PROVEN
ENERGY

PROVEN 15

GRID CONNECT

INSTALLATION MANUAL

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1.0 Introduction

1.1 System Description

The PROVEN15 is a downwind three bladed turbine. It comprises a steel turbine frame mounted on a steel tower assembly. The turbine frame supports encapsulated windings and bearings that in turn support a rotating shaft and permanent magnet rotor assembly. One end of the shaft has a propeller blade assembly comprising glass thermoplastic composite blades that are hinged on a rotor plate. The blades are held in their correct position by dampers that allow the blades to form a cone shape in high winds. In this shape, the turbine is able to limit its rotational speed. The turbine frame also houses a service brake assembly that acts upon a brake attached to the rotor shaft.

The tower that is connected to the turbine frame has a steel base plate that incorporates a raising and lowering mechanism. The top of the tower has a yaw bearing assembly that permits the turbine frame to rotate. The blades are therefore able to turn depending on wind direction and speed. A winch mounted inside the tower is connected to the service brake in the turbine frame.

The generator encapsulated stator windings are connected to a slip ring unit at the top of the tower for onwards connection to a certified junction box.

1.2 System Components

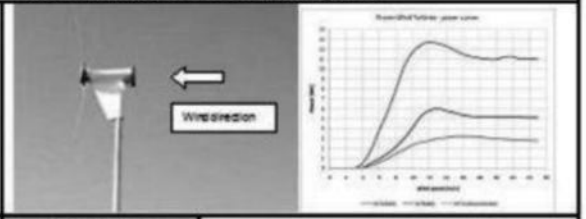
The main system components for the PROVEN15 wind turbine generator are:

- Turbine frame & generator including junction box
- Glass polypropylene blades (3 off)
- Slip ring unit
- 15m tilt up self supporting tower (in 3 sections)
- Brake assembly

Contained within the hollow tower section are the following components:

- Turbine brake rope – 3mm diameter stainless steel wire rope
- Brake winch
- Power cable - Between slip-ring unit at the tower top and the junction box at the bottom: 1 x 3 core 16sq mm cable
- Stud for the separate tower earth connection

1.3 System Specification

PROVEN 15 (15kW wind turbine)		
PROVEN TM1500 (15m self-supporting tower)		
Rotor Speed Control Above 12m/s the blades cone to self-adjust the rpm		
High Build Quality Most components are hot-dip galvanised steel, stainless steel or plastic	**Performance**	
	Cut-in wind speed Cut-out wind speed Rated wind speed	2.5 m/s 5.6 mph 54 m/s 121 mph 12 m/s 26 mph
	Rotor	
	Type Number of blades Blade material Rotor diameter Rated speed Rotor trust	Downwind, self-regulating 3 Glass thermoplastic composite 9.6 m 150 RPM 26 kN
	Generator	
	Type Output Annual output	Brushless, direct drive, permanent magnet Grid connect 300V DC, battery charging 48V DC direct heating 240V switch DC 15,000 – 30,000 kWh
Low Speed Equals Durability Low rotor speed (half of the speed of comparable machines) ensures extended durability of blades and bearings. It also means that Proven wind turbines are the quietest in the world!	**Tower**	
	Type Hub height Foundation size	Self-supporting, hinged, tapered 15 m 3.7 x 3.7 x 1.2m concrete
	Noise	
	48 dB 65 dB 70-80 dB	All readings taken with an ATP SL-25 portable meter At 5 m/s At 20 m/s Car 15 m away speeding at approx 40 mph
	Weight	
	Proven 15 TM15000	1100 kg 1478 kg
	Sample of Commercial Customers British Telecom / Scottish Youth Hostel Association / Saudi Aramco Irish Lighthouse Authority / Welsh Water / British Rail Shell Exploration / T-Mobile / Orange	

1.4 Health and Safety Information

Please refer installation and servicing to qualified service personnel only. High currents are produced by this wind turbine system and incorrect installation or use may result in

- risk of electric shock or fire
- mechanical damage

Warning!

Installation of the turbine involves handling heavy components such as the turbine nacelle, blades and covers. Appropriate work wear (e.g. gloves, helmets, safety footwear and eye protection) appropriate lifting gear, techniques and appropriate number of personnel should be used at all times.

Personal Precautions

Proven recommend a two person team as a minimum for mechanical installation of a Proven wind turbine – they should use standard protective clothing.

Use only certified lifting straps and strops.

Weather

The turbine should be installed in periods of wind speeds less than 12 m/s (25 mph or 43 km/h) and generally calm weather conditions.

2.0 Electrical Installation

The Proven 15/300 is specially designed for connection to LV network at 230Vac 50Hz nominal by means of WB6000 grid connect inverters (SMA Windy Boy).

It is suitable for domestic, agricultural and SME applications and will produce from 15 – 30 MWh per annum depending on the wind resource available. A description of the main electrical component parts of the system is as follows:

2.1 Schematic for Connection

Please refer to the electrical schematic. The main elements are:

- Proven 15 wind turbine containing GW15000 3-phase AC synchronous variable speed alternator
- Proven grid connect inverter & controller package comprising
  - DC Disconnect – allowing the turbine to be isolated from the grid connect inverters.
  - ECM15004ME/300 controller which displays turbine voltage and current, rectifies AC input from the turbine and outputs DC power to the grid connect inverters
  - 3 x WB6000 6kW SMA Windy Boy grid connect inverters of the self commutating static type.
- AC Disconnect Lockable – allowing the grid to be securely isolated from the inverter(s).

The output from the AC lockable disconnect is normally connected to a spare fuse or breaker at the customer distribution board rated at >32A for 3-phase or >63A for a single phase.

2.2 GW15000

The Proven 15 contains a purpose built permanent magnet generator which is directly driven by the rotor at variable speed according to wind conditions. All of the technical information on the GW15000 below is provided for information only – the only part of the system that is "seen" by the grid system is the grid connect inverter (see following sections).

2.2.1 Type of Generator

The GW15000 is a permanent magnet synchronous 3-phase AC alternator suitable for variable speed operation.

2.2.2 Selected Operating Characteristics

The output voltage open circuit is proportional to RPM of the turbine. The output voltage during normal operation is dependent on the load placed on the generator.

The output of the generator is connected to the ECM15004ME/300 control box which contains a 3-phase rectifier.

GW15000	RPM	Approx Wind Speed	GW15000 Output Voltage Vac under normal operating conditions Vop AC	GW15000 Output Voltage Vac if grid fault (inverters disconnected from grid) Voc AC	Input DC Voltage to grid connect inverter under normal op conditions Vop Dc	Input DC voltage to grid connect inverter if grid fault (inverters disconnected from grid) Voc DC
Minimum Speed	0	0-5 mph	0	0	0	0
Maximum Speed	140 rpm	>25mph (blades feather at higher wind speeds to maintain this max shaft rpm)	225Vac 3-ph	450Vac 3-ph	300V DC	540V Dc
Typical Speed (during operation)	70-140 rpm	5-25mph	200 – 225 Vac 3-ph	400 – 450 Vac 3-ph	240-300V DC	480 V DC – 540 V DC

There are no touching parts or brushes in the generator and it is maintenance free. The GW15000 has 24 poles and has a nominal AC frequency of 20Hz @ 150 rpm.

The generator can be disconnected at any load without any problems – in this case the winding voltage rises and the turbine will speed up slightly until the blades mechanically govern to the maximum rpm. On reconnection of load, the turbine winding voltage will fall gradually to normal operating value due to the intelligent switch-on strategy of the inverters used (after the switch on delay period has passed).

2.3 ECM15004ME/300 Control Box

The ECM15004ME/300 has the following functions

- Converts output 3-phase AC variable voltage of the turbine to DC variable voltage for input to the grid connect inverters.
- Isolation point for the turbine.
- Displays V, I (DC) from the turbine.

2.4 WB6000 Grid Connect Inverter

The WB6000 grid connect inverter has the following functions

- Conversion of variable voltage DC input to synchronised 230Vac 50Hz nominal
- 180s delay after grid fault until re-connect to grid
- Trip out on over/under voltage
- Trip out on over/under frequency
- Disconnection on loss of mains

The WB6000 inverter has been type tested for suitability for use under G83/1 regulations.

2.4.1 Description of Typical System Commissioning Procedure

At the start of a typical commissioning procedure the following should be the situation

- Turbine is mechanically braked
- Turbine is isolated from the grid connect inverters
- Grid connect inverters are isolated from the grid

The typical start up sequence is:

- Connect the 3-phase ac supply from wind turbine to the inverters by switching on the 3-pole disconnect in the ECM15004ME/300 controller.
- Release the wind turbine mechanical brake. The turbine starts to rotate if wind conditions are more than about 5mph. The inverter waits until input DC voltage is >250V before starting its self test and safety procedures at which point the ORANGE LED on the front of the inverter will flash approx once per second.
- Connect the inverters to grid AC by turning the lockable AC disconnect to the **ON** position. At this point the inverters start monitoring grid AC voltage, frequency and impedance. After a few seconds the GREEN LED starts to flash. First the inverter checks voltage and frequency are within allowed ranges and that grid impedance is >1.25Ω. If all is OK then it waits 180 seconds (required by G83/1 and G59) and then starts its "connect to AC network" procedure. After completion of this procedure (will take approx 5 minutes depending on wind conditions the GREEN LED will stay on continuously.
- If the inverter input DC voltage is <180VDC for >300 seconds then there is not enough wind resource available and the inverter shuts down and goes into sleep mode (All LEDs off). Higher input DC voltages will wake it up when wind speeds increase and it will then repeat this connection procedure.

2.5 Description of Typical System Operation

A typical operating strategy during a **windy period** is summarised by:-

- Continuous and automatic monitoring of Vac and fac by the inverter.
- Inverter will disconnect from grid network in <0.5 seconds should V_{ac} or f_{ac} go out of their allowed ranges under the connection settings chosen.
- Inverter continuously adjusts output AC amps to match the wind energy available.

A typical operating strategy during a **calm period** is summarised by:-

- Inverter goes into sleep mode after disconnecting from grid network.
- If wind increases then the inverter will start up as described in section 2.4.1 above.

A typical operating strategy during a loss of mains is summarised by:-

- Inverter disconnects from grid network in < 0.2s and monitors V_{ac} and f_{ac} continuously. At this point the wind turbine will speed up slightly and the generator winding voltages will rise as described in section 2.4.1.
- Should V_{ac} and f_{ac} return to allowed ranges then the inverter will start up as described in section 2.4.1.

2.6 Method of Disconnection from Grid

The WB6000 inverter contains an independent disconnection device "SMA grid guard 2" (all-pole isolation on grid side). In some countries a separate G59 relay or similar arrangement might be required.

- Excerpt from a Windy Boy manual: "The Windy Boy is equipped with the SMA grid guard 2. This is a type of automatic disconnection device. It ensures that the Windy Boy complies with the new VDEW (Verband der Elekrizitatswirtschaft – German Electricity Industry Association) regulations for the operation of power-generating systems in parallel to the low-voltage grid of the electricity supply company and with DIN VDE 0126-1-1, which forms a part of these regulations.

2.7 Electrical Wiring

Proven recommend that electrical wiring and installation are carried in accordance with the Energy Saving Trust publication CE72 – 'Installing small wind – powered electricity generating systems' and BS7671 – ' IEE Wiring Regulations for Electrical Installations'.

The schematic drawings provided in appendix A have been provided to assist in wiring components to the above mentioned standards.

3.0 Mechanical Installation

3.1 Tools Required

Number	Description	Used for
2	10 mm spanners (1 open ended)	Slip ring brushes
2	13 mm spanners (1 open ended)	Slip ring unit – brake winch fittings
2	17 mm spanners (1 open ended)	Spring loaded yaw rollers – damper rod ends
2	19 mm spanners (1 open ended)	Blade fixings – static yaw rollers
2	22 mm spanners (1 open ended)	Swivel end off solid rod on damper
2	24 mm spanners (1 open ended)	Frame assembly – static yaw rollers – blade/damper fixing
2	30 mm spanners (1 open ended)	Yaw bearing assembly
2	32 mm spanners (1 open ended)	Damper assembly fixings
1	Socket set (10 mm to 32 mm)	Turbine head assembly
1	7 mm socket including ratchet	Fastening bulldog clips on brake cable
1	Torque wrench (up to 330 Nm)	Frame assembly
1	3 mm allen key	Slip ring grub screw
1	4 mm allen key	Yaw bearing grub screw
1	Pair of wire snips	Trimming cover cable ties
1	46 mm and 55 mm sockets	55 mm for TM1500 tower bolts 46 mm for M30 foundation bolts
1	Torque wrench and/or multiplier (up to 2750 Nm)	Fastening tower/base bolts
1	M36 tap (optional)	Cleaning /repairing tower boss threads
1	Podger (optional)	Assists in frame assembly
1	Tube of glazing silicon and gun	Cover sealant
1	Loctite 577 or equal product	All fixings – **must be used with all stainless steel nuts and bolts** – stops cross threading
1 set	Pliers, wire strippers, large crimping tool, assorted crimp lugs etc.	Wiring
1	Hacksaw	Removing locked stainless steel nuts (this can sometimes happen)
1	Battery grinder (optional)	Removing locked stainless steel nuts - trimming covers if required
1	Flat, round and square file set	Removing any galvanising build up
1	Screw driver set	Slip ring brushes
1	Battery drill and nut driver	Blade fixings
1	12 T hydraulic jack	For initial tilt of turbine during lowering
1 set	3.2t hydraulic Tirfor winch, 60m Tirfor wire rope 16mm diameter with 3.25t shackle one end. 2 x 8t snatch blocks for 16mm wire rope, 4 x 5.75t bell end shackles with 60mm opening, 3.6t wire sling approx 2m long	Raising and lowering with hydraulic Tirfor winch

3.2 Frame and Tower Assembly

Proven TM1500/15000 is a 15m tilt up self supporting galvanised steel tower.

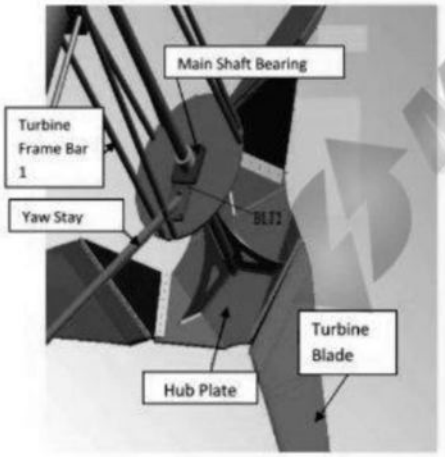
The tower is supplied in three sections. The tower is supplied with a set of two gin poles.

Section Dimensions & Weights:

• Base section	5.5m (L) x 0.90m (W)	594 kg
• Middle section	5.5m (L) x 0.54m (W)	492 kg
• Top section	5.5m (L) x 0.45m (W)	392 kg
• Gin pole (2off)	7.2m (L) x 0.18m (W)	216 kg each

3.2.1 Procedure

- Lift parts off vehicle
- Take tower sections to foundation.
- Fit lower tower section to base plate using hinge pins.
- Lift middle section of tower into position.
- Slide middle tower section over the top end of the base section.



- Winch the two sections together.

- Lift the tower top section and slide over to the winched tower section. Now the three sections together.

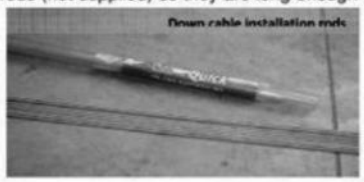
Advice

Ensure the mast is locked in position for safety before proceeding with rest of the installation.

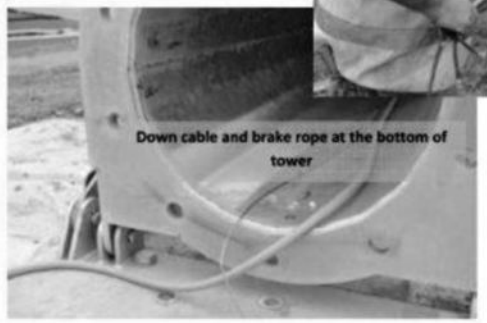
3.3 Preparing the Cable Termination at the Turbine Head End

3.3.1 Procedure

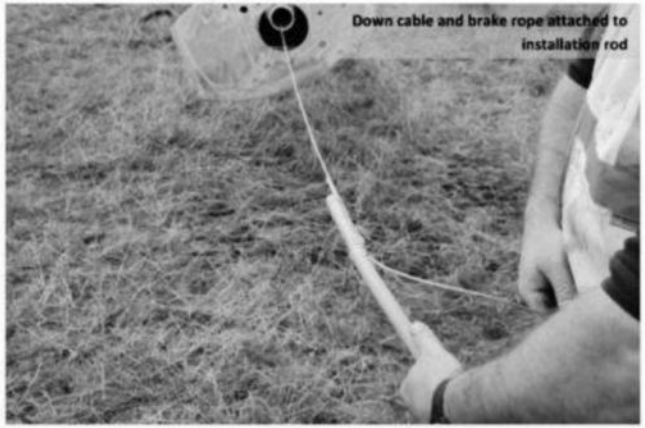
- Assemble down cable installation rods (not supplied) so they are long enough to match tower height. Alternatively a draw string or other suitable methods can be used to pull cable down from the top of tower to the bottom.



- Feed the assembled installation rods (now a long rod) through the tower top to the bottom of the tower.



- Using an adhesive tape, attach the brake rope and down cable to the assembled installation rod. Pull the end of the rod at the bottom of the tower till other end with the attached rope appears. Now detach the rod from the down cable and brake rope.



- Secure the down cable to the side of the stainless steel cable guide ("trumpet") using two cable ties

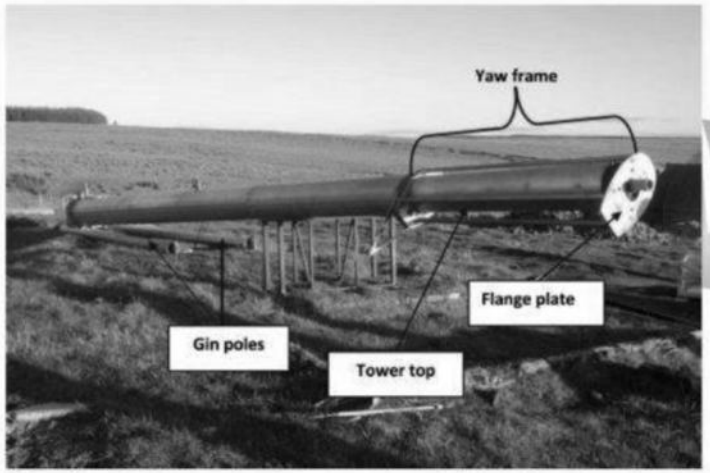
- Feed the ends of the brake rope through the stainless steel cable guide and the ends of the down cable through the holes on the side (top hat) of stainless steel cable guide. **NB: Turbines manufactured after September 2009 come with a two-piece plastic cable guide and top hat. Top hat is locked to the cable guide using a single heavy duty circlip.**

3.4 Connecting the Turbine Head to the Yaw Frame

Important

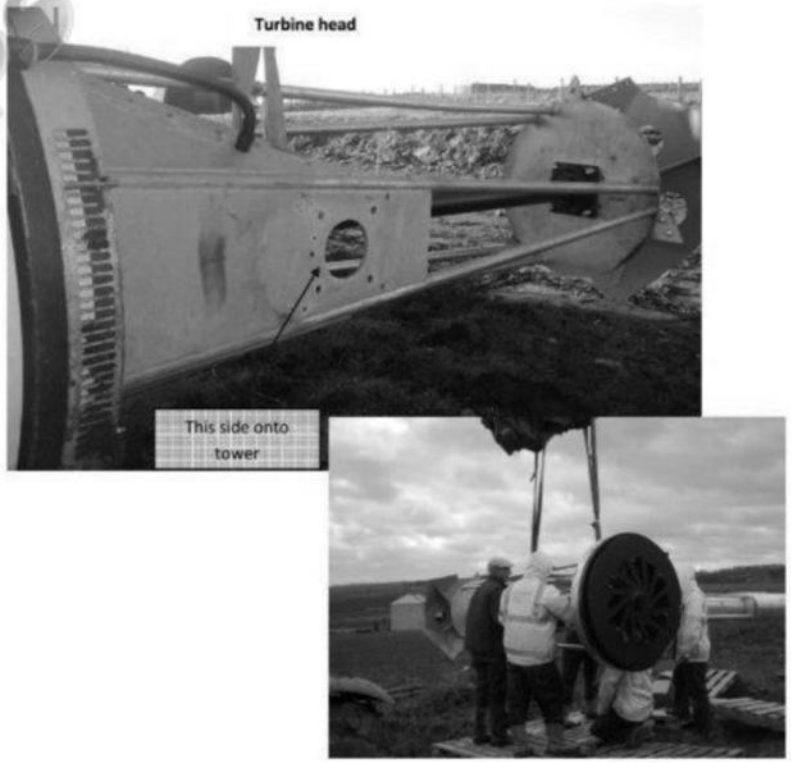
Mechanical and electrical installations will be required in the nacelle of the turbine.

Also if the turbine head is above normal working heights, provision will have to be made for scaffolding or other access means.

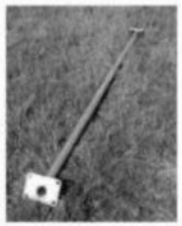


3.4.1 Procedure

- Attach yaw bearing to the spigot ensuring it seats on the small machined step. Loctite grub screws and fix in place.
- Slide the yaw frame onto the tower top and locate hard against bearing surface as shown in the picture above.
- Lift main frame as shown below and locate main frame against yaw frame surface.
- NOTE: Care must be taken not to damage cables when passing through the holes.
- Locate the 2 frame parts using the 4 x M16x50 bolts provided. Do not tighten at this time.
- Lift the 2 frame parts to locate the 4 x M20x80 bolts provided. Do not tighten at this time.



- Position the yaw stay by sliding it in between the turbine frame tubes to fit against the main frame and lower yaw frame surface.



- Locate using the 8 x M16x50 bolts provided.
- All fixings can now be tightened and torque (M16 – 150Nm / M20 – 330 Nm). Remember to use Loctite.

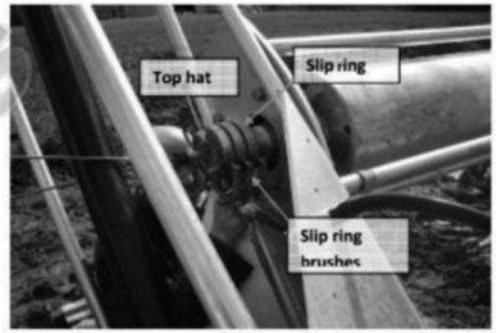
3.5 Slip Ring Assembly

3.5.1 Description

A slip ring is an electromechanical device that allows continuous electrical connection and transmission of power from a stationary part to a rotating structure. Additionally, the slip ring helps prevent the down cable and brake rope from twisting.

The slip ring assembly consists of:

1. Slip ring (3-ring) including grub screws
2. Mount stand for slip ring brushes
3. Slip ring brushes for each ring



3.5.2 Procedure

- Smooth down the tower spigot surface to be fitted with the slip ring with a sand paper.
- Slide the slip ring onto the tower top spigot and position slip ring so that it overhangs the tower spigot by about 10mm so the top of slip ring lines up with "top hat". Use a 3mm allen key to fix grub screws in place - use Loctite 577 or equal on grub screws.

- Loosen the 3 stud nuts on top of the slip ring unit and connect the down cable ends at the top hat to the 3 studs. Tighten the stud nuts with a 13mm spanner. Note: Any one of the cable ends can be fitted to any of the studs. The two washers go on top of the crimped down cable ends. The copper washer is placed first.

- Now using two 17mm spanners (or a spanner and socket) attach the slip ring brushes to the turbine frame.

- With a 10mm socket loosen the bolts on the brushes till the brushes can be moved freely. Position the brushes in the middle of the rings. Adjust for good contact and then tighten bolts.

- Connect the generator lead out wires to the top of the brushes and tighten using a 10mm socket.

- You can now connect the down cable and the SWA cable at the bottom of the tower using a certified junction box and then connect the separate tower earth cable where applicable.

3.6 Brake Assembly Details

The wind turbine has a brake for safety during raising/lowering and maintenance and in case of emergency.

The brake stops to the turbine prior to any raise and lower operation.

The brake assembly is in two parts. There is the hand operated brake winch to be mounted to the inside back face of the tower behind the tower door using 2 off M8 x 30mm bolts and nuts. The other part is the disc brake assembly consisting of a metal brake disc, two brake pads with plates, spacers and springs, small lever and square bracket and wire rope.

Application of the main brake winch causes the various parts of the assembly to move with ultimately the small lever in the head being pulled down and pushing the pads either side of the disc directly into contact with the disc.

Turbine will slow and stop completely when fully engaged.

3.7 Brake Rope Installations

The mechanical brake assembly is made up of the following components located in the nacelle of the turbine:

1. Brake disc
2. Brake pads
3. Nacelle brake levers, which are already factory fitted and connected
4. The first brake rope runs from nacelle brake lever to the pulley just below the brake guide.

3.7.1 Procedure

- Feed brake lever connecting cable (green cable in picture) over the swivel pulley and then connect to the stainless steel brake rope as shown in the picture below.

- Attach the ends of the brake lever connecting cables to the brake lever. Note the ends are split around the shaft as shown in the picture below.

- The free end must be attached to the winch end (as shown below) using a swivel and a shackle, the wire should be fed through and around the pin of the shackle and adjusted to suit, finally being secured with the two wire rope grips supplied. Make sure that the brake winch is payed out before the cable is secured.

- Using 3mm rope - two grips are required to secure the end of the rope.
- The grips should be fitted in such a way that the correct tightening of the grip does not damage the outer wires of the rope grip.
- Position the clips and apply light tension on the rope and tighten all nuts evenly, alternating until reaching the specified torque.
- Length of rope to turn back: 85mm – Tightening torque for nuts: 6.1 Nm.

Due Care & Attention Required

3.7.2 Brake Operation

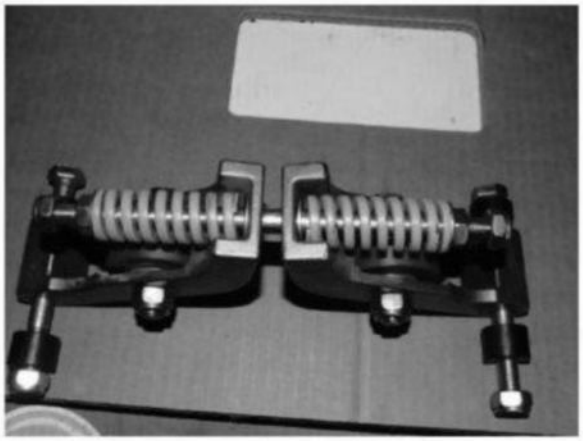
- Using tower door key remove tower access door
  - Brake is applied by using socket "T" bar wrench on M12 nut attached to drive spindle.

3.8 Yaw Roller Installation

The turbine is supplied with

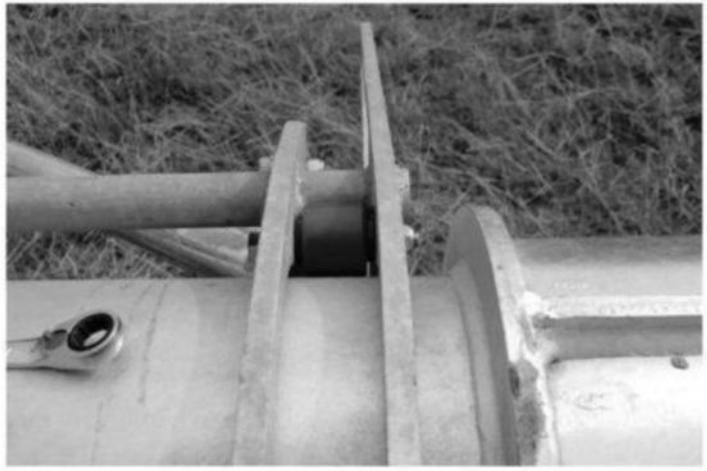
- 2 off self lubricating yaw rollers

- Spring loaded yaw roller assembly

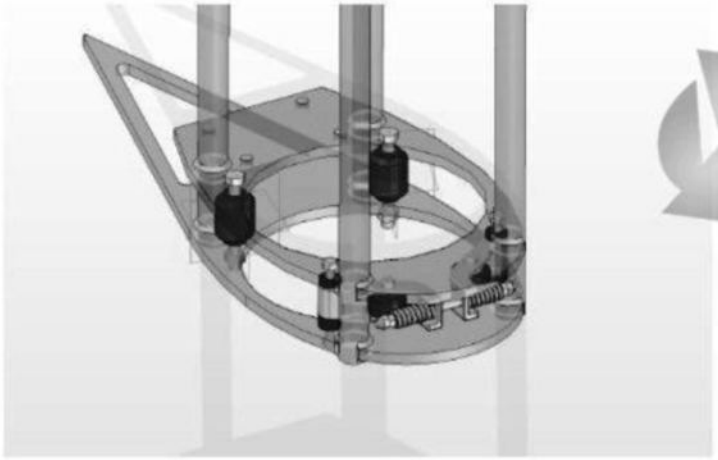


3.8.1 Procedure - Yaw Roller Installation

- First take the spring loaded yaw roller assembly. Remove the two M12 bolts from the assembly and then remove the M10 locknuts from the spring assembly and slacken the two ordinary nuts back to the end of the threads.
- Insert the assembly into the yaw frame with the bolt holding the rollers into the assembly point down the way. There are two black washers for each 12mm bolt. Thinner one is to be fitted above the casting and the thicker one below. Now fit the 12mm bolts through the frame and the castings with the washers fitted. Tighten the 12mm nuts just till they touch the plate – they do not need to be torqued.
- At this point fit the static yaw rollers remembering to grease the bolts. The nuts fitted to these bolts only need to be tightened up to the plate – they do not need to be torqued.



- Now tighten the two M10 ordinary nuts on the spring assembly till they hit the shoulder at the end of their threads as shown below. Then fit the M10 locknuts and lock them against the ordinary M10 nuts.



3.9 Fitting the Covers

The turbine is supplied with the following covers:

1. Yaw cover (supplied in 3 pieces)
2. Nacelle cover (also called the rotor shaft cover - supplied in 2 pieces)

The covers are made from black or white U.V. stabilised polypropylene plastic.

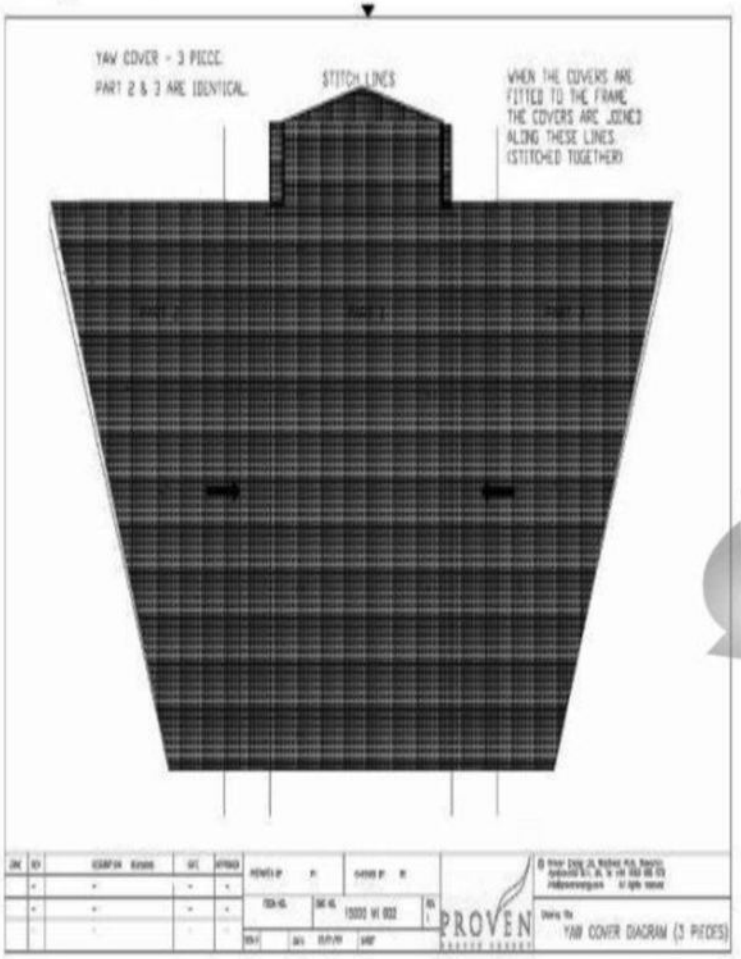
The three yaw cover pieces are to be stitched together using the weatherproof cable ties supplied before fitting.

The covers are also fitted to the wind turbine frame using cable ties. The two – piece nacelle covers are stitched together after fitting to the turbine frame individually.

Advice

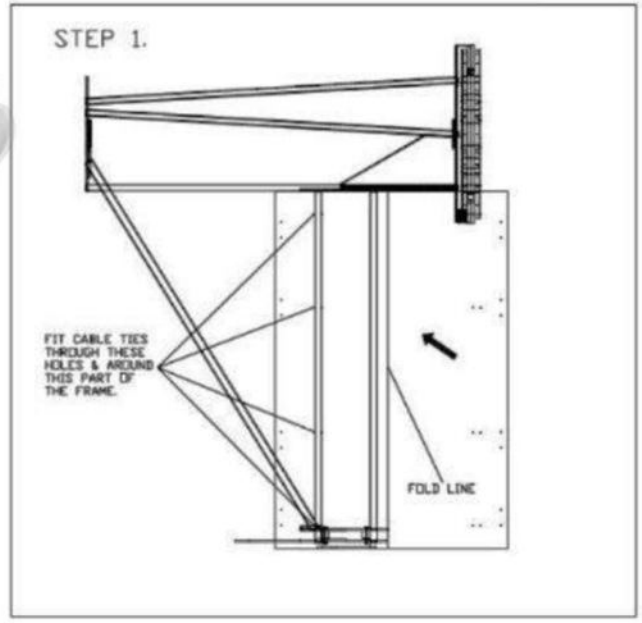
The yaw cover must be fitted **first**.

3.9.1 Fitting the Yaw Cover

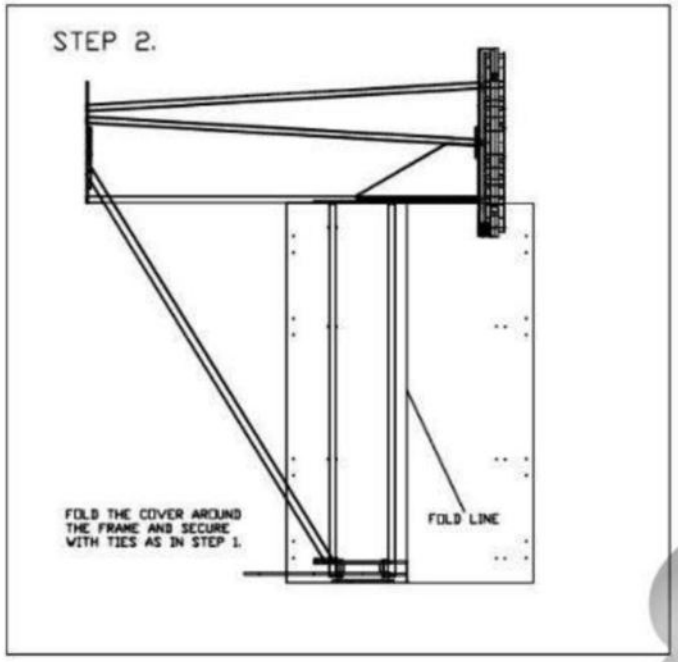


Procedure

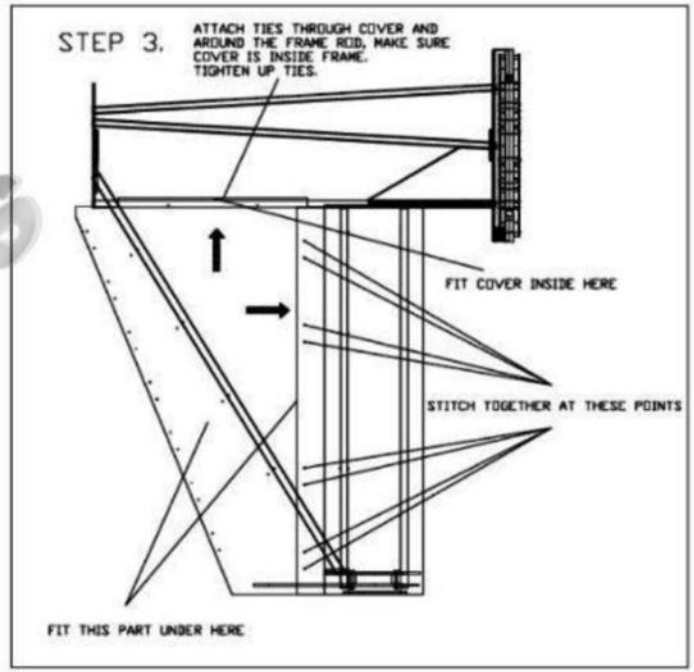
Step 1: Offer up yaw cover part 1 to the frame and attach using the cable ties at the positions shown. Feed cable tie from front through cover around the steel bar and back through the other hole, secure tie but **do not** fully tighten until all ties have been fitted.

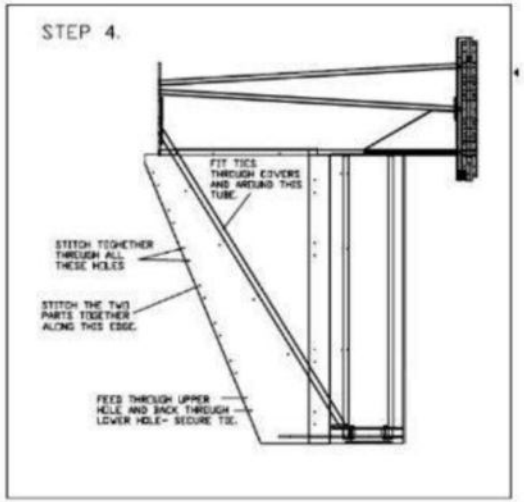


Step 2: Fold the cover around the frame under the generator end and secure the cover to the frame as in step 1.



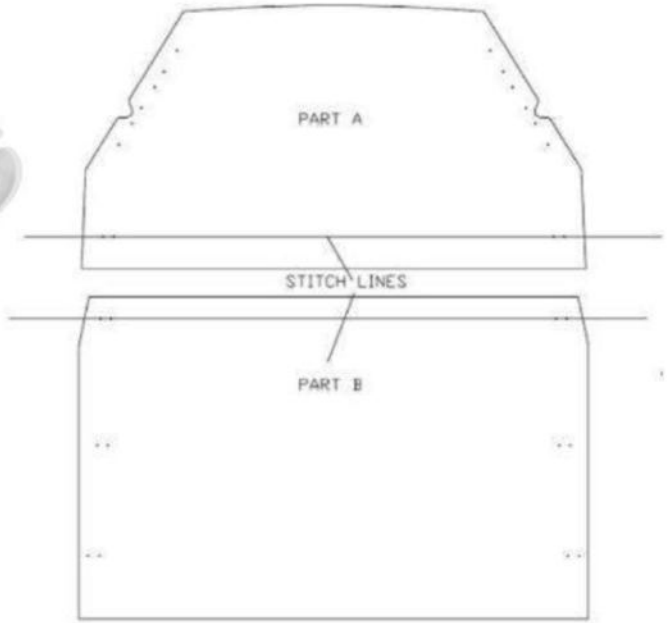
Step 3: Offer up either yaw cover part 2 or 3 (depending on side you are working from) to the frame. Fit the cover under part 1 and inside bottom frame, secure cover to the frame then stitch together the two cover parts as shown.





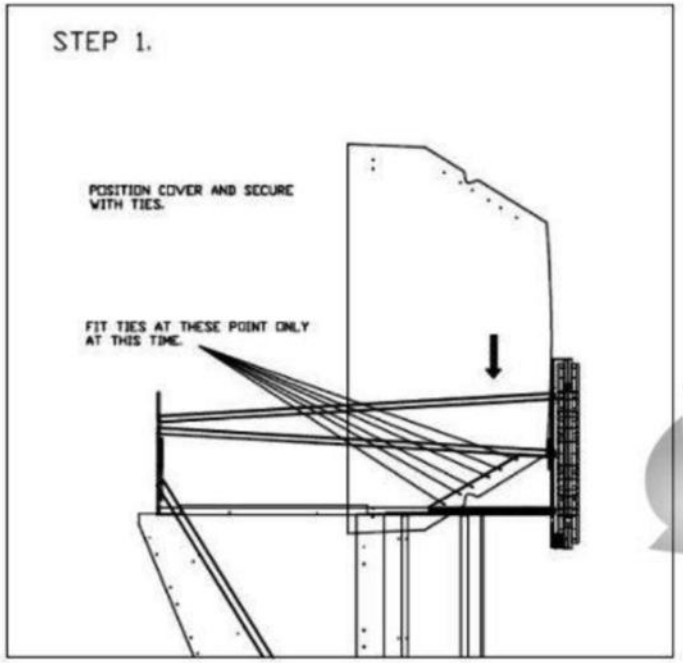
Step 4: Offer up the final part of the yaw cover and fit as in step 3. Now feed cable ties through the covers, going around the diagonal tube piece and coming back through the covers. This secures both parts 2 and 3 to the tube and to each other. Now stitch the ends of parts 2 and 3 together as shown. Finally tighten all ties and trim.

3.9.2 Fitting the Nacelle Cover

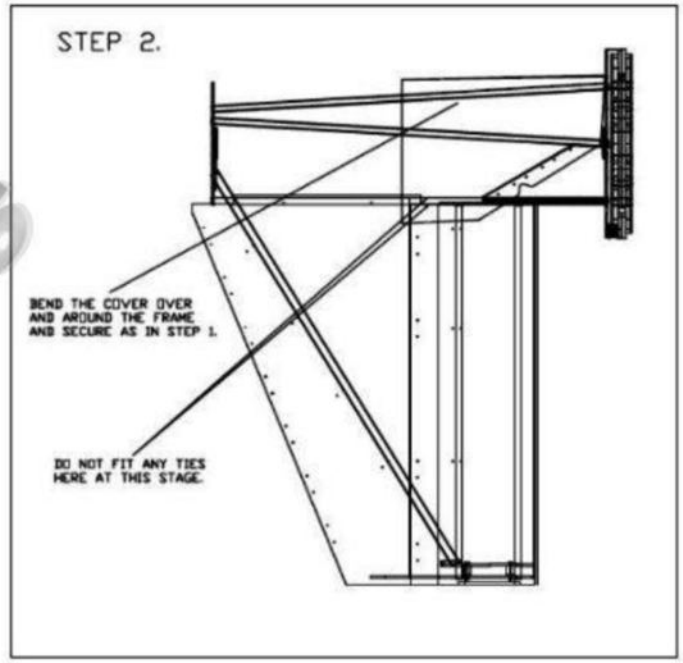


Procedure

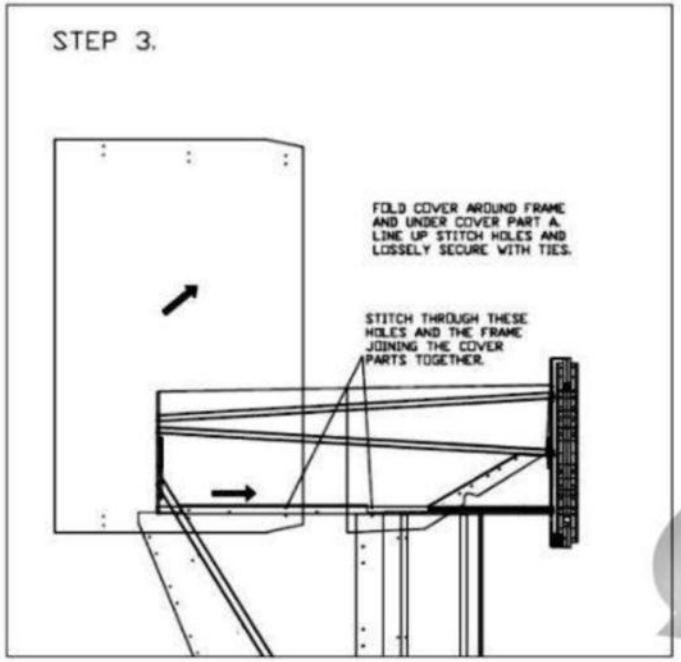
Step 1: Offer up rotor shaft cover part A to the frame, attach using the cable ties at the positions shown. Feed cable ties through cover then through plate and back through cover and secure. This joins cover to frame. It may be necessary to join cable ties together to get the required length.



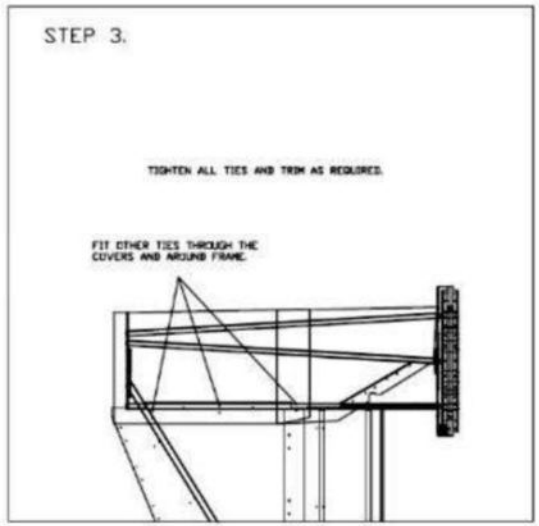
Step 2: Fold the cover over and around the frame and secure as in step 1.



Step 3A: Offer up rotor shaft cover part B to the frame. Fold around the frame and fit this cover under the edge of rotor shaft cover part A as shown. Loosely stitch the cover parts together at the points shown. When stitching these parts together be sure to go around the frame as well.



Step 3B: Fit ties through the rest of the cover holes and around frame parts. Finally tighten all cable ties and trim.



4.0 Blade & Spring Damper Fitment

The correct fitment of blades and dampers is critical to the correct operation of the turbine!

Please ensure you carefully follow the assembly instructions below.

4.1 Blade Details

Caution!

Treat the blades with exceptional care – especially the leading and trailing edges of the airfoil.

The blades are supplied as a balanced and matched set of three. Ensure each balanced set is keep and used together at all times.

4.1.1 Blade Description

The blades are an assembly made from the following parts;

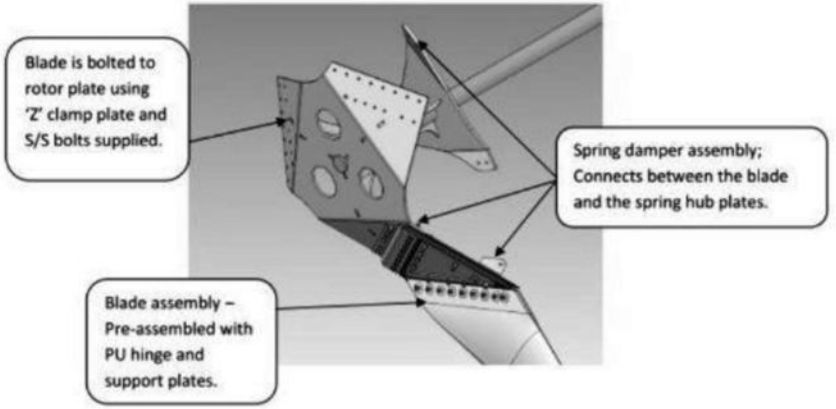
An airfoil – Glass reinforced thermoplastic

Zebedee hinge at blade root – Polyurethane reinforced with rope and steel inserts.

Support plates and brackets – Galvanised steel.

These three parts are supplied already assembled (PU15000).

4.1.2 Assembly Details

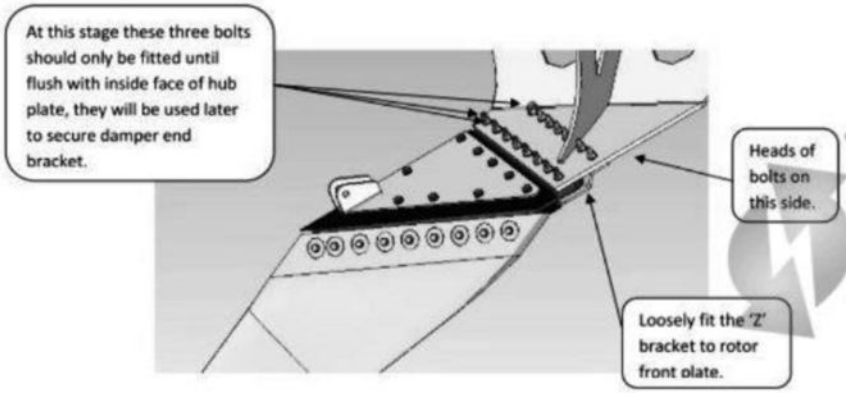


4.2 Fitting the blades.

At least two people are required to fit these blades.

In order to easily and correctly fit the blades to the turbine the turbine head should be winched up to a suitable working height, this is normally with the hub at about chest height. After doing this you should brace the tower in this position raised position for added safety.

- Fit blade clamp plate to the front (outside) face of the rotor plate with supplied M12 x 80 mm bolts (heads of bolts should be on outside face of rotor plates). Tighten the bolts enough to close the gap between the clamp plate and the rotor plate. Remember to leave enough space to fit the blade and the two plastic washers in the gap.



- Lift blade up into position and insert the edge of the hinge into the clamp plate. Ensure you have the blade in the correct orientation – as you offer up the blade **the leading edge should be in your left hand and the trailing in your right.** Remember to insert a plastic washer either side, top and bottom of the hinge and inside the clamp plate.

- Use a screwdriver or similar to help align the hinge holes with the holes in the rotor plate. Start inserting the M12 x 80mm bolts from the front side of the hub through the hinge and the plastic washers. Secure with Nyloc nut and some thread lock liquid.

- The two M12 and the single M16 bolts shown above should be fitted through the front hub plate and hinge but left flush with the inside edge of rotor plate. These will be used later to secure the damper assembly.

- With the exception of the two M12 bolts and the M16 bolts detailed above, all of the other M12 bolts can be tightened up fully to a torque of 90 Nm. Use thread lock liquid on all bolts.

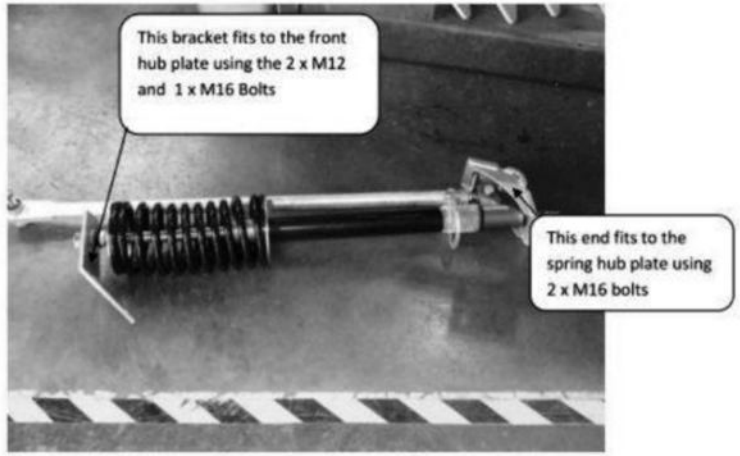
- Complete above procedure for the other two blades.

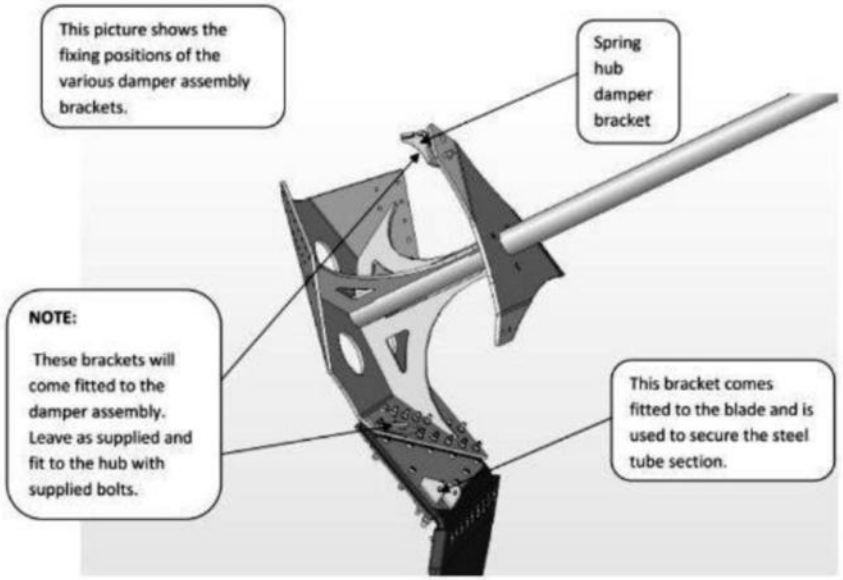
4.3 Fitting the dampers

4.3.1 Damper Assembly Details.

The dampers come with the fixing brackets loosely fitted and should have required fixing bolts attached.

Damper assemblies are supplied with the solid rod attached as shown below.

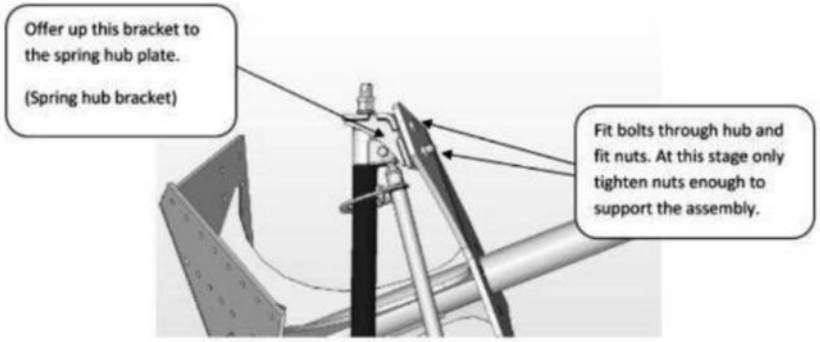




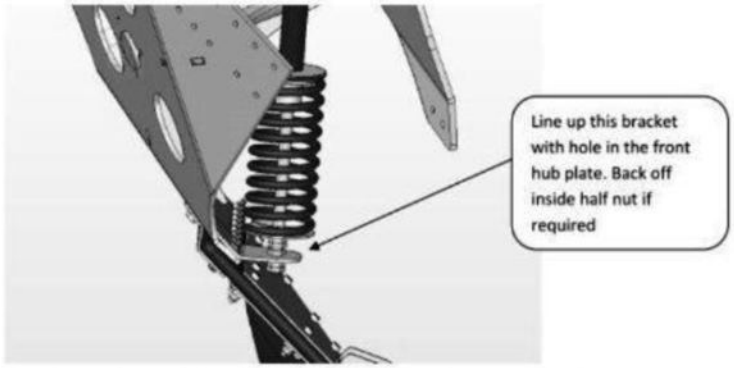
4.3.2 – Fitting the damper assembly to the hub.

Caution the damper units are heavy!

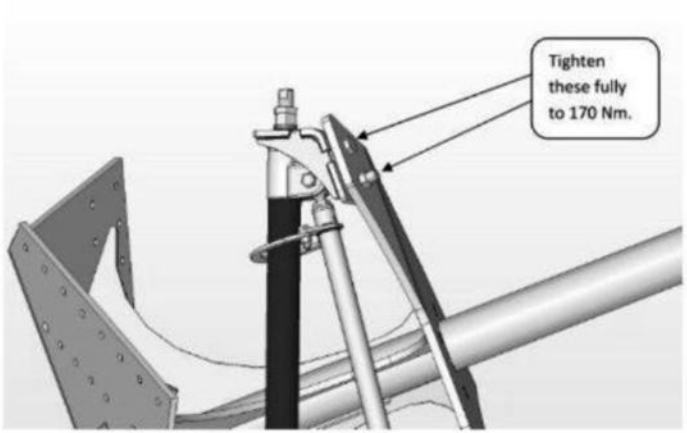
- Present the damper assembly to the hub – line up the spring hub bracket with the two holes in the spring hub plate.
- Fit two M16 bolts through the bracket and the spring hub plate – fit nyloc nut enough only to support the damper assembly at this stage. Note that back bolt goes down the way and front bolt goes up the way as shown below.



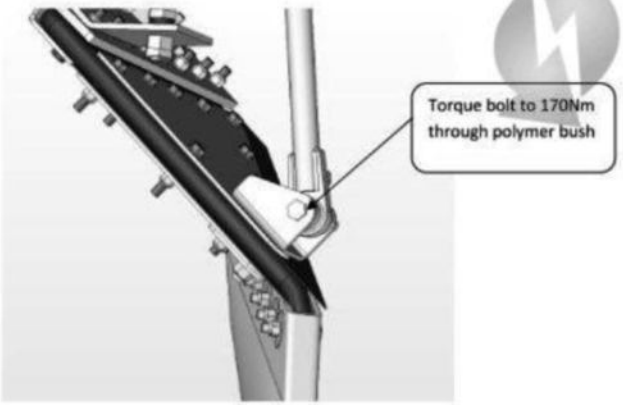
- Line up the other end of the damper assembly with the holes in the front hub plate – 3 holes 2 x M12 and 1 x M16.



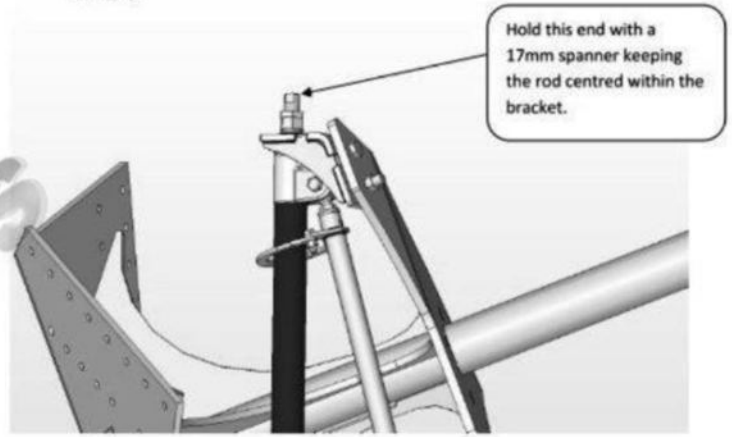
- Push home the 2 x M12 and M16 bolt through the clamp plate, hub, hinge and damper bracket. Note the single half-nut inside the bracket may require to be backed off a few mm to allow correct alignment. Secure M12 and M16 bolts with thread lock and nyloc nuts supplied. Torque bolts fully: **M16 to 170Nm and M12 to 90Nm.**
- Go back to the spring hub bracket end and loosen back the M22 half nut and then the M22 full nut for one full turn to allow the spherical washers to align freely. The spring hub bracket can now be tightened up fully against the spring hub plate. Torque the M16 bolts fully to 170Nm.

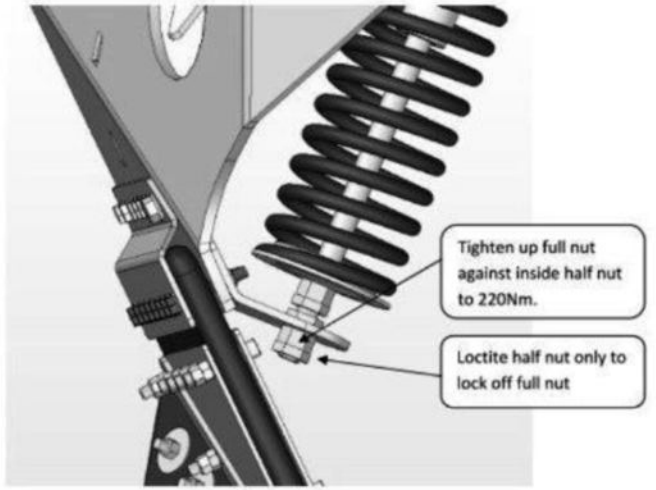


- At the hinge end, fit polymer bush end of rod to bracket on hinge with M16 bolt, torque to 170Nm including thread lock



- Thread the single half-nut inside the damper front hub bracket so that it is tight to the bracket.
- You now need the second person to hold a 17mm spanner at the spring hub bracket end to centre the damper rod within the bracket while you thread down and tighten up the other end full M22 nut to 220Nm torque.
- Tighten the **lock nut** against the full nut **using thread lock** to lock in place securely.





- Repeat above procedure for the spring hub bracket end. This time tighten the full nut up to the plate at 220Nm torque and then lock half nut against the full nut using Loctite on the half nut only.

- Repeat above procedure for the other two damper assemblies.
  Remember to use thread lock only where detailed.

The blade and damper assemblies should now be fully fitted.

You should now check all blade and damper assemblies are correctly assembled and tightened to correct torque values.

You should also check that there are no tools or equipment left resting on the hub.

4.4 Raising the Turbine.

Caution!

- Keep brake fully engaged (ON) throughout till turbine is ready to be commissioned.
- Clear lifting area of all non-essential personnel. Do not allow any non-essential personnel to be in the vicinity of the wind turbine whilst raising and lowering.

4.4.1. Methods for raising the turbine

The only recommended method for raising and lowering of the turbine is using a pulley system and a manual or hydraulic winch.

4.4.2. Pulley system and winch (manual or hydraulic).

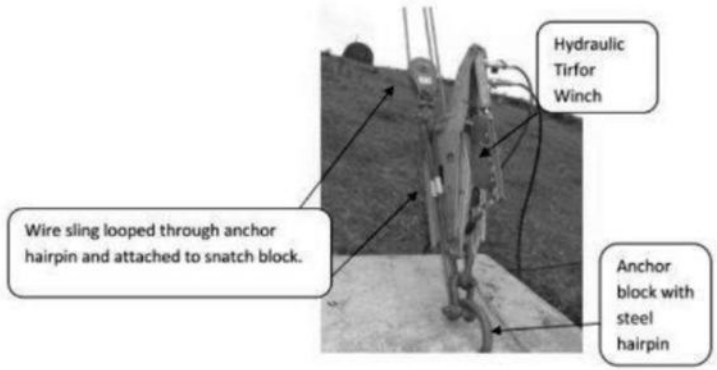
Requirements:

- 1 x 3.2t hydraulic Tirfor or similar rated manual winch.
- 60m Tirfor wire rope 16mm diameter with 3.25t shackle one end.
- 2 x 8t snatch blocks capable of taking the 16mm tirfor rope
- 4 x 5.75t bell end shackles with an opening of approx 60mm
- 1 x 3.6t wire sling approx 2m long.

Procedure

1) Connect the tirfor rope at the end of the gin poles using 5.75t shackle.

2) Loop wire sling through anchor pin and attach a snatch block to the sling.
3) Open snatch block and pass tirfor rope through the block close the block.



4) Attach 5.75t shackle and the other snatch block to the end of the gin pole.

5) Open snatch block and pass the tirfor rope through the block close the block.

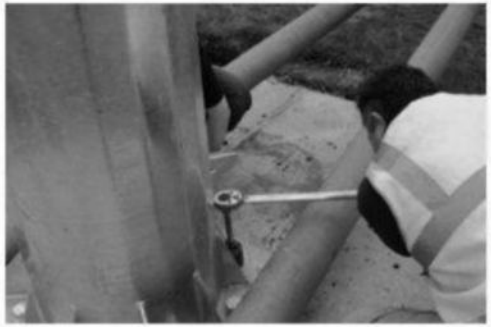
6) Pass the end of the tirfor rope through the tirfor pull through the excess rope.

7) Attach the tirfor to the anchor using the other two 5.75t shackles.

8) Lock off the tirfor ready for use and attach power pack!

9) Set the tirfor for raising the tower. Clean the top of the base plate, the underside of the tower flange ensuring there is no debris which can be trapped under the bolt head or between the tower flange and the base plate. Check that down and SWA cables will not be trapped under the mast.

10) Winch turbine assembly to upright position – keep rope tension at this point. Fit the tower flange bolts with spherical washers under the bolt heads. Use both parts of the spherical washers with the curved surfaces facing each other. Initially torque the tower flange bolts evenly to 200Nm. Use shims if there is a gap between the underside of the tower flange and the top of the base plate. (use 55mm socket and extension bar – see separate table for final bolt torque settings). Release tension on wire rope and remove pulley/wire rope from the lifting area. Dismantle gin pole assembly and wrap gin pole rope around the tower.



4.5 Lowering the Turbine

Caution!

Clear lifting area of all non-essential personnel. Do not allow anyone to be in the vicinity of the wind turbine whilst raising and lowering.

Procedure

- Apply wind turbine service brake. Place tressal to provide support for turbine when in lowered position.
- Fit gin pole and pulley assembly as for raising above. Check all shackles, bolts and fittings are secure – check again before lowering.
- Fit end of pulley rope to winch system as detailed earlier.
- Make sure hinge pin and its splits are in place.
- Loosen and remove tower base bolts
- Fit a hydraulic jack to the jacking point of the tower. Pay out a little rope and pump up jack to start tilting the tower.
- Lower the turbine using the winch system.

5.0 Wind Turbine Operation

Once installed and commissioned the Proven15 operates automatically.

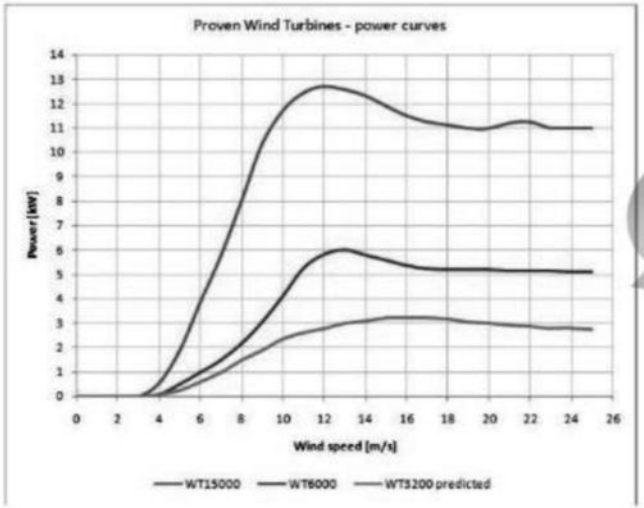
Power output will vary with wind speed according to the power curve.

5.1 Power Curve

The power curve is a graph that illustrates how the power output of the wind turbine varies with wind speeds. The power curve has been developed from collating a number of data logs obtained through standard testing procedures for a year.

Cut-in Wind Speed: Is that wind speed at which the wind transfers enough force to turn the rotor blades.

Start-up Wind Speed: Is that wind speed at which the turbine just begins to produce power. At start-up, the rotor blades turn fast enough and have adequate torque to enable the generation of power.



Although cut-in and start-up wind speeds are fairly close, they should not be mistaken to be the same.

5.1.1 Power output

The power output from the turbine can be determined from the meters installed on the panel of the wind turbine controller (rectifier box). This is done by multiplying the instantaneous voltage reading in Volts on the voltmeter and the instantaneous current reading in Amperes on the ammeter to obtain the instantaneous power in Watt. Note that 1 kilowatt (kW) = 1000 Watt (W).

5.2 Vibration

The turbine should run smoothly at all wind speeds. Any significant vibration of the turbine and tower assembly should be reported to Proven Energy and the turbine stopped.

5.3 Noise

Virtually every device with a moving part makes noise and turbines are no exception. The turbine noise is produced by swishing sound from the blades as they rotate in the wind and is generally proportional to the wind speed and turbulence level. Noise is measured in decibels (dB). The noise the wind turbine creates is expressed in terms of sound power level which is a measurement of the noise power emitted by the turbine.

Proven Wind turbines have low noise levels because they have no gearboxes which are a major source of turbine noise. For example at 5m/s the emitted noise level is 48 dB (A) It is perfectly normal to stand underneath the turbine and practically have a conversation without shouting. At the rated speed however i.e. the speed where the blades cone in to limit power output to rated; the noise level will increase slightly.

Other than that any non-air noise should be reported to Proven Energy.

6.0 Wind Turbine Maintenance

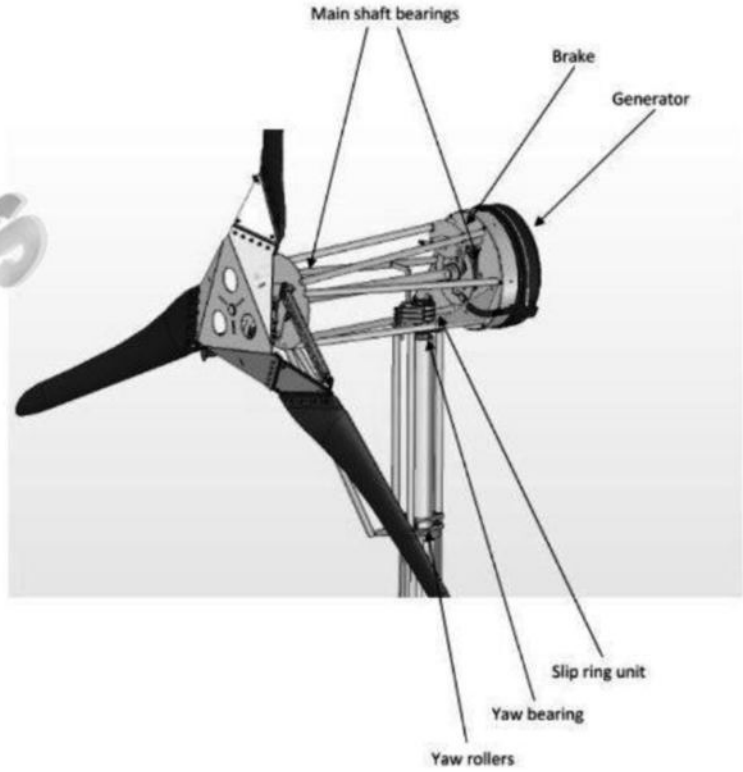
Your Proven 15, like all Proven Energy turbine models, requires minimal maintenance. We recommend an annual service and regular visual inspection to spot any unusual occurrence.

Annual Maintenance

- Lower wind turbine as described previously
- Grease main shaft bearings and the yaw bearing.
  1 or 2 pops is recommended.
  - Use water resistant Kluberquiet BHQ72-102 or equal on the yaw bearing and on the generator end main shaft bearing (NSK bearings)
  - Use lithium base NGLI2 or equal on the rotor end main shaft bearing (Dodge-type bearing)
- Clean slip-ring assembly with emery cloth
- Check flange bolts and tower base bolts for tightness
- Listen for any abnormal noises or excessive vibrations, if any exists check for possible loose fittings or components
- Check brake pad thickness is more than 2mm and replace if worn beyond 2mm
- Check brake operation before raising wind turbine
- Check for general wear and tear and replace any worn parts
- Pay particular attention to the blades, especially the blade root. A damaged or cracked blade should be repaired or replaced immediately.

Caution!
Any damaged or cracked blade should be repaired or replaced immediately.

6.1 Wind Turbine Maintenance Schematic



6.2 Wind Turbine Maintenance Schedule

TASK	TYPE OF SERVICE CHECK			
	INITIAL 3 MONTHS	QUARTERLY	ANNUALLY	10 YEARS AFTER
Check for smooth running	√	√	√	√
Check tower bolts	√	√	√	√
Check ph-ph voltage	√	-	√	√
Check brake operation	√	-	√	√
Check blades	√	-	√	√
Clean slip rings	-	-	√	√
Check slip ring brushes	-	-	√	√
Grease shaft bearings	-	-	√	√
Grease yaw bearing	-	-	√	√
Check covers	-	-	√	√
Check welds	-	-	√	√
Check springs	-	-	√	√
Change blades	-	-	-	√

6.3 Recommended Service Tools

Tools and equipment	Check
1. Large socket set with extension handle	
2. Sledge hammer	
3. Stainless steel shim strip	
4. Tressal	
5. Gin pole & bolts	
6. Fixings, screws & rawplugs	
7. Electric drill & extension	
8. Large crimping tool	
9. Small crimping tool	
10. Selection of crimps	
11. Snips	
12. Wire Strippers	
13. Pliers	
14. Knife	
15. Threadlocking compound (Loctite 577 or equal)	
16. Shifting spanners	
17. Ratchet & socket	
18. Spanners (all sizes)	
19. Screwdrivers	
20. Allen keys (all sizes)	
21. Cable ties	
22. Cable clips	
23. Silicone sealant	
24. Sealant gun	
25. Electrical test meter	
26. Safety glasses	
27. Safety goggles (batteries)	
28. Gloves	
29. Insulation tape	
30. Fuses & relays	
31. Tower door key	
32. Spare hinge & split pins	
33. Spare nuts & bolts	
34. Spare washers	
35. Grease gun(s) with recommended grease(s)	

6.4 Maintenance Check List

KEY:

- X = Check
- C = Clean
- G = Grease
- R = Replace if need be
- A = Adjust if need be

TOWER / BASE			
1 GENERAL CONDITION	X		
2 FOUNDATIONS	X		
3 NUT / BOLT TIGHTNESS	X	A	
4 S/S SHIM	X	A	
5 WELDS / FILLETS	X		
6 HINGE BOLTS	X		
7 GIN POLE ASSEMBLY	X		
SLIP RING ASSEMBLY			
8 SLIP RING CONNECTIONS	X		
9 SLIP RING BODY	X	C	
10 SLIP RING BRUSHES	X	A	R
11 TOPHAT	X		
12 NUT / BOLT TIGHTNESS	X	A	
13 CABLE GUIDE	X		
BLADES & SPRINGS			
14 BLADE CONDITION	X		
15 P.U. HINGES	X		
16 BLADE FIXINGS	X		
17 DAMPER FIXINGS	X		
18 DAMPER CONDITION	X		
19 NUT / BOLT TIGHTNESS	X	A	
20 WASHERS / CLAMPS	X		

BRAKE SYSTEM			
21 BRAKE ASSEMBLY PARTS	X		
22 BRAKE OPERATION	X		
23 BRAKE PADS	X	R	
24 SHACKLES / SWIVEL	X		
25 BRAKE ROPE CONDITION	X	R	
26 BRAKE WINCH	X		
ELECTRICAL SYSTEM			
27 CONTROLLER OPERATION	X		
28 V & I METER OPERATION	X		
29 CABLE CONNECTIONS	X	A	
30 CONDITION OF WIRING	X		
31 INVERTER CONNECTIONS	X		
COVERS & OTHER CHECKS			
32 YAW COVER CONDITION	X		
33 NACELLE COVER CONDITION	X		
34 CABLE TIES	X	R	
35 MAIN SHAFT AND YAW BEARINGS	X	G	

6.5 Recommended Spares

- Set (3) of turbine blades with PU hinge & fixings
- Set (4) of yaw rollers with fixings
- Set (3) of dampers with solid rods
- Set (4) of brake pads
- Slip ring with brushes and fixings

Caution!
Any damaged or cracked blade should be repaired or replaced immediately.

7.0 Trouble shooting

Problem	Possible Cause(s)	Diagnosis	Remedy
Louder than quoted noise level	- Loose fittings or components	- Check to see if all fittings and components are tightly fitted - Check for components rubbing	- Tighten loose fittings or components
Turbine fails to turn in good wind	- Shorted cables - Shorted diodes - Failed bearings - Foreign object in generator - Brake on - Shorted generator	- Check connections - Visually inspect generator through vents - Remove tower door to check brake - Check ph–ph voltage & resistances across the phases	- Repair short circuit - Replace faulty diodes - Replace bearings - Remove obstruction - Release brake - Replace generator core
Turbine turns slowly in good wind	- Partial short in cables - Diode short	- Check connections	- Repair short circuit - Replace diode
Low output	- Low wind speeds - Obstructions around turbine - High power usage	- Measure wind speed - Check siting of turbine - Check power usage	- Site turbine in a better location or height - Economise power use
Turbine vibrates excessively	- Blades incorrectly fitted or out of balance - Damper failure -Yaw bearing or yaw roller worn	- Check blade fittings - Check dampers - Check yaw bearing - Check yaw rollers	- Fix blade properly and balanced - Replace damper(s) - Replace yaw bearing - Replace yaw rollers
No output though turbine turns in high wind speed	- Cables disconnected - Controller ammeter open circuit	- Check connections	- Fix cables - Replace meter
Turbine free wheeling	- Inverter(s) disconnected	- Check fault code on the inverter(s)	- Refer to inverter manual for recommend solution

8.0 Appendices

Appendix A: Electrical Schematic Drawings

Appendix B: Proven Warranty Statement

Appendix C: Delivery, Storage and Handling of Proven Wind Turbines

Appendix D: Bolt torque table

Appendix A

Electrical Schematic Drawings

PROVEN 15 INSTALLATION USING THREE WINDY BOY 6000

PROVEN PARAMETER SETUP LIST (UK) FOR WINDY BOY 6000

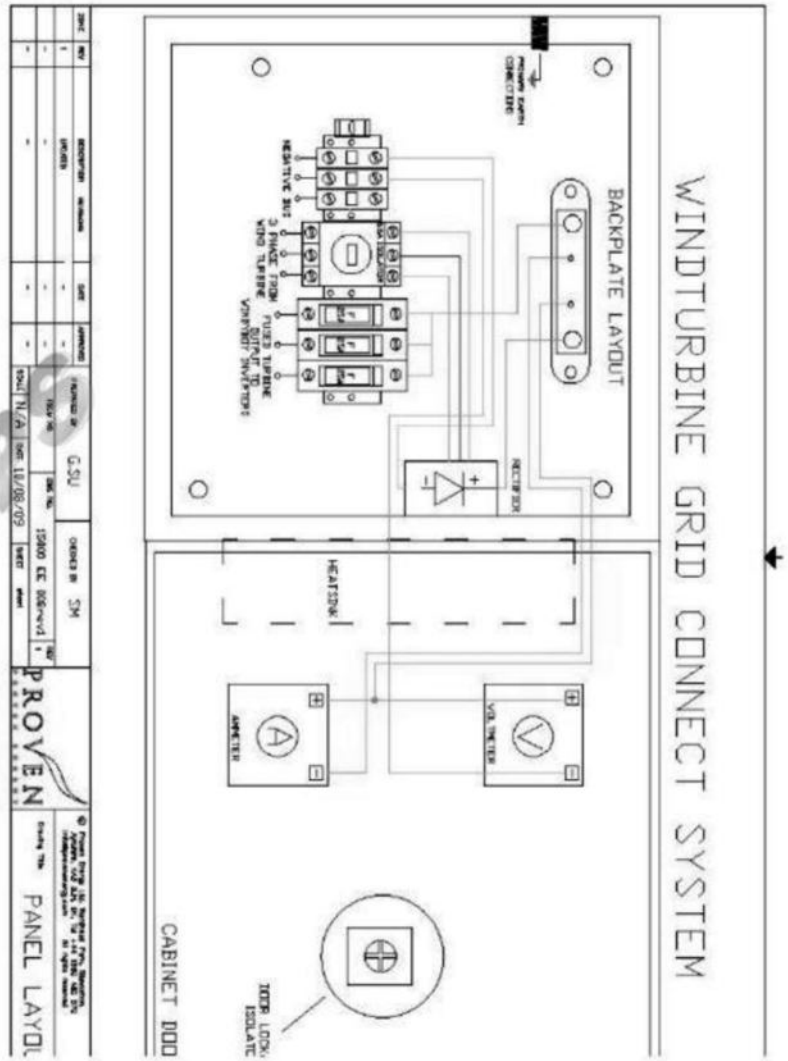
INVERTER SERIAL No. _____

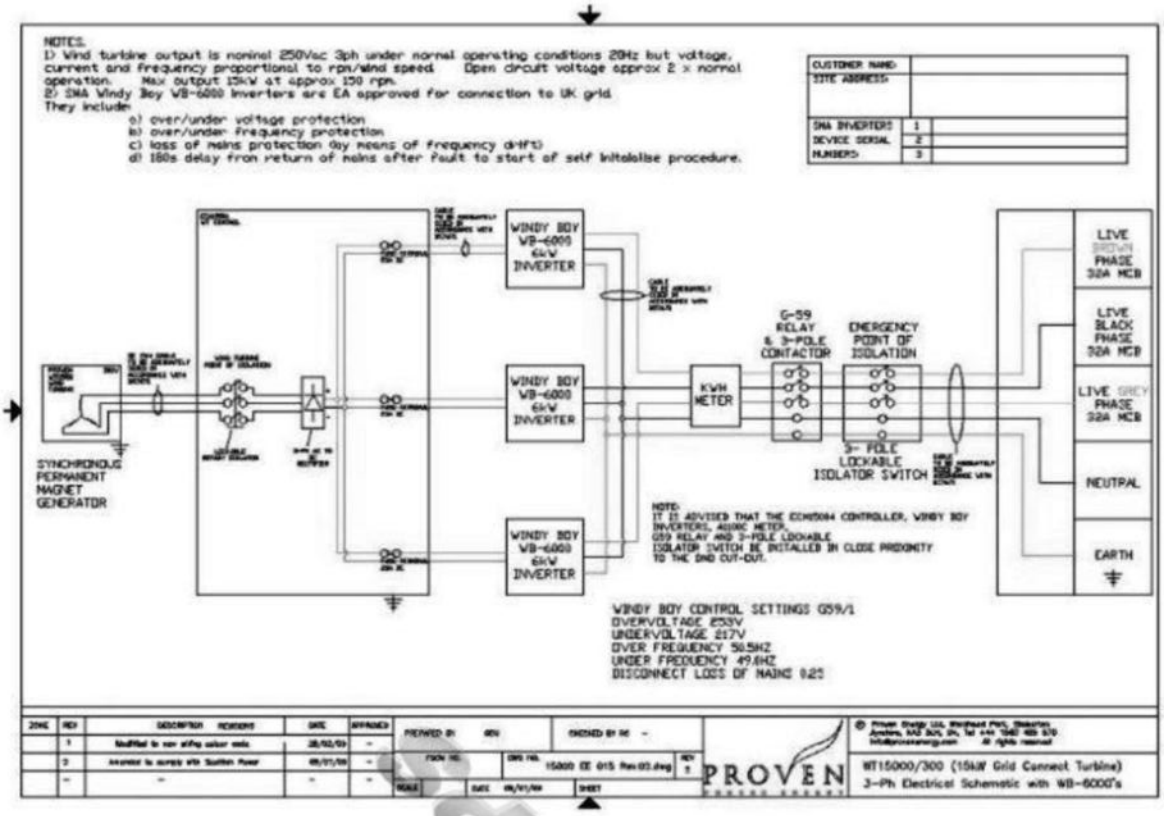
CUSTOMER NAME: _____

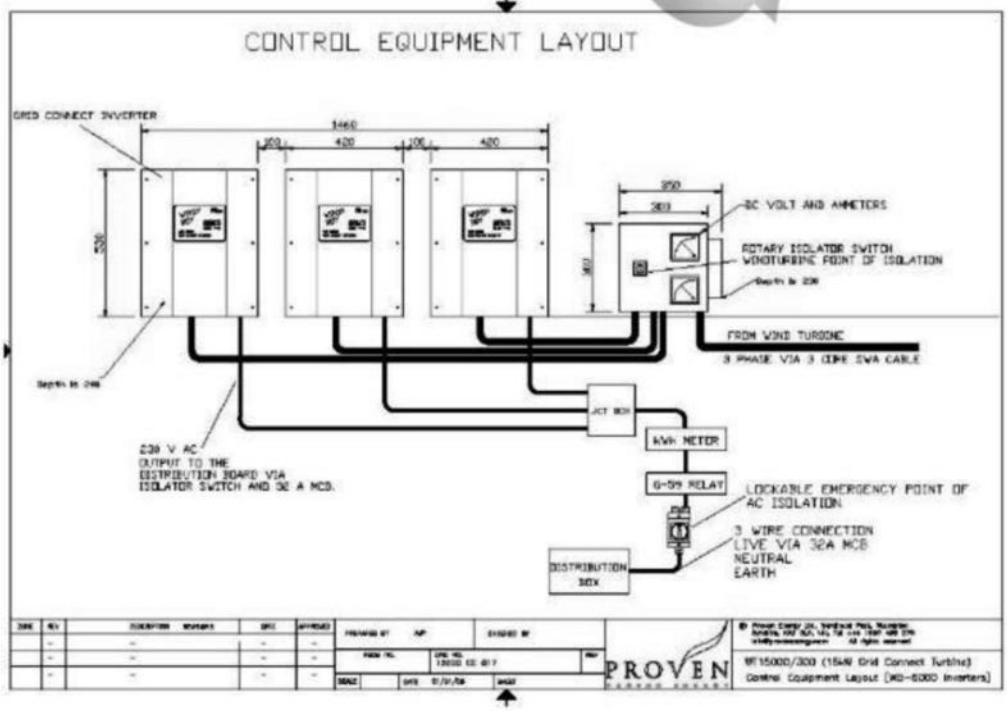
INSTALLER NAME: _____

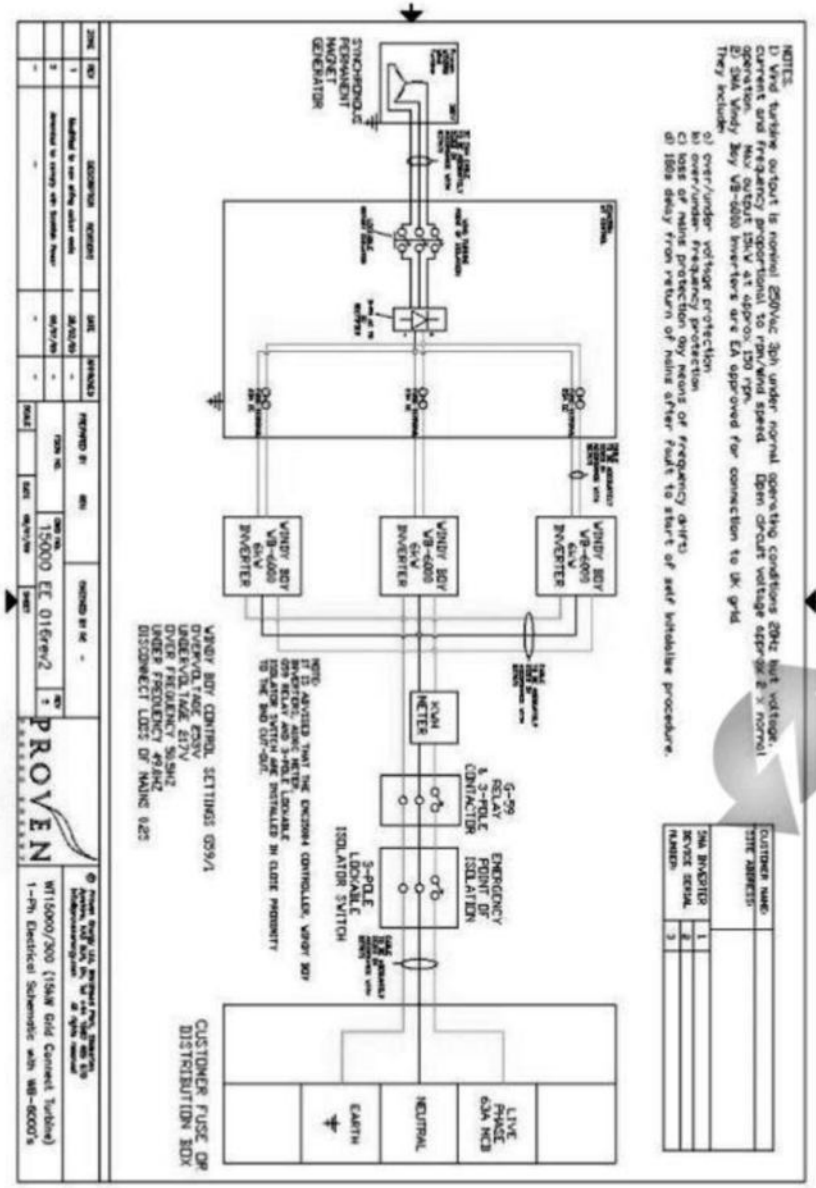
PARAMETER	VALUE		
	INVERTER 1	**INVERTER 2**	**INVERTER 3**
Upv - Start	250.000v	250.000v	250.000v
T - Start	180.000 s	180.000 s	180.000 s
T - Stop	300.000 s	300.000 s	300.000 s
Usoll-Konst	600.000 v	600.000 v	600.000 v
P Limit	6000 W	6000 W	6000 W
I-NI TEST	0.00mA	0.00mA	0.00mA
Uac - Min	209.000 v	209.000 v	209.000 v
Uac - Max	264.000 v	264.000 v	264.000 v
AcVtgRPro	263.00 v	263.00 v	263.00 v
Vac-Tavg	80.000ms	80.000ms	80.000ms
Fac - Delta -	3 Hz	3 Hz	3 Hz
Fac - Delta +	0.5 Hz	0.5 Hz	0.5 Hz
Fac-Tavg	80.000ms	80.000ms	80.000ms
dFac - Max	0.25 Hz/s	0.25 Hz/s	0.25 Hz/s
dZac - Max	350.0 mOhm	350.0 mOhm	350.0 mOhm
Hardware - BFS 1.00 Version			
Software - BFR 2.550 Version			
Software - SRR 2.550 Version			
INST CODE	INSTALLER	INSTALLER	INSTALLER
Udc Wind Start	260.000v	260.000v	260.000v
Udc Wind Mid	300.000V	300.000V	300.000V
Udc Wind Max	320.000v	320.000v	320.000v
KP-Wind Reg	0.015	0.015	0.015
KI-Wind Reg	0.005	0.005	0.005
Fac-Start delta	1.000Hz	1.000Hz	1.000Hz
FacLimit delta	2.000Hz	2.000Hz	2.000Hz
T-Stop-Fan	50.000grdC	50.000grdC	50.000grdC
T-Start-Fan	70.000grdC	70.000grdC	70.000grdC
T-Max-Fan	90.000grdC	90.000grdC	90.000grdC
Fac-Test	0	0	0
P-Wind-Ramp	1000.000W	1000.000W	1000.000W
P-Wind-Mid	3000.000W	3000.000W	3000.000W
Betriebsart	Turbine	Turbine	Turbine
Memory Function	Keine Function	Keine Function	Keine Function
*Default	GB / G83	GB / G83	GB / G83
Storage	Permanent	Permanent	Permanent

* Please change the Default setting to GB/G83 before proceeding to change the rest of the parameters

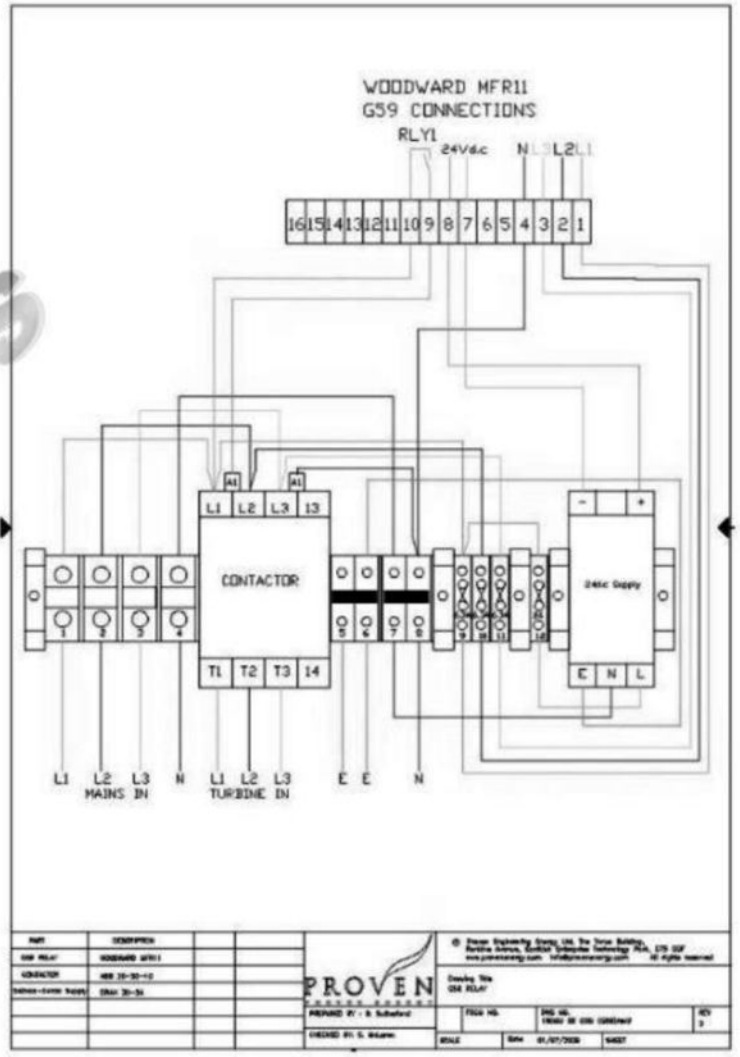



NOTES.
1) Wind turbine output is nominal 250Vac 3ph under normal operating conditions 20Hz but voltage, current and frequency proportional to rpm/wind speed. Open circuit voltage approx 2 x normal operation. Max output 15kW at approx 150 rpm.
2) SMA Windy Boy WB-6000 inverters are EA approved for connection to UK grid. They include:
a) over/under voltage protection
b) over/under frequency protection
c) loss of mains protection (by means of frequency drift)
d) 180s delay from return of mains after fault to start of self initialise procedure.
CUSTOMER NAME:
SITE ADDRESS:
SMA INVERTERS SERIAL NUMBERS: 1 2 3
WINDY BOY WB-6000 6kW INVERTER
WINDY BOY WB-6000 6kW INVERTER
WINDY BOY WB-6000 6kW INVERTER
SYNCHRONOUS PERMANENT MAGNET GENERATOR
KWH METER
G-59 RELAY & 3-POLE CONTACTOR
EMERGENCY POINT OF ISOLATION
3- POLE LOCKABLE ISOLATOR SWITCH
LIVE BROWN PHASE 32A MCB
LIVE BLACK PHASE 32A MCB
LIVE GREY PHASE 32A MCB
NEUTRAL
EARTH
NOTE:
IT IS ADVISED THAT THE ECM5094 CONTROLLER, WINDY BOY INVERTERS, 4010NC METER, G59 RELAY AND 3-POLE LOCKABLE ISOLATOR SWITCH BE INSTALLED IN CLOSE PROXIMITY TO THE DNO CUT-OUT.
WINDY BOY CONTROL SETTINGS G59/1
OVERVOLTAGE 253V
UNDERVOLTAGE 217V
OVER FREQUENCY 50.5HZ
UNDER FREQUENCY 49.6HZ
DISCONNECT LOSS OF MAINS 0.2S
PROVEN
WT15000/300 (15kW Grid Connect Turbine)
3-Ph Electrical Schematic with WB-6000's


CONTROL EQUIPMENT LAYOUT
GRID CONNECT INVERTER
1460
420
420
DC VOLT AND AMMETERS
ROTARY ISOLATOR SWITCH W/TURBINE POINT OF ISOLATION
FROM WIND TURBINE
3 PHASE VIA 3 CORE SWA CABLE
JCT BOX
kWh METER
G-59 RELAY
LOCKABLE EMERGENCY POINT OF AC ISOLATION
3 WIRE CONNECTION
LIVE VIA 32A MCB
NEUTRAL
EARTH
DISTRIBUTION BOX
230 V AC OUTPUT TO THE DISTRIBUTION BOARD VIA ISOLATOR SWITCH AND 32 A MCB.
PROVEN
WT15000/300 (15kW Grid Connect Turbine)
Control Equipment Layout (WB-6000 Inverters)



G59 Relay schematic drawing (where applicable)



Appendix B

Proven Warranty Statement

Proven Energy Universal Warranty

PROVEN ENERGY

Products designed and manufactured by Proven Energy Limited ("Proven") or its sub-contractors acting under its control are carefully designed, manufactured, tested and inspected. In consequence we undertake to replace any part found to be defective in material or workmanship free of charge for a period of five years from installation date on the terms set out below. This warranty applies only to those products designed and manufactured by Proven or its sub-contractors acting under its control and supplied by Proven or its authorised re-sellers and does not apply to parts and materials sourced from suppliers other than Proven and its authorised re-sellers (even if supplied with Proven products), nor does it apply to any element of installation, responsibility for which rests solely with the installer.

Warranty

Subject to the terms set out below, Proven warrants to any end-user who purchases new products designed and manufactured by Proven or its sub-contractors acting under its control from Proven or from an authorised Proven re-seller (but not from another end-user) that such products will be free from defect in material or workmanship in normal use for a period of five years from installation date (the "Warranty Period").

If a defect arises and a valid claim is received within the Warranty Period, at its option and to the extent permitted by law Proven shall either (1) repair the defect at no charge, using new or refurbished replacement parts or (2) exchange the product with a product that is new or which has been manufactured using new or serviceable used parts or (3) refund the purchase price or a reasonable proportion of the purchase price.

A replacement product or part, including an end-user-installable part that has been installed in accordance with instructions provided by Proven, assumes the remaining Warranty Period of the original product or one (1) year from the date of replacement or repair, whichever provides longer coverage for the end-user.

When a product or part is exchanged, any replacement item becomes the end-user's property and the replaced item becomes Proven's property. Parts provided by Proven in fulfilment of its warranty obligation must be used in products for which warranty service is claimed. When a refund is given, the product for which the refund is provided must be returned to Proven and becomes Proven's property.

Exclusions:

This warranty does not cover damage to Proven products resulting from:

- Improper transportation or storage of products prior to installation
- Unauthorised alteration or modification of the products
- Misuse of the products.
- Improper installation of any kind (see below concerning use of Proven wind turbines with mast or towers manufactured by others).
- Improper operation.
- Failure to conduct periodic inspections and maintenance.
- Damage caused by flying debris, bird strike, lightning or other unforeseen acts.
- Damage occurring during periods of wind speeds exceeding 70m/s for the 2.5kW and 6kW turbines
- Damage occurring during periods of wind speeds exceeding 54m/s for the 15kW turbine
- Acts of God.
- Reasonable wear and tear.

This warranty does not apply to:

- consumable items unless damage is caused to them due to defects in materials or workmanship, or
- cosmetic damage of any kind.

Conditions:

Unless we confirm otherwise in writing, this warranty may only be enforced by the party who purchased the relevant products new from Proven or from an authorised Proven re-seller and not by any party who acquired the relevant products from a third party after the date of first installation of the relevant products.

For this warranty to apply:

- Proven's wind turbine and associated equipment must be installed only by individuals who have each attended a Proven training course for the installation of the turbine and equipment in question.
- Proven's wind turbine must be connected in a manner that meets the relevant national electrical code requirements of the installation country and must be installed by an electrician properly licensed under the legal and regulatory requirements of the installation country.
- The warranty must be registered in the manner set out below.

Warranty registration:

To register the warranty, Proven requires the following details to be submitted within one calendar month of the time of installation:

- Date of installation with full site address and contact details, including email.
- Full details of system installed along with tower installed and electrical schematic drawings.
- List of device(s) under warranty with the serial number(s) if present.
- Digital photographs of the turbine and tower installed including panoramic view of site.
- Digital photographs of the electrical installation.
- Name and address of installer.
- Name and address of supplier of Proven equipment (if different from installer).

Ideally, registration will take place via the Proven web site, www.provenenergy.com but otherwise the required documentation, using the postcard provided with the relevant products, should be sent to Proven at the headquarters address shown on that web site.

Proven will use all reasonable endeavours to contact the end-user within a month of receiving the registration details, using the contact details provided by the end-user, to confirm warranty cover and/or to ask for clarification or for additional or missing details to be provided.

Use of Proven Wind Turbines with Mast or Towers manufactured by others:

Poor mast or tower design may cause vibration and/or failure both in the mast and the wind turbine. Faults arising from poor mast design shall be classed as improper installation. Where a Proven wind turbine has been used with a non-Proven mast or tower, the onus shall lie with the owner to show their mast or tower has not caused the fault.

Shipping and Transport Costs:

Where practical, warranty repairs will be made at the installation site. Where this is not practical, repairs will be made at the premises of Proven Authorised Representatives or our factory. The end user or installer must return the defective component(s) properly packed, and with all freight and insurance charges prepaid. No goods must be returned without first obtaining a returns authority and number from Proven. All freight, shipping and insurance costs including duties, taxes and import charges incurred in returning Proven products are to be met by end user.

Labo(u)r Costs:

Where a repair is being carried out under the terms of this warranty by someone other than Proven itself, the cost for such repair must be agreed, in writing, with Proven before work commences and under no account will Proven accept charges for work in excess of the cost as agreed, or other than that strictly required to effect the repair.

Disclaimer:

Proven shall not be liable for any incidental or consequential damages resulting from the proper or improper use, for any purpose whatsoever, of Proven products. For the avoidance of doubt, Proven will not be liable for costs, directly or indirectly associated with any loss of production caused through product failures covered under this, or any other, warranty.

Statutory rights and limitations:

This warranty in no way diminishes the end user's statutory or legal rights.

This warranty gives the end user specific legal rights, and the end user may also have other statutory rights, which vary from country to country.

Proven's responsibility for defects is limited to the repair or replacement service as determined by Proven.

All express and implied warranties, including but not limited to any implied warranties and conditions of merchantability and fitness for a particular purpose, are limited in time to the term of this limited warranty.

Save to the extent permitted by law no warranties, whether express or implied, will apply after the expiration of the limited Warranty Period.

No Proven reseller, agent, or employee is authorized to make any modification, extension, or addition to this warranty.

If any term is held to be illegal or unenforceable, the legality or enforceability of the remaining terms shall not be affected or impaired.

Except as provided in this warranty and to the extent permitted by law, Proven is not responsible for direct, special, incidental or consequential damages resulting from any breach of warranty or condition, or under any other legal theory, including but not limited to loss of use; loss of revenue; loss of actual or anticipated profits (including loss of profits on contracts); loss of the use of money; loss of anticipated savings; loss of business; loss of opportunity; loss of goodwill; loss of reputation; loss of, damage to or corruption of data; or any indirect or consequential loss or damage howsoever caused including the replacement of equipment and property.

The foregoing limitation shall not apply to death or personal injury claims, or any statutory liability for intentional and gross negligent acts and/or omissions.

Some countries do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation may not apply to the end user.

Actions in the Event of a Defect Occurring During Warranty Period:

In the unlikely event of a defect arising, **first ensure the safety of people and equipment by electrical disconnection and application of the wind turbine brake, as appropriate.** Please notify the supplier of your Proven equipment immediately who will advise on the correct procedure for making a claim under this warranty.

Minor Faults:

If the fault is a minor one and can be rectified by replacing components which could be simply fitted by the end user or installer, then a replacement part will be sent as soon as possible by post or courier. Proven will meet the costs of postage or courier in the event that the warranty claim is valid.

Serious Faults:

In the unlikely event of a serious fault, Proven or a Proven Authorised Reseller will arrange for an engineer to attend the site, if required, and rectify the fault. The work will be charged at standard rates if the conditions of the Proven Warranty as set out above do not apply.

If it is not practical to correct the fault at the installation site, the defective components must be returned to Proven or Proven's authorised representative on the basis set out above under the heading "Shipping and Transport Costs".

Appendix C

Delivery, Storage and Handling of Proven Wind Turbines

PROVEN ENERGY

Delivery, Storage and Handling of Proven wind turbines

1. Delivery

Before delivery, Proven wind turbine and its various components should be protected to ensure the components remain in good condition until they are ready for installation. All materials for delivery should be verified against the delivery document. All required accessories should be delivered together with the main components (excluding the foundation kit which should be delivered prior to the wind turbine shipment). Materials could be packed in either wood pallets or wood/carton boxes. Upon delivery on site, the materials should be checked for damages during transportation and that the delivered materials are in compliance with the specifications. Any damaged or incorrect materials should be returned to Proven Energy.

2. Storage

Delivery of materials should be carefully planned according to the installation schedule as to minimise the storage time on site where the possibility of damages is higher. Proper site storage is important in preventing damages to the Proven wind turbine and it's components. A suitable storage location should be:

- sheltered from weathering and fallen objects; and
- located for ease of material handling and movement.

Components should be placed so that there is no direct contact with the ground. In addition, the various components should be arranged according to the installation sequence to facilitate ease of retrieval, i.e. to minimise searching and unnecessary shifting of materials which may lead to damages. For ease of installation all blades with PU hinges should be stored away from direct sunlight to avoid thermal expansion of the hinge.

3. Handling

All handling should be performed in accordance with the Proven wind turbine installation manual using only approved lifting equipment and slings suitable for the load. Exceptional care should be given to the blades – especially the leading and trailing edges of the airfoil. Even minor dents can cause a noise issue when the turbine is operational.

Appendix D

Bolt Torque Table

PROVEN ENERGY

Foundation Bolt Torques Nm

Size	Grade	
Medium viscosity oil	8.8	10.9
M20	320	460
M24	550	800
M30	1100	1600
M36	1900	2750