

This procedure gives a clear action sequence for the following procedures:

- i) Procedure for starting and activation
- ii) Procedures during normal running
- iii) Procedure for stopping and de-activation
- iv) Procedure for routine maintenance

Procedure for Starting

(Assumption: The turbine is braked and electrically isolated)

- Ensure that all personnel and animals are well clear of the turbine tower
- Engage the turbine fuse holder F1/F2 in the interface unit to connect the turbine.
- Release the electrical brake switch S1 located in the interface unit
- Approach the tower base and insert the “T” bar into the brake winch.
- Apply light pressure to the brake and release the ratchet lever.
- Release the mechanical brake by unwinding the brake winch.
- Observe the turbine to start rotation in the wind.
- Re-apply the ratchet lever and remove the “T” bar.

Procedures During Normal Running

(Assumption: The turbine is running normally)

- No operating procedures are required. Take every opportunity to visually observe the system in operation and to listen for any unusual noise. This is always a good practice.

Procedures for Stopping and De-activation

IMPORTANT NOTE: A stopped turbine will still yaw and align to follow the wind. A braked machine although stopped, can still cause serious injury to personnel. The machine must be fully secured before approaching and must only be approached in calm or very light wind conditions.

(Assumption: The turbine is to be stopped and electrically isolated)

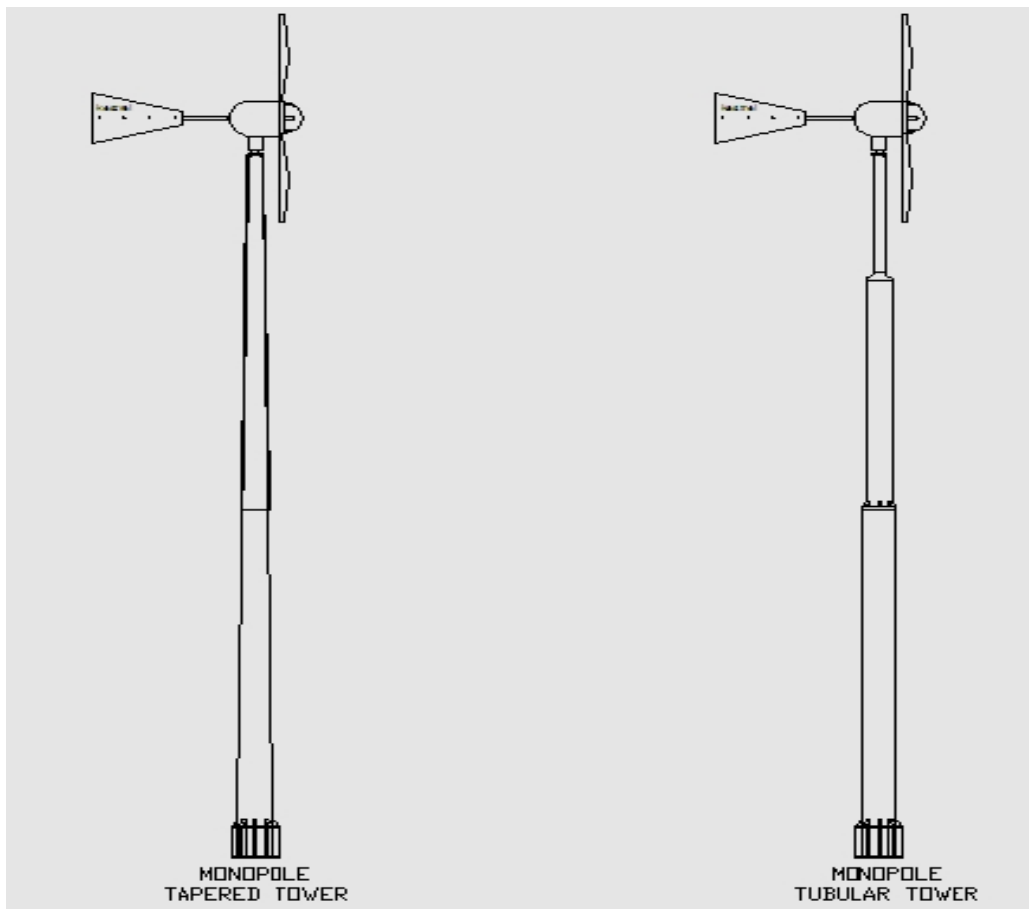
- Procure the brake “T” bar and approach the tower base.
- Verify that the brake ratchet mechanism is engaged.
- Insert the “T” bar into the brake and wind the handle a little to verify the ratchet operation.
- While observing the turbine, slowly wind the brake handle until the brake tension is detected and the turbine slows down to be stationary.
- Wind the handle two more “clicks” and remove the brake handle.
- At the interface module, operate the stop switch S1 and pull out (disengage) the turbine fuses F1/F2.

Procedures for Routine Maintenance

Routine maintenance is described in Section 7.0 of this manual. The same start and stop procedures are used for maintenance.

The tower brake “T” bar must be removed to prevent accidental brake release and to “Lock out” the turbine brake.

2.0 The Tower



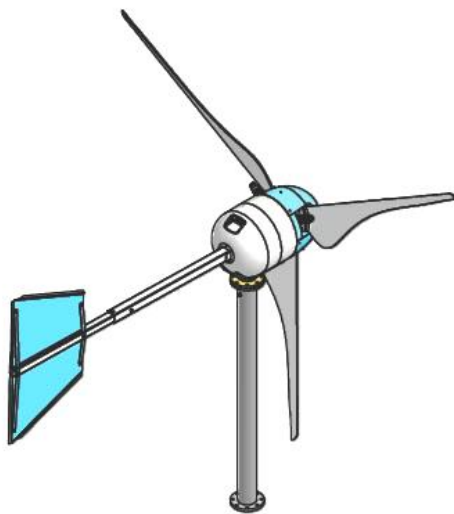
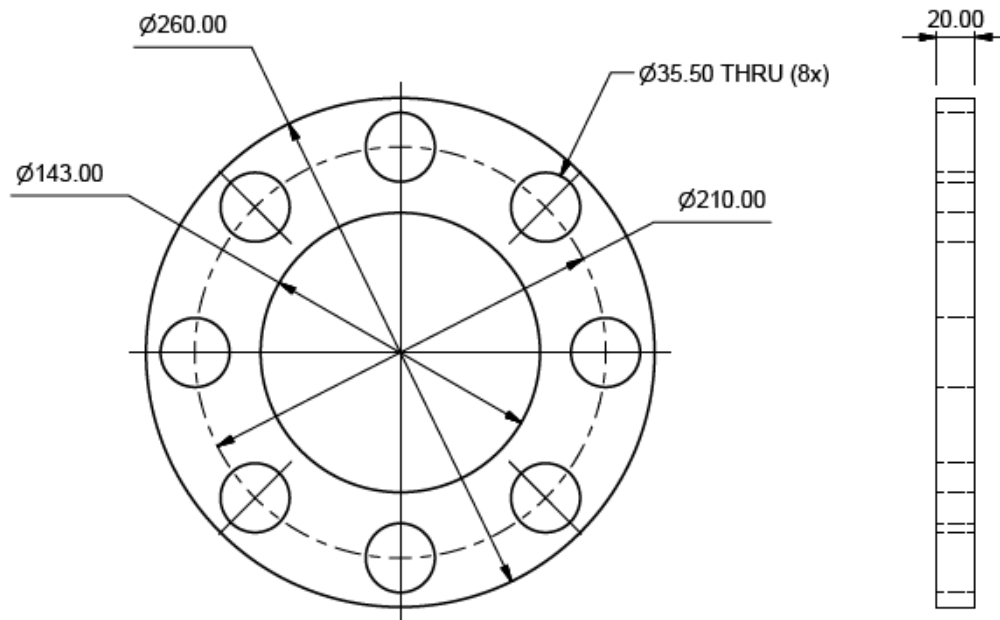
A monopole free standing tower is preferred for the Kestrel e400nb. The tower sections can be taper formed or parallel tubular. These towers use larger diameter sections to increase rigidity and strength but optimise the total tower weight. This tower type is also the easiest to assemble and install due to its simple design and optional hydraulic or electro-mechanical lifting pack.

Monopole towers are usually available in 12m (40') and 18m (60') versions. Consult the factory for higher options.

Other acceptable tower types include lattice construction and tripod towers. Guyed towers are preferred when much greater heights are desired. Although Kestrel only supplies standard approved towers, the turbine characteristics and parameters for tower design are available from the factory.

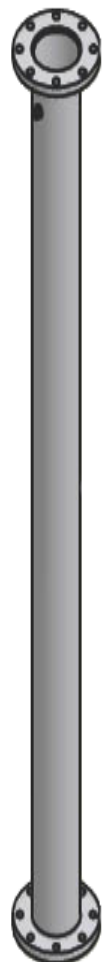
2.1 Mounting Flange and Tower Top

The tower for the Kestrel e400nb is fitted with a circular flange made from 20mm 300WA mild steel. The dimensions are shown below.



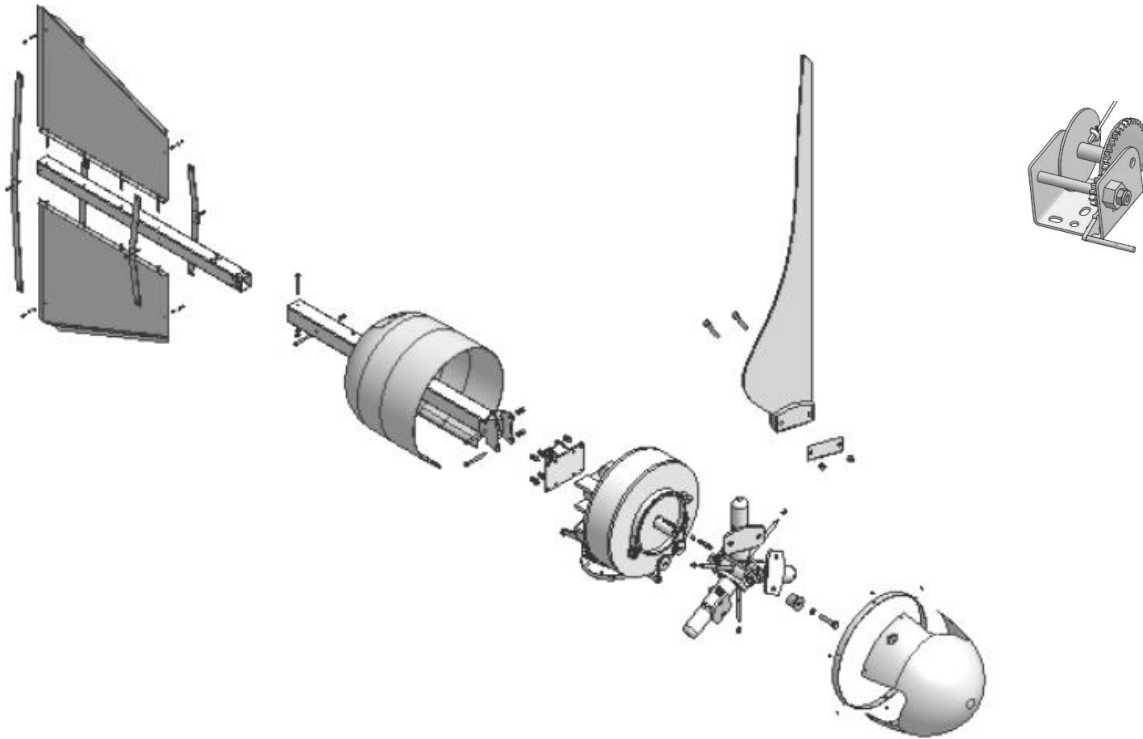
The following specification is recommended for the top pipe section of the tower. Mild steel pipe grade 350WA Nom. Dia 125mm (5.5") SCH 40 by 1.8m long

A standard adapter pipe is available from Kestrel where the turbine will be fitted to an alternative structure. The pole includes a securing point for the tower cable. Consult your dealer for more details.



3.0 Unpacking the Wind Turbine

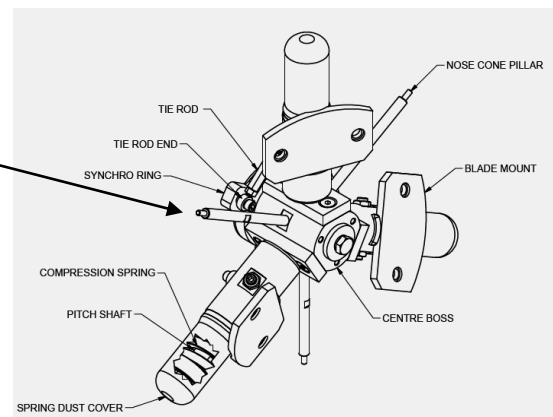
A Packing list is packed with the product. Ensure that all parts are present. Notify your dealer of any shortages.



The e400nb is contained in one shipping crate. Check the crate for any transit damage and then carefully remove the top of the crate to reveal the contents. Check that everything is intact. Pay special attention to the blade package. Carefully remove all the parts for safe storage. The last item to be removed is the generator assembly, which is fully secured to the packing case base.

IMPORTANT NOTE:

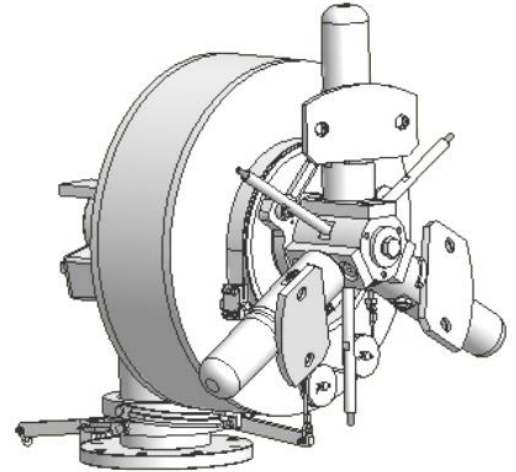
Do not lift or maneuver the generator USING THE NOSE CONE PILLARS. This will damage the pillars and cause unbalance.



The bare generator and pitch control is factory assembled. This complete sub-assembly weighs approximately 170kg (375lb).

Unpack and check the following parts. Inform your supplier of any defects or shortages.

- ▶ Remove the blade package and store safely.
- ▶ Remove the nacelle and nosecone with ring and store safely.
- ▶ Remove the two boom sections.
- ▶ Remove the two tail plates.
- ▶ Remove any other accessories that were shipped for you.
- ▶ Locate and remove the fastener pack (assembly grease inc.).
- ▶ Remove the complete generator assembly.



*Note: The fasteners are supplied in marked packs. Each pack contains a set of fasteners for different parts of the turbine. The enclosed grease is used on all nuts that are M10 or larger.

*Note: One additional fastener pack contains one spare unit of every fastener used on the turbine.

It may be useful to remove the sides of the packing case to access the assembly. Remove the securing bolts and pads to free the generator assembly. If possible, use lifting gear to remove the assembly from the case. Otherwise have at least three other assistants to lift the assembly from the case. Two lifting straps may be fitted to the generator for lifting. Beware of the generator tipping forward and causing injury to hands.



Beware not to damage the output cables below the generator. The generator assembly is heavy at the front and will easily tip over. When installed, the turbine is balanced on the yaw shaft.



4.0 Turbine Assembly and Installation

* You will need the following hand tools.

- ▶ Trestle, table or other support to support the turbine that is safe for 250kg (550lbs).
- ▶ Plastic or rubber mallet, brass mallet/ hammer & 8mm pin punch.
- ▶ Full set of ring spanners from 10mm – 24mm.
- ▶ Metric socket wrench set.
- ▶ Set of standard screwdrivers (plain and Philips).
- ▶ Torque wrench suitable for torques of 0 – 180Nm (132ft lb).
- ▶ Electrical pliers, cutters & crimping tool.

Refer to the diagrams and follow the instructions to assemble the complete wind turbine.

This manual assumes that the support tower is already installed and lowered to ground level ready for turbine installation.

4.1 Identification Marking

The turbine is fitted with a rating label similar to the image.

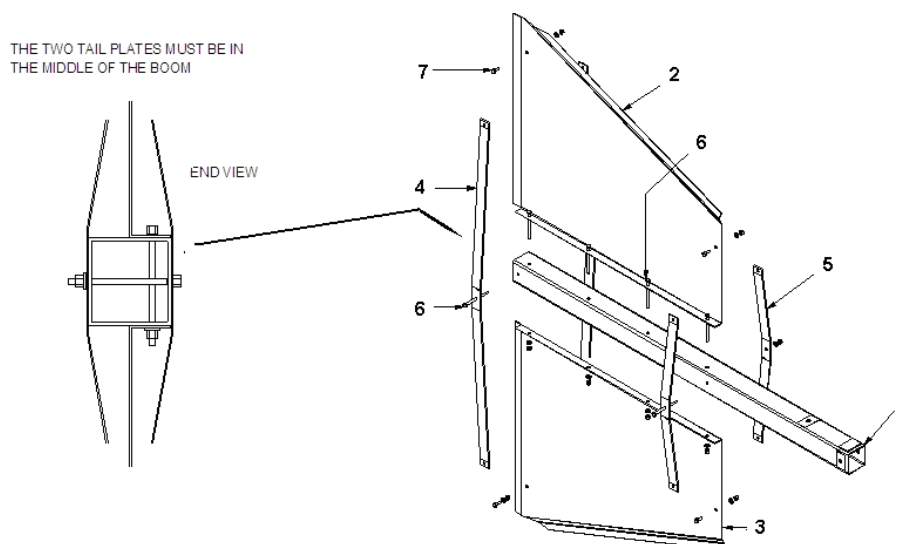
* Note down your turbine serial number for future reference!

			
PRODUCT RATING LABEL			
TYPE	e400nb	REV	1.0
MODEL	0404-3500-250		
V (maximum)	560	Vdc	A (maximum) 22
V (nominal)	250	Vdc	A (nominal) 15
P (maximum)	3600	Wdc	ROTOR DIAMETER 4.0 m
P (rated)	3500	Wdc	SWEPT AREA 12.5 m ²
SWT CLASS No	I	SURVIVAL WIND	70.0 m/s
REFERENCE ANNUAL ENERGY AT 5m/s		4315 kWh	
MANUFACTURED	###	TOWER TOP MASS	250 kg
SERIAL NUMBER	###	##	
MADE IN SOUTH AFRICA BY		Eveready Diversified Products (Pty) Ltd T/A Kestrel Wind Turbines P.O. Box 3191, Struandale, North End Port Elizabeth, 6056 RSA	

Note: Only the e400nb 3.5kW 250V version has MCS or SWCC Labels



4.2 Tail Assembly



PARTS LIST		
ITEM	QTY	DESCRIPTION
1	1	Tail Boom Extension
2	1	Top Tail Plate
3	1	Bottom Tail Plate
4	2	Rear Stiffener
5	2	Front Stiffener
6	6	Hex Bolt M6 x 80 long, washer and nut
7	4	Hex Bolt M6 x 16, washer and nut

ASSEMBLE EXACTLY AS SHOWN IN THE DIAGRAM. FIT ALL THE FASTENERS BEFORE TIGHTENING.

- * The tails will be in the middle line of the boom
- * You need the fastener pack marked “Tail Assembly” for this work.
- ▶ Top (2) and bottom (3) tail plate to boom (1) with four off stainless bolt sets (6). Nuts and washers on the bottom.
- ▶ Two rear stiffeners (4) to boom (1) with one stainless bolt set (6).
- ▶ Two front stiffeners (5) to boom (1) with one stainless bolt set (6).
- ▶ Bolt all stiffeners (4) and (5) to top and bottom tail plates (2) and (3) with four off bolt set (7).
- ▶ All tail fasteners are M6. Torque all fitted bolts to **10Nm (7.5ft lb)**.

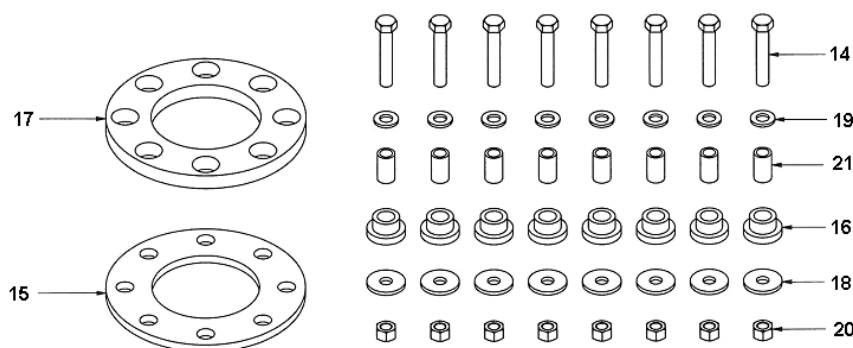


4.3 Generator to the Tower with damper kit

- * The steel flange (17) is fitted and welded to the tower top to adapt non-Kestrel towers. Kestrel accepts no responsibility for any third party tower design or application.

Each e400nb turbine is supplied with a standard rubber mounted resilient kit. The purpose of the kit is to eliminate generator acoustical noise being transferred down the length of the tower. The kit consists of the following components:

PARTS LIST		
ITEM	QTY	DESCRIPTION
14	8	Hex Bolt M16 x 90 H.T 8.8 ZP
15	1	Rubber flange
16	8	Rubber sleeve
17	1	Steel Flange (for welding to tower)
18	8	Fender washer
19	8	16mm standard washer
20	8	M16 Hex Nut
21	8	Compression sleeve



- * Take note that the damper kit includes a steel resilient flange (17) that must be welded to third party towers and surface treated before turbine installation.
- * The already installed tower is lowered to ground level before mounting the generator. The power cable is also fitted.
- * Secure the tower cable at the top of the tower. The tower cable must not hang or pull on the generator cables. Leave enough tower cable to make the connection to the generator.
- * Do not “spin” the generator by hand. Short the red (+ve) and black (-ve) generator output cables until wiring is to be done.



* Avoid damage to any paint finishes by protecting with suitable sundry material (HD foam, carpet tiles, cloth rags etc).

* Make all power cables ends safe by insulation before installing the generator.

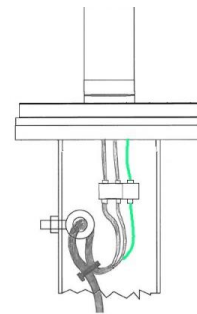


► Support the lowered tower at a suitable height to receive the generator. Be sure that the support can bear the total weight after the generator is mounted. Allow for 250kg (550lbs).

► Support the generator at a similar height with the mounting flange in line with the tower flange. Allow for 250kg (550lbs)



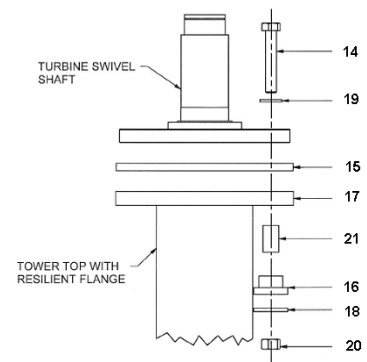
* Observe polarity on electrical connections. Connect +ve (red) and -ve (black) generator output cables correctly. Reverse polarity will damage the generator and any connected equipment.



► Remove the short across the generator wires. Make and complete the electrical connection between the generator and the tower cable. The 250Vdc generator can output up to 550Vdc when unloaded. The 48Vdc generator can deliver up to 80A. Use properly rated connectors and ensure that this connection is good and secure and completely watertight. The generator earth wire is connected and extended down to the ground earth for the tower.

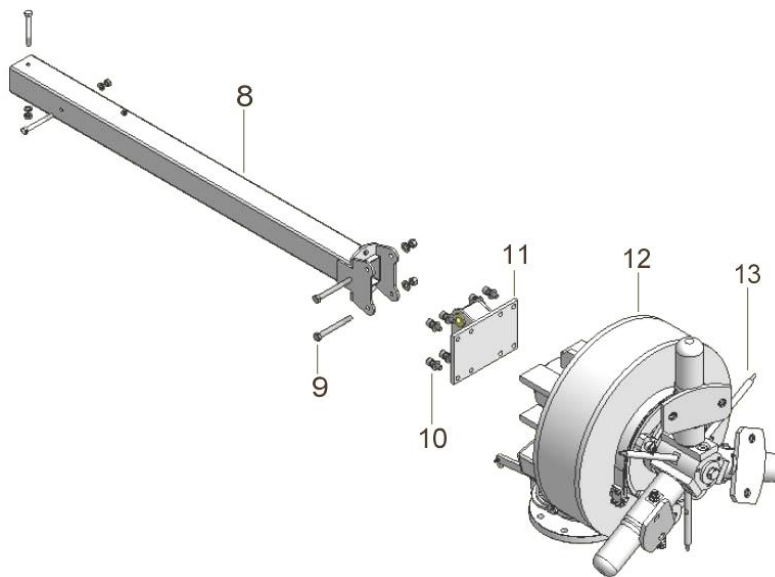


► Fit the generator to the tower while storing the cable and connector down the inside of the tower. Fit the resilient kit in the order as shown above. Ensure that no cable is damaged during this operation



► . Torque the flange bolts to **120Nm (88ft lbs)**.

4.4 Tail Boom Weld Assembly to the Generator

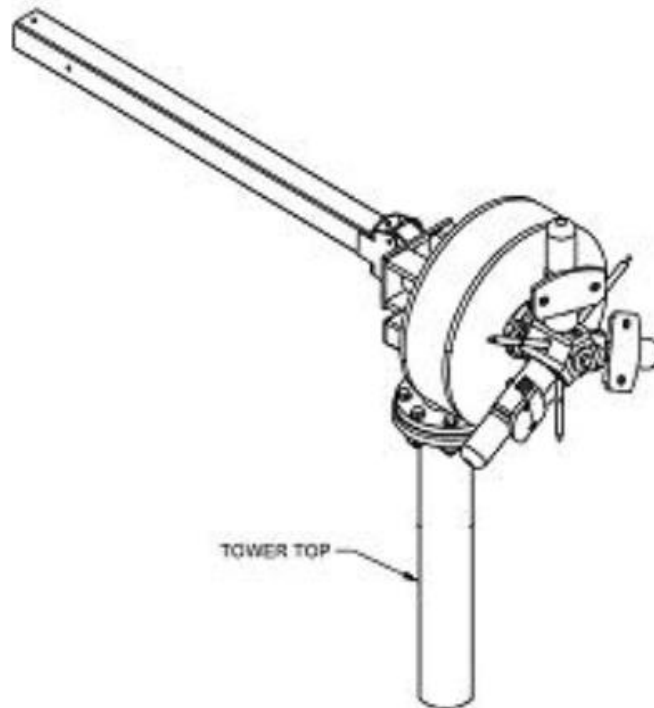


PARTS LIST		
ITEM	QTY	DESCRIPTION
8	1	Tail Boom Weld Assembly
9	2	M12 Tail Boom Bolt, washer and nut
10	8	M12 Allen cap bolts and washers
11	1	Tail Boom Flange
12	1	Generator
13	1	Pitch Control

- * THE GENERATOR SHOULD BE FITTED ON THE TOWER BEFORE FITTING THE BOOM ASSEMBLY TO THE GENERATOR.
 - * FIT ALL THE FASTENERS BEFORE TIGHTENING AND ASSEMBLE EXACTLY AS SHOWN IN THE DIAGRAM.
 - * Take note of the “this way up” orientation indicators on each component.
 - * You need the fastener pack marked “Tail Boom weld Assembly” for this work.
-
- Fit the flange weld assembly (11) with yellow bushes to the rear end of the generator (12) using the 8 M12 bolt sets (10). Torque to **50Nm (36ft lb)**
 - Fit the boom (8) to the flange weld assembly (11) using the 2 M12 bolt sets (9). Torque to **50Nm (36ft lb)**.
 - Store the remaining fasteners for later use.



The finished generator installation is shown below

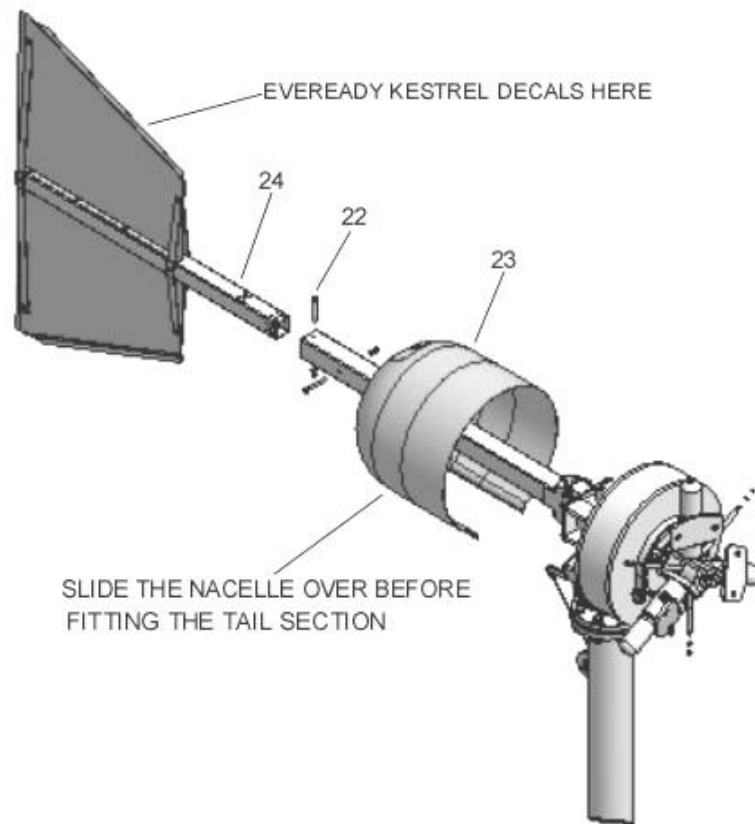


4.5 Tail Assembly to the Boom

PARTS LIST		
ITEM	QTY	DESCRIPTION
22	2	Hex Bolt M10 x 90, washer and nut
23	1	e400nb Nacelle
24	1	Complete tail assembly

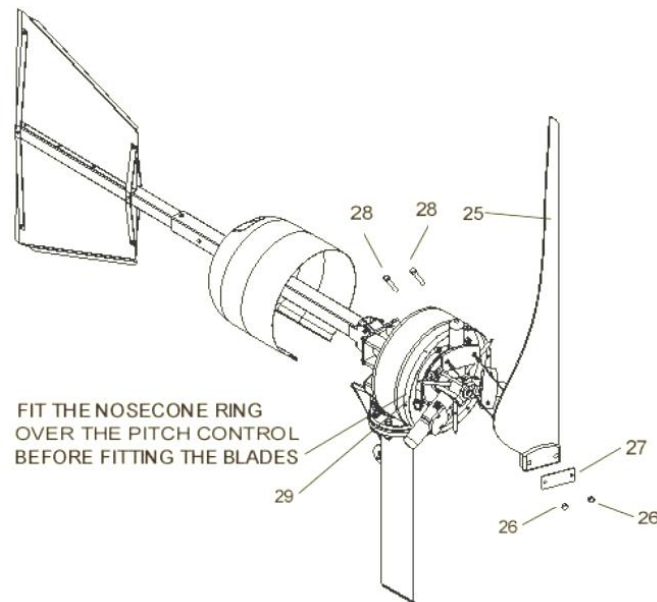
✱ You need the fastener pack marked “Tail Boom weld Assembly” for this work.

✱ Slide the nacelle over the boom weld assembly before fitting the tail assembly !!



- Slide the tail assembly (24) to the boom as shown. Place a little grease inside the two nut threads. Fit the two stainless M10 bolt sets (22). Torque to **35Nm (25ft lb)**.
- Raise the tower and generator to a suitable height from the ground for blade fitment.

4.6 Blades and Nosecone Stiffener Ring



PARTS LIST		
ITEM	QTY	DESCRIPTION
25	3	Blade
26	6	Hex Nut M16 Nylock
27	3	Compression plate
28	6	Hex Bolt M16 x 100
29	1	Nose Cone stiffener ring

* You need the fastener pack marked “Blade Fasteners” for this work.

* Fit the Nosecone stiffener ring (29) over the pitch control before fitting the blades (25) and leave it loose in place !! The ring is tapered and the smaller diameter must face forward to match the shape of the nosecone. The ring is later bolted inside the nosecone.

* Each blade is fitted with 2 steel positioning sleeves. The protruding end of each sleeve must locate in the recessed hole on the blade mount.

► Insert the two bolts (28) from the rear, through the blade mount and push them through to the front.

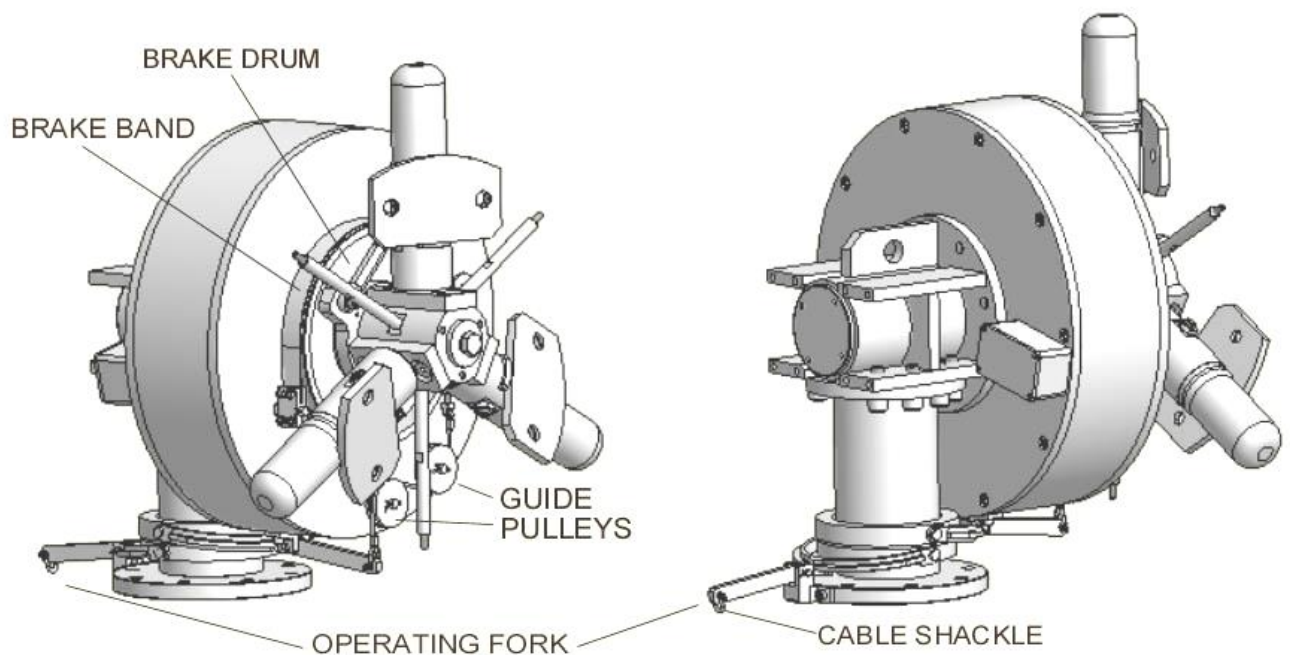
► Offer the first blade (25) to the blade mount and slide the blade over the two fixing bolts. The blade serial number must face forward and be visible from the front.

► Fit the compression plate (27) on to the blade and protruding bolts.



- * Stainless nuts can seize on the bolt. Put a little waterproof grease inside the stainless nut before fitting.
- Fit the two M16 nylock nuts (26). Tighten to **90Nm (65ft lb)**
- Repeat the fitment for the two other blades.
- * Note that no balancing procedure of the turbine blades is required.

4.7 Mechanical Brake Assembly (e400nb only)



The Kestrel e400nb is fitted with a mechanical band brake. This brake is activated by a manual cable winch and a drop cable that are shipped with the turbine. A “T” bar is also included that is inserted into the tower to operate the winch.

The brake mechanism is a factory fitted assembly and is operated by one singular drop cable. No adjustment is required to the brake mechanism on the generator assembly.

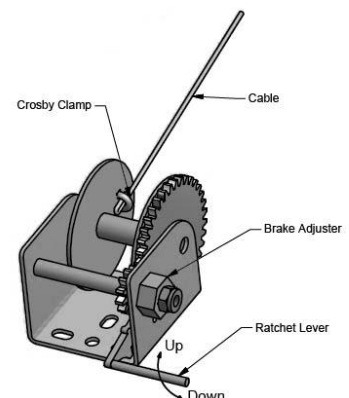
Assembly of the brake winch:

- * The tower is in the lowered position to assemble the brake winch.
- ▶ Remove the single brake pulley at the tower top so that the cable can exit.
- ▶ Thread the operating cable into the tower. The cable end with the fitted eye is connected to the turbine brake lever using the supplied shackle. Retrieve the cable at the top of the tower from the exit slot.
- ▶ Refit the pulley wheel at the top of the tower
- ▶ Connect the brake cable to the brake fork using the shackle provided. Tighten to 6Nm and lock by the preferred method.
- * Either apply a little Loctite to the shackle pin or use a small piece of stainless wire to secure the shackle pin after fitting.

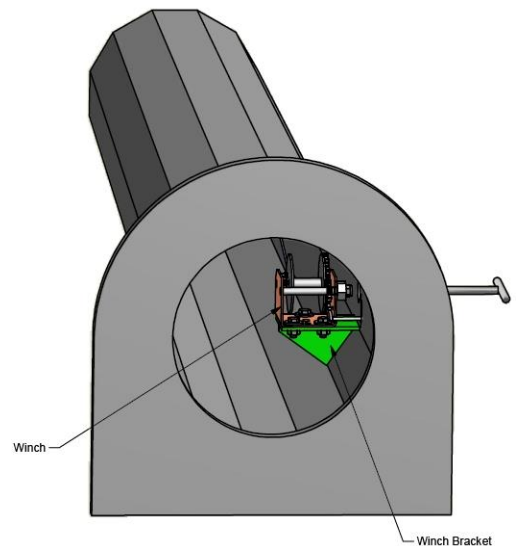


* Do not wind excess brake cable on to the cable drum. A tensioned brake cable can cause excessive cable to become trapped between the cable coils that prevents the brake mechanism to release. Only four or five cable coils turns must wrap around the drum when the brake is operated.

- ▶ Cut off any excess cable. Only four or five turns of cable should wind on to the winch when it is in the installed position. Fit the brake operating cable to the winch and secure using the provided Crosby clamp.



- ▶ Install the winch assembly inside the tower and fit by using the three provided nuts and bolts.
- * Ensure that the operating handle freely enters the tower side and turns the winch.
- * Ensure that the ratchet lever exits the tower freely and operates the ratchet.



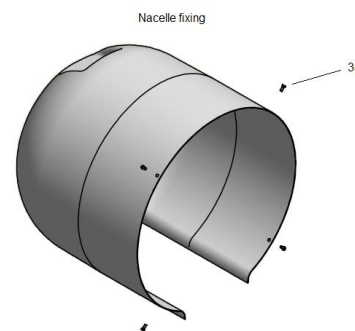
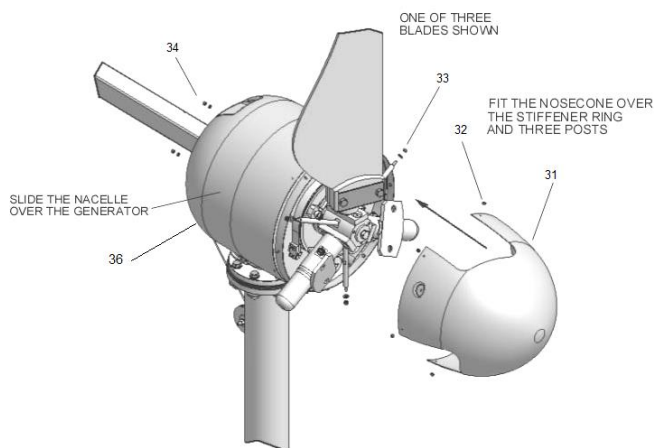
- ▶ Engage the ratchet at the brake winch and only wind up the slack in the cable.



- * Note that only a small force is required to operate the brake. Do not over-tension the brake cable. Do not stress the brake winch by using any form of extension on the operating bar.
- ▶ Operate the brake winch and ensure that the mechanism is braking and functioning correctly.
- ▶ Now that the brake is functional, leave the brake on for the remainder of the installation to give added safety.



4.8 Nacelle and Nosecone



PARTS LIST		
ITEM	QTY	DESCRIPTION
31	1	Nose Cone
32	6	M6 Nylock nuts and washers
33	3	M8 Nylock Nuts and washers
34	2	M6 Nylock Nuts and washers
35	4	M5 CH screws and washers
36	1	Nacelle

✳ Check all previous work before fitting the “covers”.

✳ You need the fastener pack marked “Nacelle and Nosecone” for this work

- ▶ Slide the nacelle (36) over the generator and secure at the rear with two M6 nut sets (34). Torque to **4Nm (3ft lb)**.
- ▶ Secure the nacelle at the front with four M5 screws and washers (35), Torque to **3Nm (3ft lb)**.
- ▶ Fit the nosecone (31) over the stiffener ring. Fit the nosecone over the three support posts.
- ▶ Secure the nosecone to the stiffener ring with six off M6 Nylock nut sets (32) and torque to **4Nm (3ft lb)**.
- ▶ Fit the nosecone to the three support posts with three stainless M8



nut sets (33) and torque to 10Nm (7.5ft lb).

5.0 Electrical Installation

5.1 Lightning Protection (No responsibility is accepted)

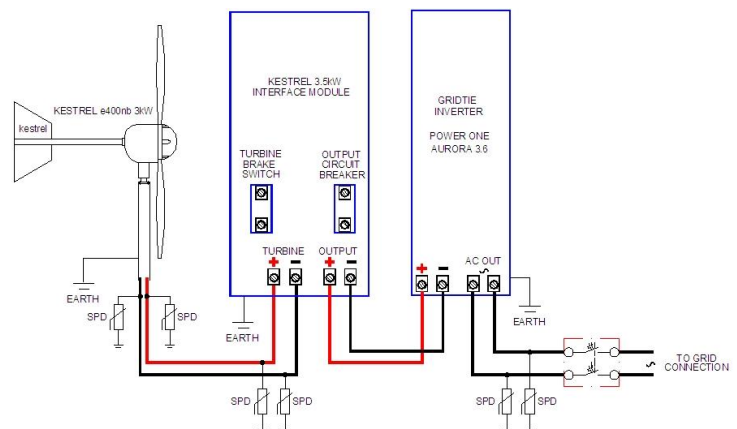
The tower must be properly grounded to local codes. Suitable SPD's (Surge Protection Device) should be fitted at the power input connections to the electronics. SPD's are not a standard fitment in the interface module. Consult your supplier for guidance and fit locally approved SPD's.

The following is included for guidance only.

The turbine will operate over a range of voltage given in the table below. The SPD must be rated for dc use.

Turbine Voltage	48Vdc	110Vdc	250Vdc
Operating Range	0 – 140Vdc	0 -290Vdc	0 – 580Vdc
SPD Voltage	200Vdc	350Vdc	650Vdc

The turbine output power form is two wire dc. Many authorities require GFD (Ground Fault Detection) and therefore the turbine output wires are isolated and not connected to ground. It is recommended to utilise an inverter or charge controller with internal GFD. Alternatively, a separate GFD unit can be installed. If the cable distance between the tower base and the input to the downstream electronics is less than 10m (33') then surge protection may be fitted only at the electronics. If the distance is greater, then surge protection should be fitted at the tower base and at the electronics.



Note that the same positioning of SPD's applies to a battery charging installation where a charge controller replaces the inverter.

5.2 Earthing (Grounding) (No responsibility is accepted)

Induced surges cannot be stopped; they can only be directed away from equipment. The objective is to create the same zero potential and minimum impedance to ground on all equipment.



The tower and all fitted equipment must be properly earthed. Note that the positive and negative power lines from the turbine are isolated and must not be connected to ground. Any grounding of the power circuit would be done in accordance with the associated equipment being installed. Do consult a professional engineer and your supplier for guidance.

It is desirable to have only one ground point. Induced surges from an electrical storm can create a potential difference across two ground points, even in underground cable. It may not be practical to have one single ground point if the turbine and tower is distant from the installation. In that situation, the sheath of the supply cable should be grounded at each end.

5.3 Cable Sizes and Installation

The tower power cable must be fitted inside the tower wherever possible and should be buried underground. The cable must either be armoured or run in underground electrical conduit.

Measure the distance from the tower top to the controller. Select a suitable cable from the table.

- * The distance is one way and allows for +ve and –ve wires.
- * Distance is in metres and (feet).
- * Wire size is in square millimeters and American wire gauge (AWG)
- * Wiring must comply with local electrical standards. Consult a professional in your area for compliance.
- * % power loss means that more power is lost as cable size reduces.

250Vdc Grid Tie

Wire Size Table for Kestrel e400nb 3.5kW 250Vdc 14A

One Way Distance	3% Power loss	4% Power loss	5% Power loss
20m (66ft)	1.0mm ² (17)	1.0mm ² (17)	1.0mm ² (17)
40m (130ft)	2.5mm ² (13)	1.8mm ² (14)	1.5mm ² (15)
60m (200ft)	3.5mm ² (12)	2.7mm ² (13)	2.1mm ² (14)
80m (260ft)	4.7mm ² (10)	3.5mm ² (11)	2.8mm ² (12)
100m (330ft)	5.9mm ² (9)	4.4mm ² (10)	3.5mm ² (11)
120m (400ft)	7.0mm ² (8)	5.3mm ² (10)	4.2mm ² (11)

48Vdc battery charging

Wire Size Table for Kestrel e400nb 3,5kW 48Vdc 65A

One Way Distance	3% Power loss	4% Power loss	5% Power loss
20m (66ft)	30mm ² (2)	23mm ² (3)	18mm ² (4)
40m (130ft)	60mm ² (00)	46mm ² (0)	36mm ² (1)
60m (200ft)	92mm ² (000)	70mm ² (00)	55mm ² (0)

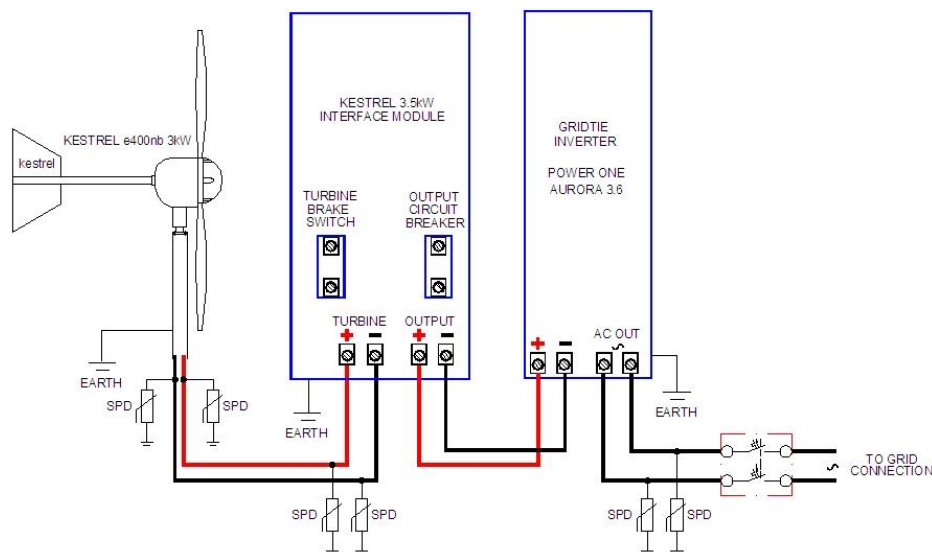
110Vdc battery charging

Wire Size Table for Kestrel e400nb 3,5kW 110Vdc 37A

One Way Distance	3% Power loss	4% Power loss	5% Power loss
20m (66ft)	6mm ² (9)	4,5mm ² (10)	4mm ² (11)
40m (130ft)	16mm ² (5)	12mm ² (6)	10mm ² (7)
60m (200ft)	25mm ² (3)	16mm ² (5)	12mm ² (6)
80m (260ft)	35mm ² (1)	25mm ² (3)	16mm ² (5)
100m (330ft)	50mm ² (0)	35mm ² (1)	25mm ² (4)

5.4 Electrical Installation (e400nb 250Vdc and Grid Tie)

- * Under no circumstances shall the Kestrel e400nb be directly connected to any grid tie inverter. The turbine must be connected via the Kestrel interface module (575V).
- * A grid tie installation supplies electrical energy from the wind turbine to the utility electrical grid. This type of installation is strictly regulated by local electrical codes and practices.
- * The installation must comply with the local electrical codes that are in force in the country of installation. Please consult your area dealer or a local qualified electrician.
- * The grid tie inverter must be installed by qualified personnel and comply with the local electrical codes.



The diagram shows the simple connection that is required. Metering is excluded for simplicity. The e400nb is directly connected to the Kestrel Interface Module. This module contains the necessary turbine brake switch, switchgear and terminations. The output from the module is connected to the grid tie inverter.

The use of this arrangement depends on the input voltage range of the chosen inverter which must be able to accept up to 600Vdc. The Power-One Aurora 3.6 is suitable because it can accept up to 600Vdc.

Detailed information can be found in the grid-tie inverter manual. The following information highlights points relevant to the turbine.

The Kestrel e400nb wind turbine is rated at 250Vdc. The power range from 0 – 3.5kW is developed between 220Vdc and 250Vdc. This is the normal working voltage range. In certain modes of operation, the turbine can output much higher voltage.

This 250V turbine is solely intended for use in grid tie installations. The turbine must connect to a Kestrel 3.5kW interface module (575V) that in turn is connected to the grid tie inverter input. Any grid tie inverter will disconnect itself from time to time. These times of disconnection are normal during the correct operation of the inverter. When such a disconnection takes place, the output voltage of the then unloaded turbine can rise to 550Vdc. The inverter must be rated to accept up to 600Vdc on the input.

The Kestrel e400nb remains in control through reliable blade pitch adjustment. The interface module has an additional overvoltage protection circuit.

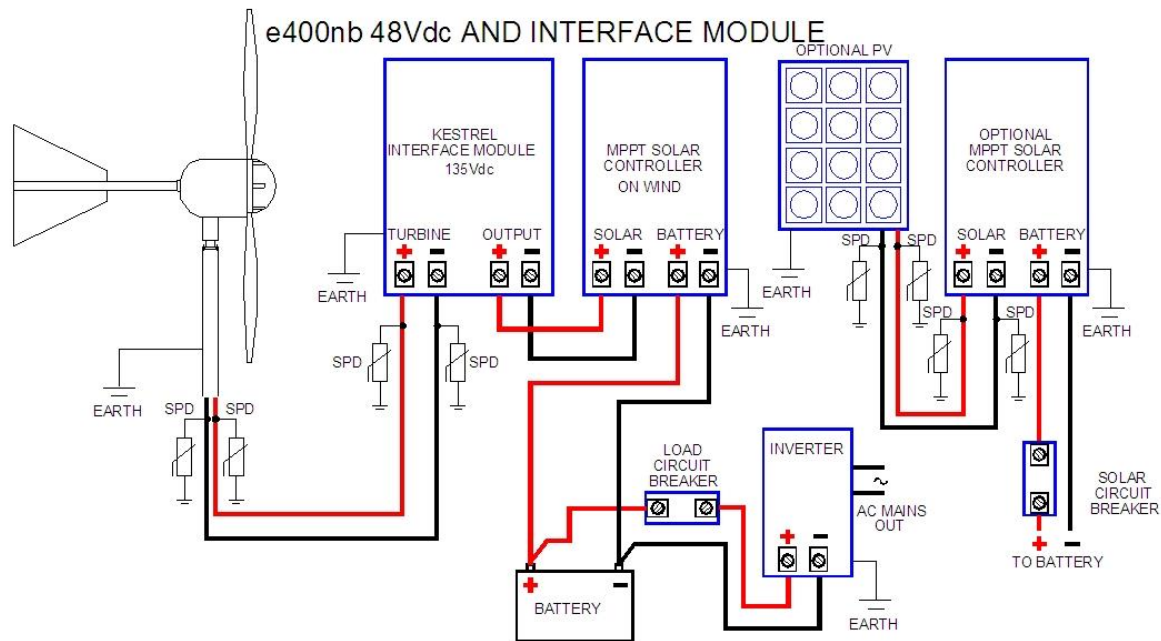
5.5 Electrical Installation (e400nb 48Vdc and MPPT Charge Control)

- * Under no circumstances should the Kestrel e400nb be directly connected to any charge controller. The 48Vdc turbine must be connected through the Kestrel interface module (175V).
- * A charging installation supplies electrical energy from the wind turbine to an installed battery. A Kestrel voltage limiter does not provide any charge regulation or control. Charge control is the function of an additional charge controller.
- * The installation must comply with the local electrical codes that are in force in the country of installation. Please consult your area dealer or a local qualified electrician.
- * The installation must be installed by qualified personnel and comply with the local electrical codes and norms.



This method makes it possible to charge 12, 24, 36, and 48Vdc batteries. In general, certain applications allow the use of alternative charge controllers with the e400nb 48V as shown. These controllers often disconnect to perform measurements and other functions. The turbine voltage is restricted (capped) by the blade pitch control. In addition, a safety overvoltage shutdown circuit is contained within the interface module.

Kestrel recommends the Midnite Classic 200 charge controller.

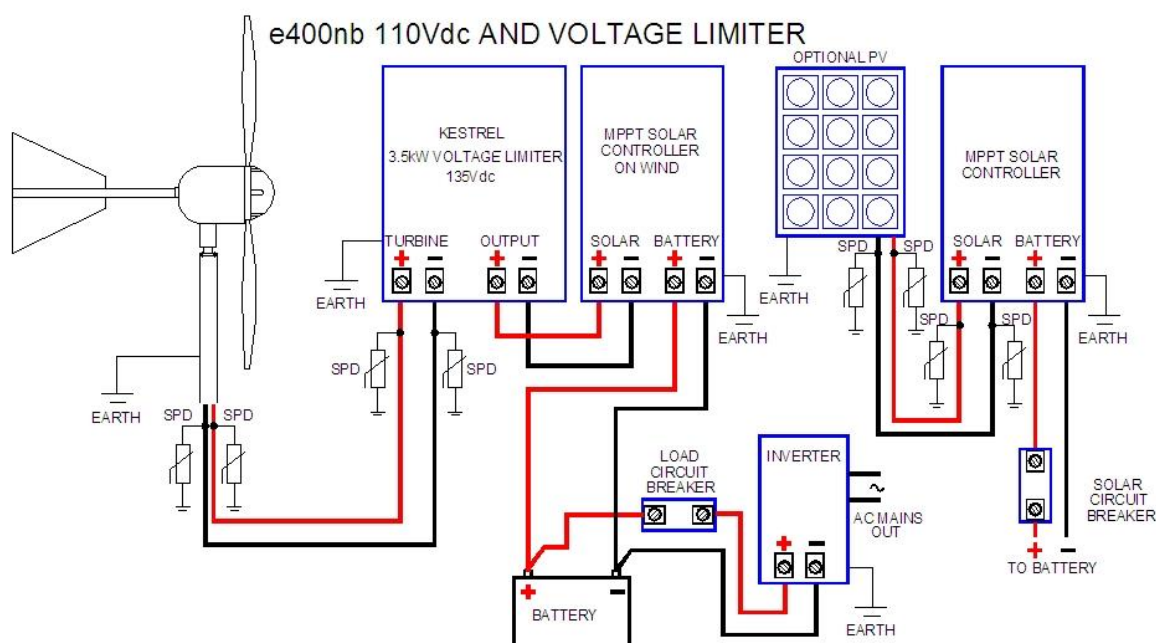


The Kestrel Interface module includes a turbine brake switch and isolating battery circuit breaker. The e400nb is selectively wound to provide the maximum energy efficiency. Any MPPT (Mean Power point Tracking) algorithm in a third party controller will enhance the generator low wind performance. There are many successful installations and possibilities.

Most alternative controllers are designed for use with solar panels but the high quality dc output from a Kestrel wind turbine allows them to be used. In any situation, the turbine voltage must never exceed the controller input voltage limit which is usually 150 - 200Vdc.

5.6 Electrical Installation (e400nb 110Vdc, limiter and MPPT)

This method makes it possible to charge 12, 24, 36, 48 and 60Vdc batteries. When the distance between the turbine and battery is excessive, an option is to use a 110Vdc supply as shown in Fig 3. This system uses the Kestrel e400nb 110Vdc and a Kestrel 3.5kW Voltage Limiter (175V). The turbine power cables are considerably thinner and there is an improvement in efficiency.



Kestrel recommends the Midnite Solar Classic 200 charge controller. All charging installations use the same e400nb 110Vdc turbine. Whenever there is an increase in turbine voltage, the limiter restricts the voltage to 135Vdc. The turbine therefore never exceeds the input voltage limit of the MPPT controller. The same charge controller type is used on both wind and solar in hybrid installations.

The Kestrel e400nb 110Vdc power range from 0 – 3.5kW is developed between 90Vdc and 120Vdc. This is the normal working voltage range. The turbine must connect to a 3,5kW Kestrel voltage limiter. When the load is disconnected, the output voltage of the turbine can rise to 280Vdc if not controlled by the voltage limiter.

6.0 Installation Commissioning

The turbine installation on the tower is complete. The electrical installation is also complete and approved. Safety precautions are in place ready for the tower to be raised. The electric brake is standard on the e400n and e400nb. The additional mechanical brake is only fitted to the e400nb.

- ▶ Complete a visual check on the wind turbine and ensure that no foreign objects or tools are on or adjacent to the turbine.
- ▶ Clean the turbine and blades removing any finger marks.
- ▶ Check all three blades thoroughly for any damage during installation. Edge damage will increase noise and change the sound signature of the turbine.
- ▶ Verify that the electrical installation is complete.
- ▶ Verify that the turbine is free to rotate smoothly with no unusual noises. Now apply the turbine electrical brake switch and engage the mechanical brake if fitted. Consult the emergency shutdown procedure.
- ▶ Observing all safety requirements, refer to the tower manual for the tower raising procedure.
- ▶ Raise the tower as instructed in the tower manual, completing the tower installation and making secure.
- ▶ Release all brakes and observe the turbine to run smoothly with no vibration or unusual mechanical noise.



Congratulations! The installation is now complete !

7.0 Maintenance Schedule

The Kestrel e400nb operates with minimum maintenance. The frequency of visual inspections and integrity checks depends on the wind class of the installation site. Wind Power Class definition for wind power density and average wind speed at a hub height of 10m is given below. In general, higher class wind sites require more frequent installation checks.

WARNING (Pitch Control)

The pitch control mechanism is a factory assembly and is not user serviceable. Specialist tools and knowledge is required to carry out any maintenance or repair procedures. Do not make any unauthorised adjustments or modifications to any part of this assembly. Do not force or twist the blades other than gently when checking for wear or defects.



7.1 Wind Power Class

Identify the Wind Power Class for the site. This number from 1 to 7 is defined by the site average annual wind speed. Values are for an anemometer height of 10m (33ft)

Wind Power Class	Wind Power Density (W/sq m)	Wind Speed m/s
1	Up to 100	Up to 4.4 (9.8)
2	100 – 150	4.4 – 5.1(11.5)
3	150 – 200	5.1 – 5.6 (12.5)
4	200 – 250	5.6 – 6.0 (13.4)
5	250 – 300	6.0 – 6.4 (14.3)
6	300 – 400	6.4 – 7.0 (15.7)
7	Above 400	Above 7.0 (21.1)

7.2 Planned Maintenance Schedule

The following schedule is designed to avoid machine failure. Component life will be reduced on sites that exhibit high turbulence. Plan turbine maintenance on the Wind Power Class selected in 7.1.

Wind Power Class	1	2	3	4	5	6	7
First post installation visual check	<i>All sites 1 month after installation</i>						
Visual Inspection, listen for abnormal noise and vibrations.	<i>After extreme weather and every 4 months</i>			<i>After extreme weather and every 2 months</i>			
Close inspection, check for any loose bolts, blade damage. Check the integrity of the pitch control (See tips below). Check the six rubber boots on the track rod ends. Check the three pitch shaft plastic covers. Treat and touch up any paint defects.	<i>12 monthly intervals</i>			<i>Six monthly intervals</i>			
Dismount the machine and check for transfer brush wear. Check for wear on pitch control parts. Replace as required. Treat any corrosion and touch up paint.	<i>Every 5 years</i>			<i>Every 3 years</i>			
Dismount the machine and replace all bearings (generator, yaw shaft and pitch control). Access the yaw shaft electrical brushes and check for wear and any buildup of dust particles.	<i>Every 8 – 10 years</i>			<i>Every 6 – 8 years</i>			

It is important to check the integrity of all the rubber covers on the pitch control assembly as scheduled above.

OTHER AUXILIARY INSPECTIONS

Inspections should also be done with regard to all other site equipment. Specific procedures are contained within the relevant user manuals. The following list illustrates typical topics.

- Inspection of the tower including all bolts/fasteners ground anchors and guy wires.
- Inspection of the Kestrel e400nb tower securing bolts.
- Check all electrical connections for tightness and corrosion.
- Functionality and general checks on all other electrical equipment.

8.0 Questions and Answers

1	The tail is swinging from side to side or moving up and down.	The blade rotor is unbalanced. There is blade damage.
2	The turbine fails to track light winds / always comes to rest in one direction.	The tower is not vertical and so the turbine is not horizontal.
3	I can hear a rattle or unusual noise.	There is a defect on the turbine or the tower. This requires urgent attention.
4	The turbine does not stop when I apply the electric brake switch.	The blades are extremely powerful. Switch the brake on and off a few times. The turbine will stop when the wind reduces down a little.
5	The turbine starts but only rotates very slowly.	The brake switch is on. There is a cable short. The generator is shorted (unlikely).
6	What maintenance must be done and how often?	Consult the maintenance schedule in this manual.
7	The tower vibrates at certain wind speeds.	The turbine is out of balance. The tower is resonating with natural vibration.
8	The turbine sounds different from when it was installed.	See (3). A blade is damaged. The blade leading edge tape is defective
9	Should I lower the turbine in high wind?	In general, No. Lowering is recommended before incident winds greater than the survival wind speed. Consult the technical data. Lower the turbine if flying debris is possible.
10	Will the turbine remain in control when disconnected?	Yes. The pitch control will always limit the rotor speed. The voltage on the wires will however be a danger!
11	I can hear a slight hum/whine from the turbine.	This is a normal sound from any generator and depends on loading.
12	The tower deflects slightly downwind and then returns to vertical as the wind speed increases.	The tower withstands the lateral thrust from the turbine. This bending force reduces as the pitch control operates.
13	Can I replace one damaged blade?	No. Blades are balanced in a set of three. All three blades must be replaced.
14	Can I adjust the pitch control to alter the machine performance?	No. The pitch control is factory assembled and calibrated. Do not tamper in any way.

9.0 Technical Specification

NOTE: Performance may vary due to site conditions and local weather pattern



Parameter	Battery Charging	MCS/BWEA Reference	SWCC/AWEA Rating
Version	e400nb 3.5kW 48/110V	e400nb 3.5kW 250V	
Maximum Power	3500W (Peak turbine)	2990W	3.03kW
Rated Power at 11m/s	2500W	2550W	2.5kW
Rated Annual Energy	4000kWh	3922kWh	3930kWh
Start-up Wind Speed	3m/s (6.7mph)		
Cut-in Wind Speed	4m/s (9mph)		
Rated Wind Speed	11m/s (24.6mph)		
Cut-out Wind Speed	None		
Governing Wind Speed	11m/s (24.6mph)		
Maximum Design W/Speed	Survival – 70m/s (157mph)		
Generator Type	Axial flux PMG		
Overspeed Protection	Blade pitch control		
Rotor Diameter	4m (13.1ft)		
Number of Blades	3		
Blade Material	Epoxy resin fibreglass		
Tower Top Mass	250kg (551lb)		
Tower Height	12 & 18m (40 & 60ft)		
Tower Type	Hinged Monopole		
Rated Sound Level	56dB(A)	Lp,60m: 57dB(A)	55.6dB(A)
Output Voltage (Turbine)	48Vdc or *110Vdc	250Vdc	250Vdc
Controller Type	US Midnite Solar Classic 200	UK Power One Aurora PVI-3.6-TL-OUTD-W	US Power One Aurora PVI-3.6-OUTD-US-W
Output Voltage (System)	24/48/60Vdc	230V 50Hz	240V 60Hz
Temperature Range	-25°C (-13°F) -- +60°C (140°F)		
Protection (Turbine)	IP65		NEMA 4X
Protection (Controller)	IP52	IP65	NEMA 4X

*Voltage limiter required for 110Vdc

10.0 Compliance



Reg. No. 2009/0054380/7
Vol. Reg. No. 4870231406
Tel. +27 (0) 41 401 2500
www.kestrelwind.co.za

EC - Declaration of Conformity

We,

**Eveready Diversified Products (Pty) Ltd T/A
Kestrel Wind Turbines**

in South Africa

herewith declare under our sole responsibility that the product

Kestrel e400nb Wind Turbine

Under Versions: 1112-3500-048 1112-3500-110 1112-3500-250

to which this declaration relates is in accordance with the following normative documents and standards and complies with the following regulations:

2006/42/EC	Directive on machinery
2004/108/EC	Directive on electromagnetic compatibility

and declare the appliance of the following European harmonised regulations or relevant parts/clauses of:

EN ISO 61400-2	Design requirements for small wind turbines, Part 2 – (IEC 61400-2:2006 Edition 2
EN ISO 12100-1	Safety of machinery Part 1
EN ISO 12100-2	Safety of machinery Part 2
IEC 60204-1	Electrical equipment of machines
IEC 60034-5	Rotating Electrical Machines

Date: 20th April 2011

Place: Port Elizabeth South Africa

Authorising Signature:

James Carpy
Technical Director

Kestrel Wind Turbine
P.O. Box 3191
North End
Port Elizabeth
6056
Republic of South Africa



Annexure 1: General Information

The Kestrel e400nb is a high quality wind turbine that often becomes a local landmark. It is a serious machine with a remarkable performance being designed to give the owner many long years of trouble free service. Please enjoy the informative annexures.

The Kestrel e400nb is a wind turbine that reliably supplies electrical energy with minimum attention and maintenance. Kestrel also promotes good customer service so that any Kestrel owner is assured of sharing in our good relationship with our product users.

A brand new turbine may require a marginally higher wind speed to start. This is normal. The startup wind speed will reduce over a few months as the main bearing seals “run in”.

The pitch control hub should be checked in the following way. Visually inspect the unit. Check for any stress cracks, broken or cracked springs and corrosion. Use gentle pressure to twist the blade in both directions. There should be virtually no movement or slackness. Push and pull the blade along it's length. There should be no movement of the blade. If any wear or defect is detected, consult your dealer or the factory. Do not under any circumstances strip the assembly down without the required knowledge.

The generator produces a slight humming sound. This is quite normal. Any other grinding, clicking or scraping noises are abnormal and must be investigated.

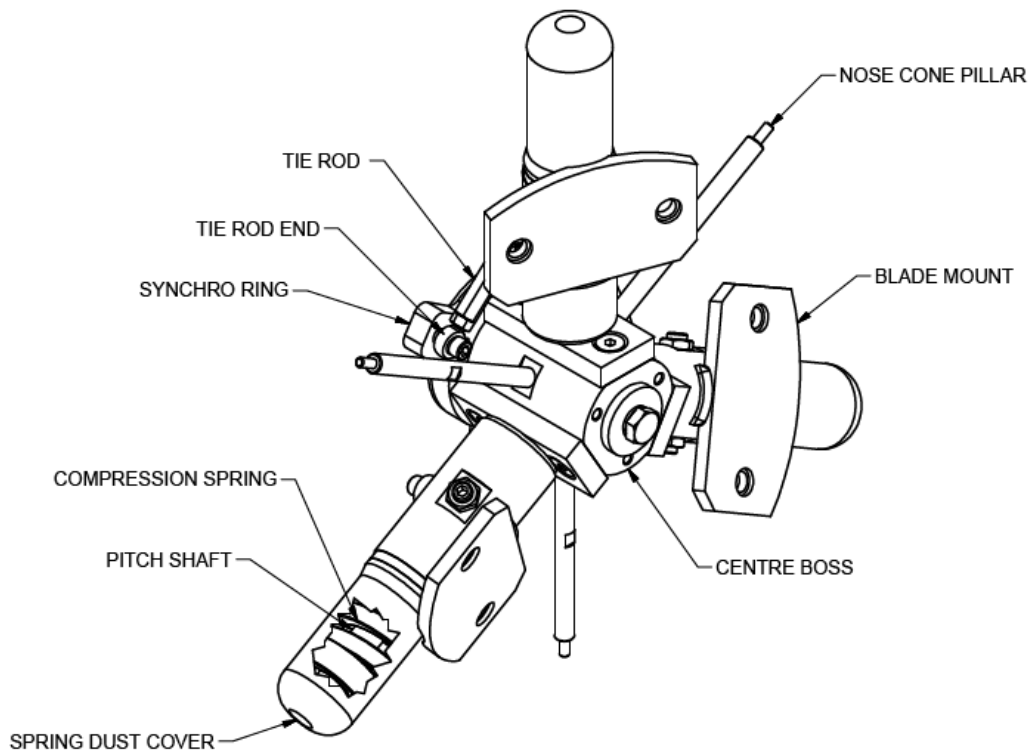
Good rotor balance is very important for long and reliable operation. The wind turbine must not be allowed to continue in operation if any unbalance is observed. The most common symptom of imbalance is observed when the turbine swings slightly from side to side as it speeds up. The swinging action will be worse at a particular rotor speed and may well disappear at higher speeds.

The rotor blades can suffer chips and erosion, mainly on their leading edge. Small chips can be repaired with glassfibre filling compound. All cracks must be carefully examined. Surface cracks can be repaired but any structural cracks must render the blade inoperative. If there is any doubt, the blade set must be replaced for safety. All blade damage can

allow water to enter. This will cause the blade set to become unbalanced which will cause other mechanical failures and shortened bearing life. Water inside a blade can freeze and cause cracks.

Pitch Control

The Kestrel Pitch control consists of a patented design that after a long development phase was thoroughly tested. The final product is maintenance free, fully sealed from the environment and is extremely reliable.



When the turbine reaches the rated rpm, the centrifugal force generated by the blades and blade mounts begin to compress the springs. As the blades move outward, they are rotated. This blade rotation alters the blade angle to the wind. The turbine is then limited to the rated maximum power and rpm. This system results in the turbine producing full power at the rated wind speed and above. The turbine continues to safely harvest the maximum energy as wind speed increases. High gusts and high wind speed result in a very small increase in rpm as the blades control the turbine. The pitch control is designed to be maintenance free. The six rubber boots on the tie rod ends and the three polyurethane spring covers must be replaced if they

are damaged in any way or show signs of deterioration over time. Although these components are UV stabilized, this may occur in environments with high solar irradiation.

The Generator

The Kestrel e400nb generator is a completely sealed unit and requires no regular maintenance. The generator carries two single deep groove bearings and one double bearing assembly. All bearings are of a high quality and are sealed for life. The generator is a brushless single rotor axial flux permanent magnet assembly with no less than 120 poles and sixty-two magnets. The magnets are rare earth neodymium boron composition. The thermal management in the generator ensures that the temperatures never reach the Curie point. The generator will never overheat and is rated for 100% duty cycle. This means that the turbine is designed to produce the full rating of 3,5kW for the complete duration of a high wind period.

Unlike many generators, the Kestrel e400nb produces dc power. There are therefore no inductive affects in cabling and radiated emission is absolutely minimal. The power output has a much lower ripple content compared to a three phase system. High ripple content reduces battery life and should be avoided.

The Transfer Brushes

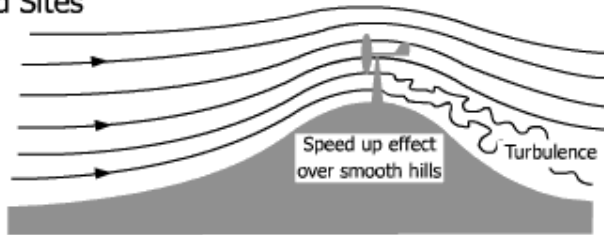
A dual brush and slip ring assembly delivers generator power to the output cables. It is located within the same assembly that supports the complete turbine on the tower. It is referred to as the “swivel assembly” and is extremely well designed and strong. The complete assembly is simple to remove from the generator and can be replaced as a complete unit. Kestrel intends in the future to provide an exchange service for the complete swivel assembly.

There is a total of four high quality copper/carbon composite brushes, two for +ve and two for –ve. The transfer system is well rated and requires no replacement for many years of service. Some owners may feel a little uncomfortable that one cannot easily inspect the brushes. Kestrel strives to produce a wind turbine that is reliable and has a minimal maintenance schedule.

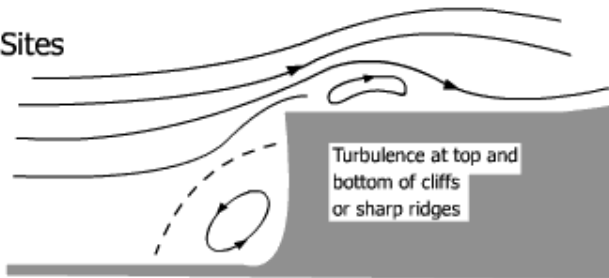
Annexure 2: Choosing a Site (Courtesy of BWEA)

Flow over hills and obstacles

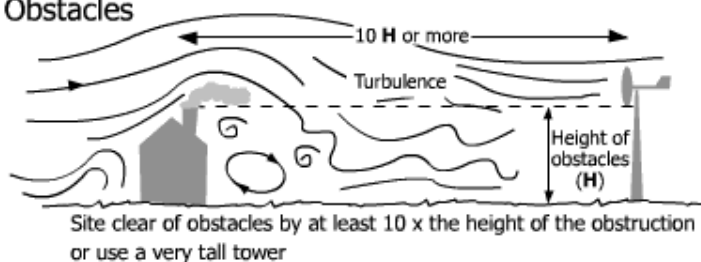
Good Sites



Bad Sites



Obstacles



The output from a wind turbine is highly sensitive to wind speed. It is essential that turbines should be sited away from obstructions, with a clear exposure or fetch for the prevailing wind. Wind speed also increases with height so it is best to have the turbine high up, and most small turbines have towers much higher relative to their diameter than large ones.

It is generally agreed that the ideal position for a wind turbine generator is a smooth hilltop, with a flat

clear fetch, at least in the prevailing wind direction. The wind speeds up significantly near the top of the hill and the airflow should be reasonably smooth and free from excessive turbulence. Excessive turbulence causes fatigue damage and shortens a turbine's working life.

In practice, especially for very small machines that need to be located near to the user, ideal siting will not be easy. As far as possible though, keep away from local obstructions such as large trees and houses, or use a taller tower to ensure that the turbine is well above the obstructions.

Before considering the installation of a wind turbine the potential site should be assessed. Initial indications of wind strength and direction can be obtained by observing the deformation of vegetation and trees,

and in many cases the user may already have a good feel for the winds in the locality. However impressions can be deceptive.

A more reliable way to evaluate the wind resource, which is strongly recommended when there is doubt over whether the wind is strong enough, is to take regular measurements over a period of several months, preferably a year. It is not straightforward to use data even from nearby sites, and probably the nearest meteorological station or airfield where records have been kept is many miles away. However, measurements taken at a proposed site can be compared with measurements taken elsewhere at the same time, and used as a guide to the probable correlation over longer periods. In addition computer models are available for professionals to use, although such predictions should be applied with care.

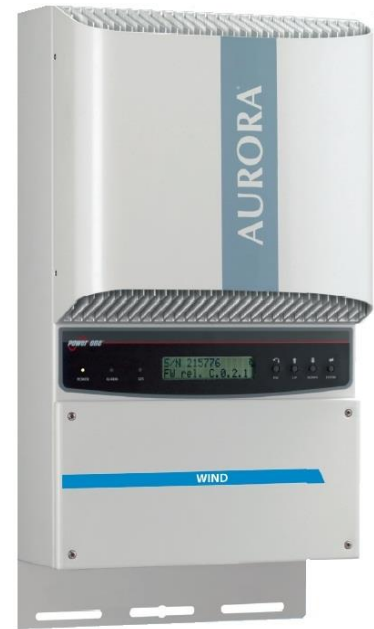
- a) Get a reliable estimate of the wind speed at the proposed site.
- b) Mount the turbine on as high a tower as possible and well clear of obstructions, but do not go to extremes. Easy access will be required for erection, and foundations for the tower may be needed depending on the size and tower type. It is also important to ensure that the wind turbine can be easily lowered for inspection and maintenance.
- c) Try to have a clear, smooth fetch to the prevailing wind, e.g. over open water, smooth ground or on a smooth hill.
- d) Use cable of adequate current carrying capacity (check with the turbine supplier. This is particularly important for low voltage machines). Cable costs can be substantial.
- e) Consult your local authority as to whether you need planning permission. You should try to minimise the environmental impact of the turbine, and it will be helpful to inform your neighbours of your plans at an early stage.

Annexure 3: Grid Tie Inverters

Kestrel does not manufacture grid tie inverters. The inverter that is installed must be suitable for connection to a wind turbine. Kestrel has fully tested the Power-One Aurora inverter which performs extremely well.

For an installation to be compliant with either the MCS scheme in the UK or the SWCC certification in the USA, the Power One Aurora 3.6 inverter must be installed with the Kestrel e400nb 3.5kW 250V

The main requirements for a suitable inverter are given below.



Continuous power rating
Input dc voltage range
Input dc current rating

3.6kW
0 – 600Vdc (minimum)
0 – 15Adc (minimum)

Control algorithm

Voltage/Power

- * Your Kestrel dealer or the factory can comment on the characteristic of any control algorithm.
- * No input rectifier is necessary. The Kestrel e400nb turbine outputs dc voltage and current.

Images are for illustration only. Kestrel does not endorse any grid tie inverter. Consult your dealer for recommendations on inverters.

Annexure 4: Manual Brake Operation

It is recommended to display a label that describes the stop and start procedure. An example is given below.

Kestrel e400nb Manual Brake Operation

You need the brake “T” bar !

**DO NOT OVER_TENSION THE
BRAKE. DAMAGE MAY RESULT**

**PLEASE OBSERVE THE USUAL
SAFETY PRECAUTIONS**



**Procedure to Stop (Only a small
force is required).**

Insert the brake “T” bar into the hole on the tower. Slide the small lever to engage the ratchet. Slowly wind the “T” bar clockwise to tension the brake until the machine starts to slow down. Check that the ratchet maintains the machine stopped. Remove the “T” bar for safety lock out.

Procedure to Release

Insert the “T” bar handle. Gently take up the brake tension manually to free the ratchet. Disengage the ratchet and slowly unwind the brake anti-clockwise. Fully release the tension on the brake and engage the ratchet. Remove the handle to storage.

Annexure 5: Brake Fitment Instructions (For e400n only)

The model e400n turbine is supplied without a factory fitted brake. The brake unit may be purchased as a standard accessory.

The correct fitment of the brake unit is extremely important for the safe operation of the turbine. Please read the instructions before undertaking this task.

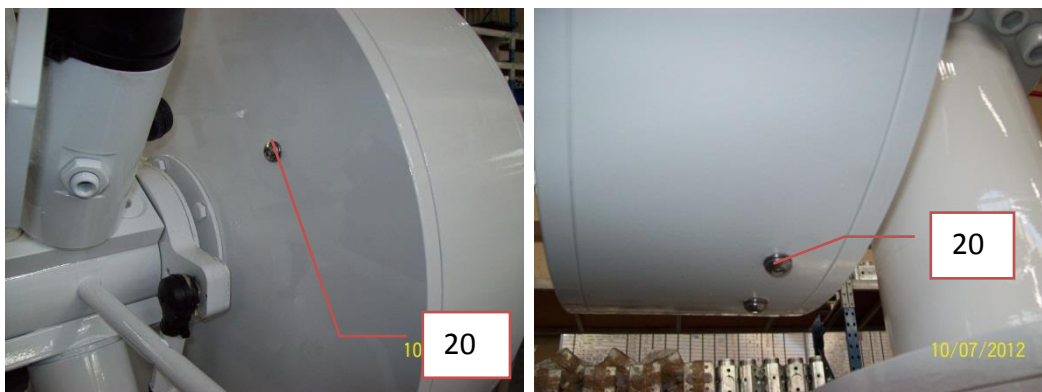
If you feel uncomfortable carrying out this procedure, please contact your sales agent for assistance.

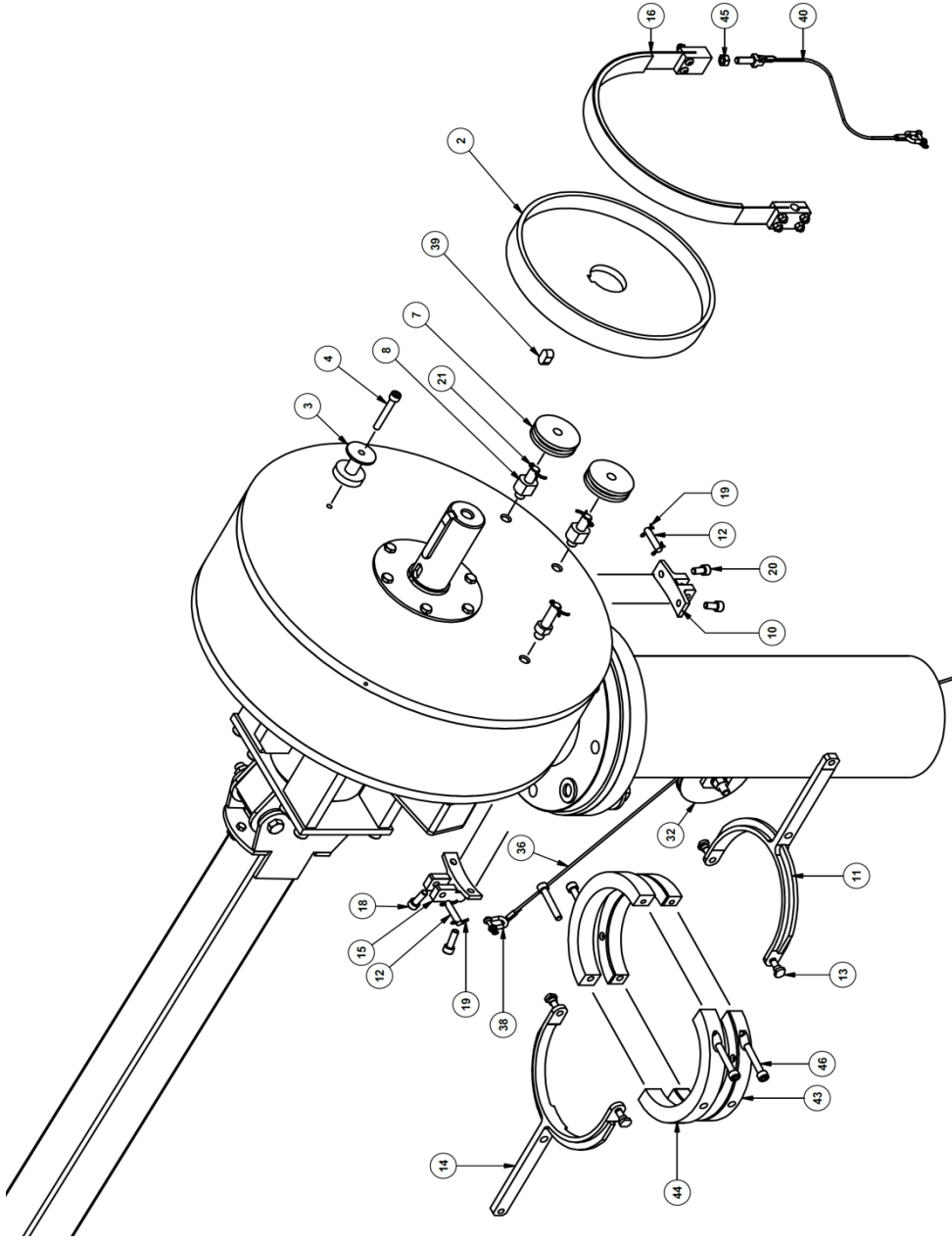
Fitment instructions are as follows.

- * You will need the following hand tools in addition to those already described in section 4.0
- * Allen key sizes 4,5& 6mm
- * Rubber mallet
- * Flat screwdriver

The following items are supplied:

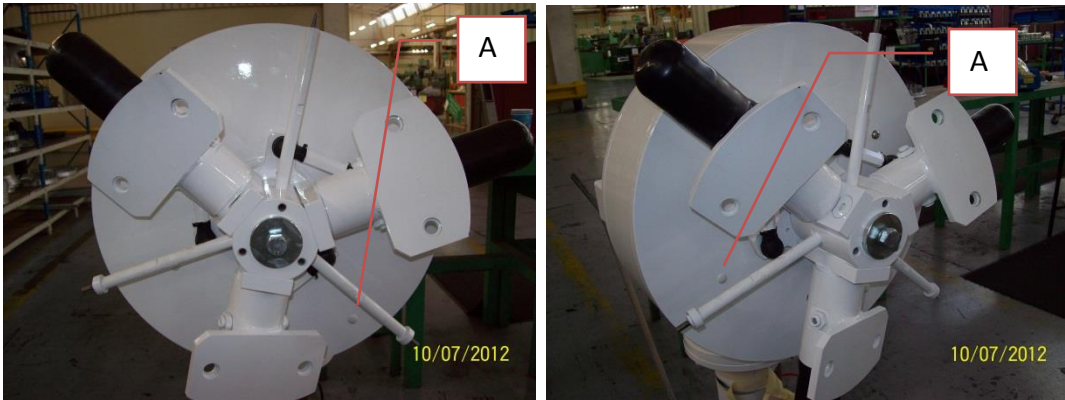
- * 1 syringe of thread glue
 - * 1 syringe of white grease
 - * An exploded view of the assembly with Item Numbers (see figure on page13)
- Remove button head screws (3-off) (Item no 20) at the front and bottom of generator using a 5mm Allen key



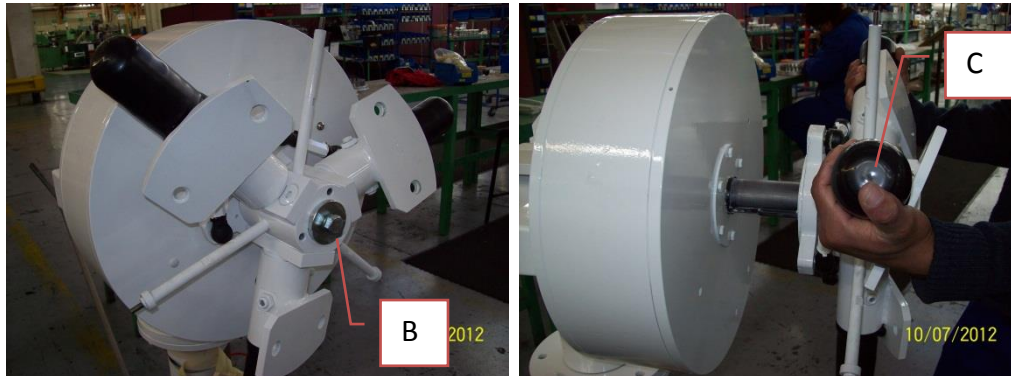


Parts List		
ITEM	QTY	DESCRIPTION
1	1	e400nb Generator Main Assembly
2	1	e400nb Brake Drum
3	1	e400nb Band Guide Pulley
4	1	Cap Screw M8 x 55 - A2 S/Steel
5	1	e400nb Band Tension Block
6	1	e400nb Band Anchor Block
7	2	e400nb Cable Pulley Pin
8	2	e400nb Cable Pulley Pin
9	1	e400nb Band Anchor Pin
10	1	e400nb Top Yoke Bracket
11	1	e400nb Top Yoke
12	2	e400nb Yoke Anchor Pin
13	5	e400nb Yoke Screw Pin
14	1	e400nb Bottom Yoke
15	1	e400nb Bottom Yoke Bracket
16	1	e400nb Brake Band Assy.
17	1	e400nb Tail & Boom Assy.
18	2	Cap Screw M8 x 25 - A2 S/Steel
19	4	Split Pin 2.5 x 14
20	2	Cap Screw - M6 x 1.25 x 16 - A2 S/Steel
21	3	Split Pin 3.2 x 20
22	6	Button Head Cap Screw - M6 x 1 x 30 - A2 S/Steel
23	8	Allen Cap Screw M12 x 30 SS
24	8	Hex Nut - Nylock M6 x 1 - A2 S/Steel
25	1	Rubber Flange
26	1	Rubber Sleeve
27	1	Plain Washer Metric 16mm MS Z/P
28	1	Rubber Sleeve Fender Washer
29	1	Hex Nut Metric M16 x 2 H.T 8.8 Z/P
30	1	Vibration Flange Compression Sleeve
31	2	Washer Plain Metric 6mm S/STEEL
32	1	e400nb Brake Cable Support Pulley
33	1	Washer Plain Metric 10mm - A2 S/Steel
34	1	Hex Nut - Nylock M10 x 1.5 - A2 S/Steel
35	1	Hex Bolt - M10 x 1.5 x 50 - A2 S/Steel
36	1	e400nb Winch Cable Assy.
37	1	Main Shaft Key
38	1	e400nb 4.5mm 'D' Shackles Assy.
39	1	e400nb Brake Drum Main Shaft Key
40	1	e400nb Band Cable Band General Assy.
41	1	Top Pipe Pulley Assy.
42	2	HDPE Wear Flange
43	2	Slip Ring Bot half
44	2	e400nb Top Slip Ring Half
45	1	Hex Nut
46	4	Cap Screw M8 x 1.25 x 50 - A2 S/Steel

- Remove white plugs (x3) (A) at the front of the generator using a thin flat screw driver



- Remove bolt (B) at the front of the pitch control using a 24mm wrench. Pull off the pitch control unit (C).



- Smear white grease onto the shaft *brake-key* (39) before inserting it into position. Also apply some of the white grease over the shaft to ease the fitment of the brake.



- Offer the brake drum (2) onto the main shaft. Slide brake drum over main shaft with the flat face against the generator. Tap the front of the drum while inserting to slide over shaft.



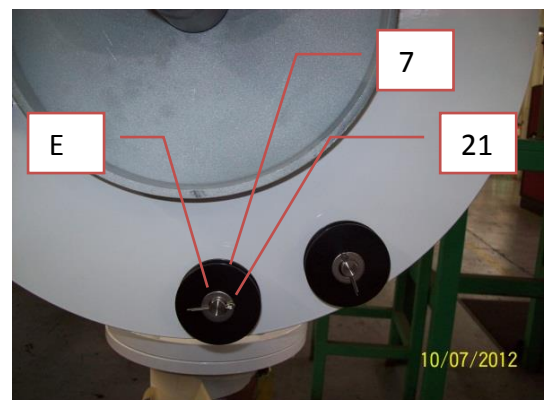
- Fit anchor pin (D) on the left side of the generator with thread glue and tighten using a 16mm spanner.



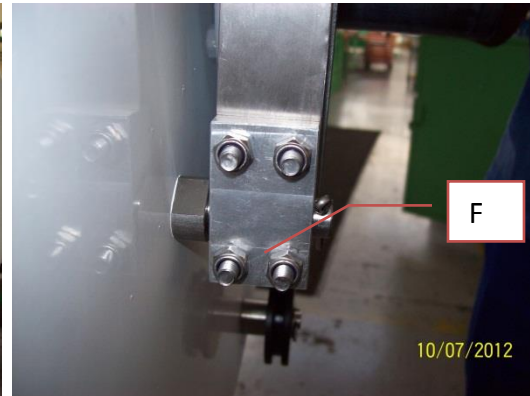
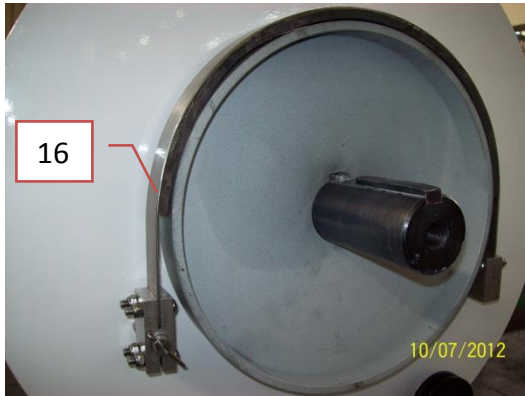
- Fit 2 x Cable pulley pins (8) with thread glue.



- Fit 2 x cable pulleys (7) to generator.
- Secure each pulley to the pulley pins with a 12 mm washer SS (E) and a split pin (21).
- Secure the split pins by bending one of the legs over.



- ▶ Fit brake band assembly (16) over anchor pin (D) and insert split pin (21). Secure the pin by bending one of the legs over. Tighten the bottom 2 bolts (F) of the anchor block using a 4mm Allen key.



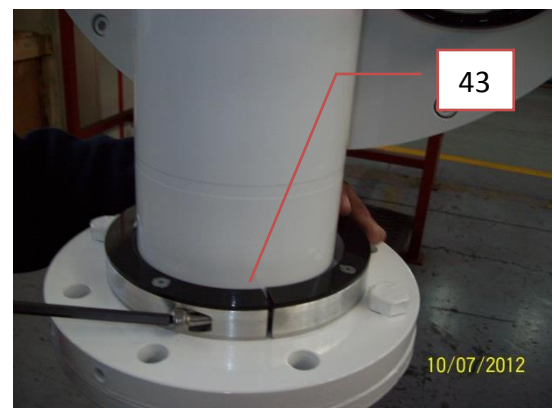
✱ ***Ensure anchor block is against the shoulder of the anchor pin***

- ▶ Fit band guide pulley (3) in position and insert M8x55 Cap screw (4) with thread glue, **tighten by hand using a 6mm Allen key.**

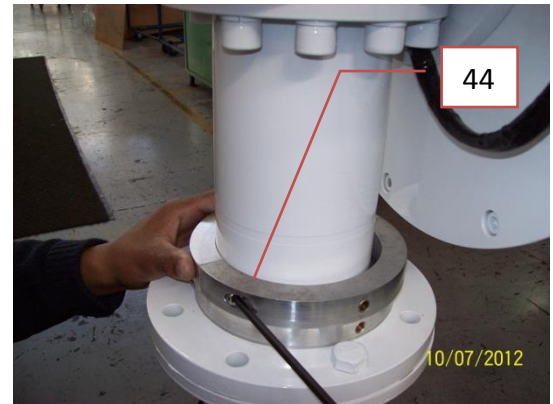
✱ ***This cap screw just needs to be nipped, not tightened.***



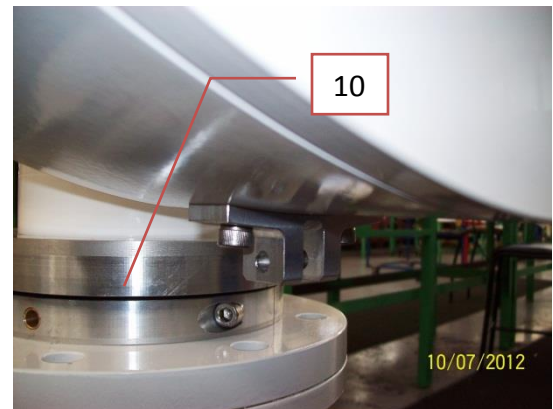
- ▶ Fit bottom slip ring 2 halves (43) over generator swivel shaft using x2 M8x50 SS Allen Cap screws (46) with the wear flange facing upwards.



- Fit top slip ring 2 halves (44) to generator swivel shaft and secure with 2 M8x50 SS Allen Cap screws. (46)

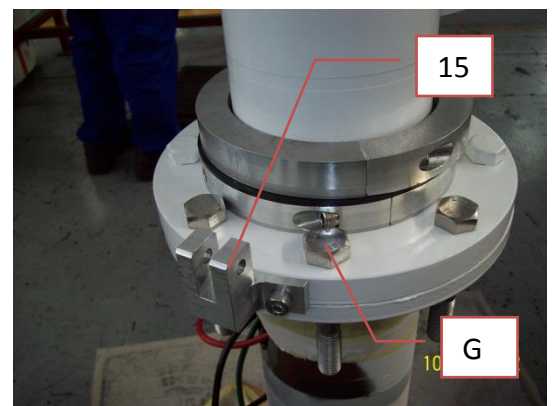


- Fit top yoke bracket (10) onto generator drum and secure with M8x16 cap screws SS (20). Secure with thread glue.



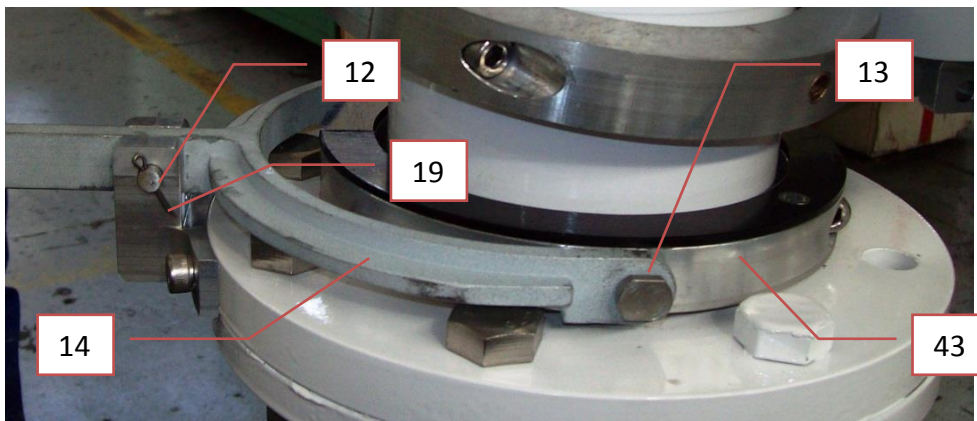
- * **Ensure that the threaded hole is clean.**

- * **Before inserting the bottom yoke, please insert 4-off M16 x 100 bolts (G) through the bottom flange at the back of the yaw shaft. After fitment of the yokes, access to these holes will no longer be available.**

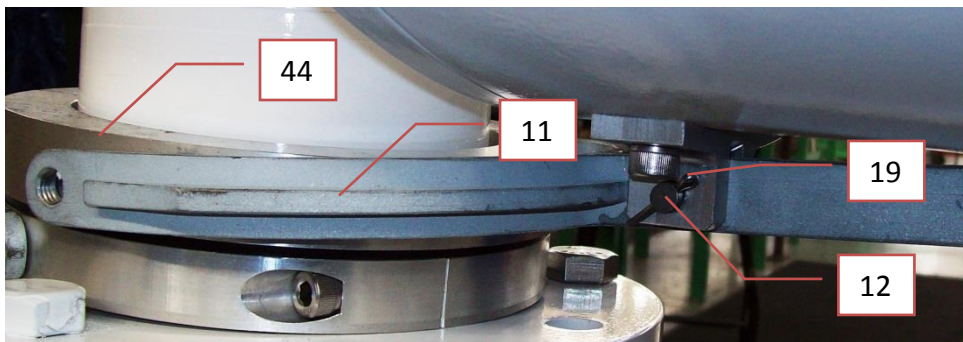


- * **Observe that the two yokes (14 & 11) are different. The bottom yoke (14) has a protrusion in the “cradle” of the yoke as well as a cut-way on both arms on the cradle. (See page 13)**
- Fit bottom yoke bracket (15) onto generator flange, secure with x2 cap screw M8x16 SS (20) with Thread glue.

- ▶ Lubricate all bushes in bottom yoke with a thin film of oil or grease before fitment.
- ▶ Fit bottom yoke (11) to slip ring with cut-out facing downwards, slip yoke into bottom yoke bracket and insert yoke anchor pin (12) and 2-off split pins (19). Secure the pin by bending one of the legs over so that it cannot pull out again.
- ▶ Applying a bit of thread glue onto the thread portion of the yoke screw pins (13) before fitting the (2-off) screw pins through the yoke (14) into the bottom slip ring (43).
- ✱ **Take care not to leave any thread glue on the bearing portion of the screw pin (13) as this will prevent functional movement of yoke.**



- ▶ Before fitting top yoke bracket, lubricate with oil or grease as above.
- ▶ Slide top yoke (11) onto top yoke bracket (10), fit yoke anchor pin (12) and (2-off) split pin (19)
- ▶ Fit the 2-off yoke screw pins (13) to the top slip ring using thread glue and heeding the same caution to only glue the thread portion.



- ▶ Fit brake band cable assembly (40) by screwing the cable bolt into the tension block by **approximately 10mm**.
- ▶ Fit the shackle-end of the brake band cable assembly (40) to the hole on the arm of the top yoke (11) after routing it over the pulleys as per the figure below. Secure shackle thread with thread glue.



- * **Set the brake band so it sits clear off the brake drum with a clear air gap. The start-up torque of the machine must not be effected.**

- * Test for up and down movement of yokes
- * Test for free rotation of the brake drum. The brake mechanism must be able to be operated by hand and be free and functional. The bottom yoke should fall freely to its original position if raised.
- ▶ To fit the pitch control back to the generator, smear white grease over shaft and hub clamping spacer before assembly.
- ▶ If you have removed the shaft main-key in the process of fitting the brake, return it to position after applying some grease to it.
- ▶ Assemble the pitch control to the generator by sliding it over the shaft in the same orientation it came off.
- ▶ Apply some grease to the M16 x 90 mm bolt before replacing it and the M16 washer. **Torque to 120 N.m**
- * Spin pitch control to ensure free movement / rotation of components.

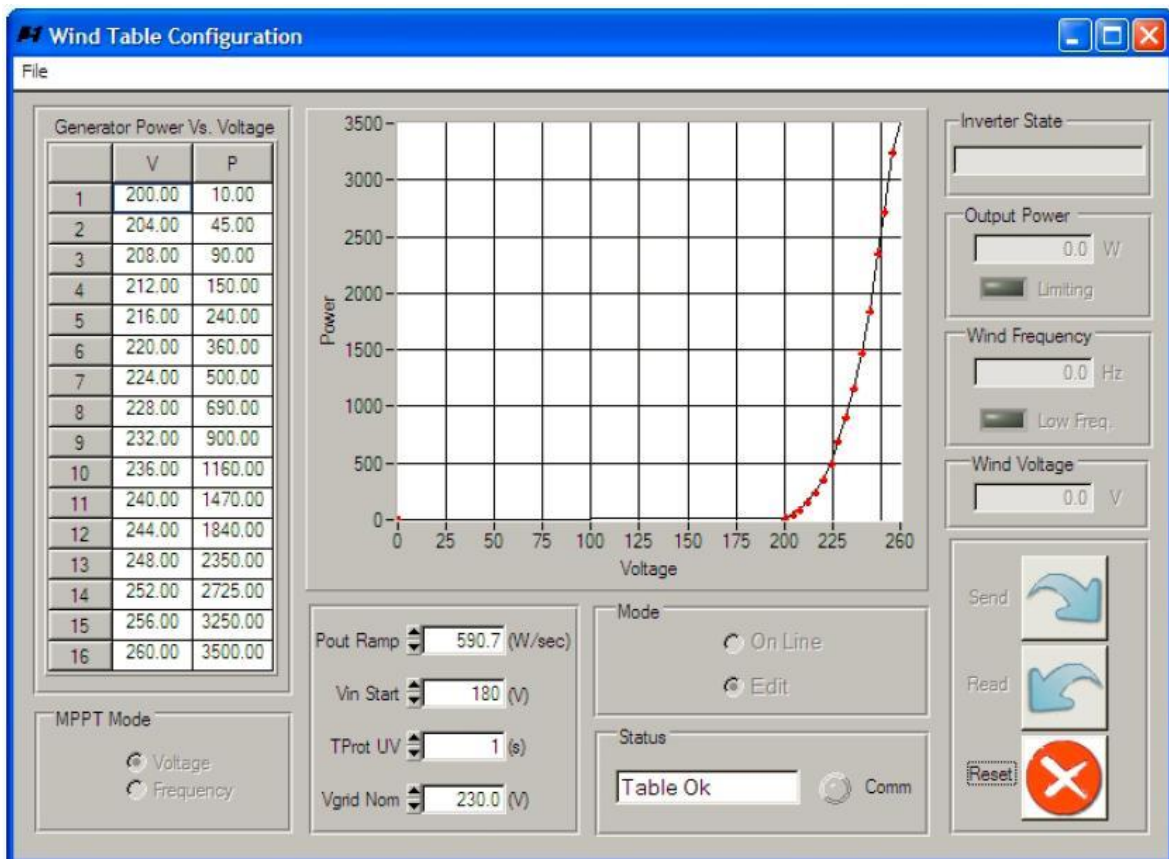


Annexure 6: Power One Inverter Settings

Both MCS and SWCC certification is awarded for the complete grid tie system and not only the wind turbine. It is therefore required that a certified installation must include a certified inverter. The Power One Aurora 3.6 is the preferred inverter.

The wind table configuration for the Aurora inverter is given in the table and in the screenshot of the Aurora software. The version of Aurora inverter used in the MCS and SWCC certification is given in the technical data on page 35 of this manual. Consult the inverter manual for full details.

	VOLTAGE (V)	POWER (W)
1	200	10
2	204	45
3	208	90
4	212	150
5	216	240
6	220	360
7	224	500
8	228	690
9	232	900
10	236	1160
11	240	1470
12	244	1840
13	248	2350
14	252	2725
15	256	3250
16	260	3500



To report errors or omissions or to suggest improvements please write to:
kestrel.technical@eveready.co.za or kestrel.admin@eveready.co.za