Chinese Wind Turbine Manual MK1 and MK2
Supplied and Modified by EcoInnovation

In normal conditions

Furling in strong winds

Introduction:

The Chinese wind turbine is a battery charging wind generator designed to supply power for light duty electrical requirements in remote areas.

It is not intended as a sole source of power in a Renewable Energy system but should be used in conjunction with Photovoltaic panels (PV) and/or hydroelectric

generation. This turbine is mass-produced in China. Replacement parts are therefore plentiful and cost effective to purchase from EcoInnovation. We have made a number of alterations that include:

- Vast improvement in blade retention
- Balancing the prop
- Reconnecting the generator for 12, 24 or 48 volt operation
- Fitting slip rings or improving them for the MK2 version
- Fitting a rectifier
- Fitting Nylocs to the generator fixings
- Improving blade retention
- Improve blade noise reduction by re-profiling blade and sanding smooth

EcoInnovation is moving away from the MK1 version and no longer sell this model. However, the MK1 version is still so popular around the world that we have written this manual with both in mind.

Please note that the Smart 500 and Smart 800 range of turbines from EcoInnovation use the MK1 turbine as the base. The Smart range are power by F&P Smart Drive PMG's that have a greater conversion efficiency and electronic controlled load stepping to give much better performance in both light and strong winds. This does add to the cost.

The Mk1 version is as pictured on the front cover, the MK2 version is shown below.

MK2 turbine

Installation:

It should take no more that one day for two people to erect this turbine on an EcoInnovation kit set tower. **Please read this manual carefully before beginning installation.**

Many home owners attempting to install a renewable energy system themselves for the first time can and often do make some fairly serious connection errors.

EcoInnovation runs courses to assist with the connection of this equipment. **If you or a third party install this equipment incorrectly and in doing so damage this or other equipment in your system EcoInnovation will not be liable.**

If you are not happy with this condition then please either engage EcoInnovation to install the equipment.

Common mistakes include (but are not limited to):

- **Working on the system and removing wires while the turbine is in operation (a potentially life threatening error)**
- Connecting wind turbine to a solar regulator not designed for a wind turbine
- Connecting the wind turbine polarity in reverse (this normally destroys the rectifier)
- Connecting the turbine to the inverter lead and then removing the battery and regulator fuses, this result is a high voltage input to the inverter and will damage it
- Not checking that the regulator is working correctly prior to leaving the site
- Installing a regulator that is too small or one that does not work and not knowing how to determine if the regulator is working

Voltage in a battery inverter system:

Primarily your battery bank and its state of charge controls battery voltage. You should always connect a wind turbine directly to your battery bank. The battery bank will clamp the output voltage of the wind turbine to be the same as the battery bank. As the battery bank charges, the voltage of the battery bank will gradually lift until it reaches fully charged. Your regulator will now start to divert surplus energy not required to a resistive element.

Solar PV regulators work by switching the PV panels on and off to control the amount of incoming energy. If this were done with a wind turbine, the removal of the electrical load would result in a freely spinning turbine, which would accelerate to the point that mechanical failure would occur and/or high voltage output would destroy most solar PV regulators. Therefore, do not consider doing this.

If you take a wind turbine designed for a 24-volt battery system and connect it to a 12-volt battery system the only outcome will be a slow running wind turbine with a stalled blade that will perform poorly.

Generally speaking you are allowed, under electrical regulations, to work on

systems up to 50-volts without qualifications. If you disconnect a wind turbine from the battery in strong winds the voltage will no longer be clamped by the batteries and can increase 5-10 times higher than normal. This is potentially very dangerous. Never disconnect a wind turbine from the battery bank while it is going.

The blades:

The blades are "pulltruded" (pull-extruded) fiberglass of constant pitch manufactured in China. Constant pitch blades are less efficient though they do provide much more starting torque out at the blade tips, this results in a wind turbine that will start in very light winds. As the blade speed rarely gets above 600 rpm there is no need for expensive leading edge tape to protect the blades. The lower tip speed means that erosion of the blade tips (even in strong winds and hail) is a very slow process.

The basic design philosophy behind the Chinese turbine is to have large blades driving a small permanent magnet generator, this results in a wind turbine that performs well in light to medium winds but will not perform well in stronger winds. Winds above 30 km/h are very rare where most people tend to live. The turbine will be running most of the time in low wind speeds (15-20 km/hr).

Replacement blades are not expensive. For original purchases of the turbine the blades are currently $120 per set. The blades should provide many years of service before they need replacing. Blades should be inspected annually and replaced if they show any sign of degradation or cracking near blades fixings. In all cases blades should be replaced every 3-years to minimize the risk of a blade failure. The bolts that secure the blades into the cast iron hub should be tight; thread locking fluid should be used to ensure the fixings cannot work loose. All threads should have either Nylocs fitted or thread locking compound applied.

The hub:

The blade and hub assembly has been balanced by EcoInnovation. You will notice on the front of the hub a balance weights, which consists of a number of washers. Ensure these remain is the same place... You will also notice that each blade is numbered and must be assembled into the correct numbered position. This will ensure good balance is maintained. After running the turbine for a time the numbers will fade, remember to re-number the blades before removing them from the hub.

Same for MK1 and MK2

This picture is for the MK1

The hub – blade retention issues:

After early testing of this turbine 3 years ago it was found that the blade tended to work loose so we advised customer to silicon the blades onto the cast hub.

This solution worked is all but a few cases where we experienced blade failure with the blade pulling out of the fixings. We are unsure as to why this has happened but in most cases it has occurred:

- Soon after installation
- In strong winds
- Insufficient silicon has been used of dubious quality
- Balancing has not been close to perfect

In order to solve the above issues of blade retention we now advise that the blade has to be attached with 5 fixings instead of the normal 4 and that a blade retention plate is used on top of the blade and that both sides of the blade are bonded with 2-pot adhesive supplied. This way the customer can install the turbine the day after the blades are glued on and balanced and not have to wait for a week for the silicon to cure.

Instructions for blade fixing:

WARNING: Ignoring this step will void the warranty. Make sure the correct blade is inserted into the correct hub position. Re-number these positions before you dismantle the turbine. Incorrect placement will lead to imbalance of the rotor. Make sure that the trailing edge of the blade is parallel to the casting edge.

Each turbine is supplied with sufficient resin to bond the 3 blades. Mix up the resin using 1/3 of the supplied amount and mix in 1/3 of the supplied red

catalyst. Work in a well ventilated area and use disposable gloves. Do 1 blade at a time. Smear half the amount just mixed on the cast hub as shown below.


Smear the other half on to the top surface of the blade as shown below. Seat the blades and attach using the fixings as shown below. Work quickly as the resin will not take long to cure, particularly on the day in hot. Align the straight trailing edge of the blade with the straight back face in the casting.


Tighten the bolts evenly to 10 ft-lb (14Nm), while ensuring that the straight edges are touching and parallel. Attach any balance washers supplied.

Clean off any excess resin with a rag and leave for 12 hours to cure in a well ventilated area.

Balance Check:

EcoInnovation insist that all turbines are checked for balance prior to erecting. This will pick up any mistakes that might have been made and allow balance to be corrected. We strongly advise you buy a balance jig from us or make your own. EcoInnovation can either sell ($120) or hire ($20) the balance jig described below. Please check the site for current prices. You must check the blades are balanced or EcoInnovation will not warrantee the product.

Wind turbine balance jig (3 in 1)

NZ$120 (or $20 to hire for 1 week)

This jig can be used to finely balance the blades and hub of the Chinese wind turbine (3 degree taper) shaft, Smart Drive splined shaft and 25mm shaft (taper lock fitting). Dust seals in the bearings have been removed to give a very free spinning bearing set. Attach to a workshop/garage wall, mount hub and blade set, and keep out of the wind. Apply weights (large washers work well) to the blade fixings until the blade is in perfect static balance. Note that static balance and dynamic balance are the same for items in a narrow plane. The cast iron hub shown is for illustrative purposes and not included. EcoInnovation recommend that all customers either purchase or hire this equipment to make sure blades are in balance prior to erecting your wind turbine. Free hire to customers, money less freight refunded upon return of balance jig.

The nose cone:

The nose cone attaches to the hub after the blades have been secured and the hub attached to the turbine. There are 3 fixings that hold this in place. Remember to use thread-locking compound. The nose cone is plastic and will after a few years weaken due to ultraviolet light. EcoInnovation holds stock of replacement nose cones if required. The nose cone is to tidy up the appearance and also protect the hub fixing from the elements.

The generator:

The generator is a brushless 3-phase alternating current generator, which utilizes a rotating magnetic field, the output is converted to direct current (DC) by the rectifier supplied (contained in the wind turbine head).

The rotor shaft is mild steel with two sealed ball bearings. In order to prevent rusting of the generator shaft to the cast iron hub it is recommend that anti-seize past is smeared between these parts prior to assembly. This will ensure they can be dismantled in the future.

The bearings in the generator should be checked every 12 months and replaced annually or as required. To check the bearings hold the turbine and try to move the hub, if you feel a slight movement then you should strip down the turbine and change the bearings.

A bearing failure would result in the magnetic rotor being damaged. If in doubt replace the bearings.

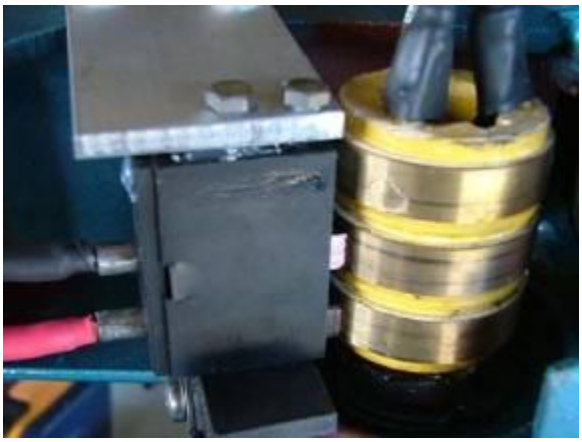
Swivel assembly:

The swivel assembly rotates and allows the wind turbine to face the wind. Housed within the swivel assembly are the 2 brushes and slip rings that carry the DC power to the cables leading to the batteries.

The swivel assembly fits inside a 50 NB galvanized pipe fitting welded inside the top on the tower and secured with 2 x 12mm bolts (remember to use thread locking compound). These bearings will last many years without the need for replacement.

Swivel assembly

Swivel assembly copper slip rings MK1



Swivel assembly copper slip rings MK2

The swivel assembly fits inside a 50 NB galvanized pipe fitting welded inside the top on the tower and secured with 2 x 12mm bolts (remember to use thread locking compound). These bearings will last many years without the need for replacement. For towers that do not have the fitting welded in EcoInnovation make an adaptor fitting so that the turbine will fit into 65 NB medium galvanized pipe as shown below.

Tower adaptor fitting

Battery charge control and over-voltage protection:

Charge control is provided using any good quality charge controller such as a Xantrex C40, such a controller will ensure that the batteries are charge correctly and divert surplus power to a resistive element such as a water heater element (special element required).
Never hook a wind turbine to a regulator designed for Solar PV panels only. Some regulators can work as either a Solar PV charge controller or as a diversion load controller. This turbine must be fitted with a diversion control regulator of suitable size to handle 300 Watts at the voltage of your system.

C40 and water diversion element

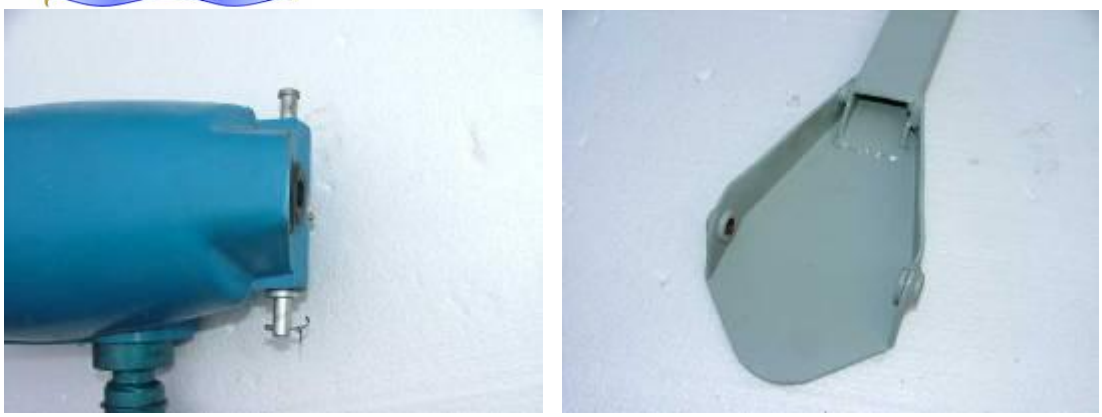
Over-speed control:

The wind turbine is protected from over speed with a side furling tail.
This governor is very simple in its operation. The tail is hinged on an inclined pivot (like a door on hinges that always closes itself) and in a light wind keeps the turbine facing into the wind. The turbine blade is offset from the swivel point, as the wind speed increases and the rpm of the blade increases the blade produces more lift (just like an aircraft wing), this lift force pushes back on the body of the wind turbine and because is it mounted on an offset pivot it turns itself out of wind.

If the tail were fixed the tail would try and prevent this from happening. This is the clever part; the tail is hinged so as the body of the turbine turns the tail stays where it is, in order to do this it moves up the inclined hinge as the body of the wind turbine turns relative to it.

As the body of the turbine turns out of wind you will notice the tail lift slightly. When the wind speed reduces the weight of the tail on the inclined hinge pin causes it to close (just like the door example) turning the wind turbine back into wind.

It is important that the tail pin does not seize due to corrosion. Re-grease the pin every 12-months. Also check the pin for wear and replace it if it shows signs of wear.



Pictures of tail pin and side furling tail

Blade noise:

Due to the low blade tip speed noise from the turbine is not excessive. All turbines makes noise and most would not meet the council requirements in built up areas, for rural customers who are 100m away from their nearest neighbour noise is not normally an issue. If you are concerned about noise you should visit our test site (address below) on a windy day so you can observe this prior to making a purchase.

Turbine testing:

To date the turbine has been subjected to 4 years of testing and has been exposed to wind gusts up to 120 km/h for short durations.

EcoInnovation has had all 48 vdc models independently tested by Smithies Technology to ascertain their true ratings. This data is still being collected but the following is currently representative of what this turbine will do:

- 100-300 watts at 30 + km/h (governor operates)
- 200 Watts at 25 km/h
- 100W at 20 km/h
- 50 Watts at 16 km/h
- 25 Watts at 13 km/h
- 12 Watts at 10 km/h
- Cut in speed of 9 km/h.

The turbine has very good performance in light to moderate winds and comparison testing on the same site with a competitor's turbine showed that this turbine outperformed a Soma 1000 up to about 200 Watts of output. The Soma 1000 is a very good machine and performs very well in stronger winds.

The unit has been tested by Industrial Research in NZ and they said about the

machine in a press release below.

> *28 July 2006*
> *Researchers at Industrial Research Ltd are backing the Parliamentary Commissioner for the Environment's comments promoting small wind turbines for homes, saying there is rising public enthusiasm for alternative energy sources such as wind generation.*
>
> *Industrial Research's Christchurch-based researchers are currently evaluating the performance of small wind turbines, similar to the one identified by Dr Williams in his report.*
>
> *"One turbine from China shows remarkably better performance that many of the others, simply because it is designed for much lighter wind conditions. Although this particular turbine is not suitable for mounting on a house roof, some of the newer designs certainly are," Mr. Gardiner says.*

Towers:

The turbine is designed to fit inside a standard sized water pipe tower made from 65mm NB (nominal bore) pipe. A stub fitting welded inside the 65mm NB pipe is made from 50mm NB pipe (inside 53 mm). The turbine is supplied with a stub to fit into 50NB pipe. For strength reasons the tower must be made from 65mm NB pipe or larger. Do not make the tower from 50NB pipe, it is not strong enough.

The tower consists of 6 x 2m lengths of 65 NB pipe supported by 2 sets of 4 guy wires. Generally 6 lengths of pipe are required to provide a 12m high tower. Note that some councils may require resource consent for structures over 10m high. If that is the case then a tower made from 5 x 2m lengths of pipe should be considered.

A lower tower made from 3 x 2m lengths of pipe is high enough in exposed sites. Your tower needs to be at least 3m above any trees or buildings close by. The tower requires screw-in anchors and a pivot at the base of the tower to allow the tower to be raised and lowered for maintenance. A gin pole consisting of 4 x 1.5m length of 50 NB pipe is used for leverage to raise and lower the tower. A winch is secured to one of the screw anchors or a suitable platform.

Tower kits are available from EcoInnovation and represent good value for money for NZ customers. Our kit includes all the parts required. Overseas customers may prefer to buy the hardware required locally as the freight charge to send our kit overseas is prohibitive.

Tower foundation:

The most cost effective tower foundations are screw-in anchors. In order to use them you need a firm clay soil that will hold them securely. Alternatively you can cast concrete foundation blocks or use a tractor mounted posthole rammer to ram in 3m lengths of galvanized steel pipe or large strainer posts. The beauty of screw-in anchors is that they can be quickly removed which may mean that your tower is not classed as a permanent structure. For example, in many parts in NZ you can drill for oil using a very large tower drilling rig that does not required a permit. It may stay on site for years. Because it is not a permanent structure it does not required a resource consent or building permit even though it may be 40m high. You could argue the same for your turbine tower. We recommend that you contact your local council for advice.

Site selection:

We do not recommend the installation of this turbine on house rooftops or within close proximity of houses; owners do so at their own risk.

The performance of your wind turbine depends upon 4 factors:

- The wind turbulence at your site
- The average wind speed at your site
- The distance from your tower to the batteries
- The height of your tower

Turbulence:

The most likely cause is obstructions such as buildings, trees and hills. When smooth air hits an obstruction it is broken up into gusts of variable strength and direction. As these gusts hit the wind generator they will cause it to continuously alter its speed. This constantly changing load will accelerate wear and tear on the turbine.

Average wind speed:

The average wind speed will determine the amount of power the wind generator supplies to the battery bank. Power goes up with the cube of the wind speed. This means that a 10m/s wind has 8 times more power than a 5m/s wind. Where average wind speeds are under 5m/s (18 km/hr) the economics of harnessing the power are poor and a better return on investment could be obtained through the purchase of Photovoltaic panels.
It is for this reason that EcoInnovation recommend that most customers spend their money on Solar PV panels and only invest a small amount in wind. This

way the wind turbine supports the PV panels during overcast windy conditions. Our view is that for every 1 kW of Solar PV you should consider installing one of these turbines. After you have lived with your system for some time you will then know if more wind or solar PV will be appropriate.

Turbine height:

The wind speed in most cases increases with height. The extent to which the wind varies with height depends upon many factors. The wind speed 10m above scrub and bush would be at least 1.5 times the wind speed at 3m above the scrub. Considering the cubic relationship between wind speed and wind power, the power at 10m is 3.5 times the power at 3 m.
Much higher energy output can be obtained from the turbine at the best possible location, a taller tower or locating on a nearby hilltop. The extra cost is usually more than compensated for by the increase in power output.

Distance to batteries:

The distance your turbine is away from your batteries has a significant bearing upon the wire size that is required. To keep wire size down EcoInnovation recommends that in most cases 24 or 48 Volt systems should be installed.

Your cable size in mm^2 can be determined by taking the rated power of your turbine and dividing it by your system voltage, this will give you the rated current from your turbine. For example our 200-Watt turbine on a 12-volt system is rated for 200/12=16.7 amps.

Multiplying the current by the cable length in meters and dividing this answer by 100 can then determine Cable size. For our example with a 100m cable length you would require 16.7*100/100 = $16.7mm^2$ the nearest largest size being $20mm^2$ would be a good choice. The cable will have low losses at low output but these losses will increase as the turbine approaches full rated output, this is not a major concern as the turbine will only reach full power rarely and higher cable losses can therefore be accepted. This will however reduce the power delivered from the turbine at the top end of performance.

The same system on a 24-volt system would only require $10mm^2$. EcoInnovation holds considerable stocks of cable at very good prices (not more than $300 for a 100m-cable run for 24 and 48-volt turbines.) for our NZ customers.

It is usually better to select a site that is further away if the site has more wind. Copper losses in your cable will be minimal at low to medium power outputs. We recommend that at 48 volts you do not site your turbine more than 250m away otherwise the economic advantage of small wind turbines become marginal.

Installing the wind generator on a tower:

The Chinese turbine consists of the following parts:

- Head and swivel
- Blades and hub
- Steel tail and steel tail fin
- Shunt and meter pack

Prior to installing the turbine on the tower raise and lower the tower and adjust the guy wires and check for correct operation and ease of use prior to attempting to lift the turbine. Refer to section on tower construction later in this document.

- The same electrical cable that runs from the tower to the batteries is fed up the inside of the pipe tower to the top. Tie a loop in the cable near the end so that the 10mm bolt can pass through the tower and loop. This will support the weight of the cable so that the strain is not placed on the terminals of the wind generator.
- Connect the positive and negative wires from the turbine head onto the wires inside the tower. You may need to connect flexible tail wires onto the larger wires inside the tower in order to do this.
- Insert the 50 NB stub into the tower and secure with the 2 x 12mm fixing, apply thread-locking compound.
- Attach the tail and tail fin, charge with grease.
- Attached the blades to the hub in their correct number sequence, smear the joint with a bedding of silicon, apply thread locking compound to the fixings.
- Attach the hub and blade set to the wind turbine generator shaft. Apply a small amount of anti-seize on to the mating parts so that this taper fitting can be separated in the future.
- Attached the nose cone.
- Once mounted on the tower you will need to connect the other end of the cable to the batteries though a fuse, the fuse protects the wire from accidental shorting and should be twice the maximum current rating of the turbine. The purpose of the fuse is only to protect the wires in the event of an accidental shorting of the cables. A battery regulator must be fitted to protect your system from over voltage, such as a Xantrex C40 with dump load. EcoInnovation can supply these parts if required.
- Erect the tower and wait for the wind. Do not erect the tower during strong winds. The first run of the turbine should be done in winds less that 25 km/h. The turbine should operate vibration free and start to charge your batteries.

Uni-T multi-meter:

EcoInnovation includes a shunt and Uni-T multi-meter to measure the voltage and current generated from your turbine. Connect the shunt into either the positive or negative wire from the turbine (in a dry place close to the batteries).

To measure the voltage follow the instructions in the booklet supplied with the meter. To measure the current connect the two leads into the spring-loaded connectors on the shunt, turn the meter knob to **the 200 mv dc scale**. The meter will now read the current though the shunt in amps (note that the meter is actually reading the mv drop across the shunt but this is the same as the current flow through it).

Uni-T multi-meter and shunt

Electrical brake:

The wind turbine may be stopped in light wind speeds by applying the electrical brake. This is achieved by shorting out the positive and negative wires from the turbine. To do this you will have to remove one of the leads from the battery otherwise you will also short the battery and blow the fuse. You can arrange for a switch to disconnect one lead from the battery, and then connect the two together to short them out. The wind turbine should slow and stop within 30 seconds. If it does not then the wind speed is too strong to attempt an electrical stop and the brake must be released otherwise you may permanently damage the generator through overheating it or damage the rectifier.

Under no circumstance should the generator be allowed to operate while disconnected from the battery, this will result in over speed of the turbine and a voltage on the output terminals that could be fatal if touched.

Maintenance:

This turbine has been designed to be strong and durable. It is a cost effective product that will be reliable and should maintenance be required then standard mass-produced replacement parts can be used. All wind turbines require maintenance mainly greasing and bearing replacement. Nuts and bolts can vibrate loose over time and should be checked every 12 months.

Maintenance procedure @ 12-month intervals:

- Engage electrical brake on a light wind day and lower the tower
- Physically inspect for rust and cracks all connections on the tower and fixings on the turbine.
- Check the blades are in good condition
- Check the tower cables are in good shape
- Check the generator bearings for any sign of play and replace if required
- Charge tail pivot with grease
- Check blade for cracks at base and replace if required
- Check blades for tip damage and replace or lightly sand

Spare parts:

Spare parts are inexpensive and can usually be sent throughout NZ within days and outside NZ within 2 weeks from the time of order.

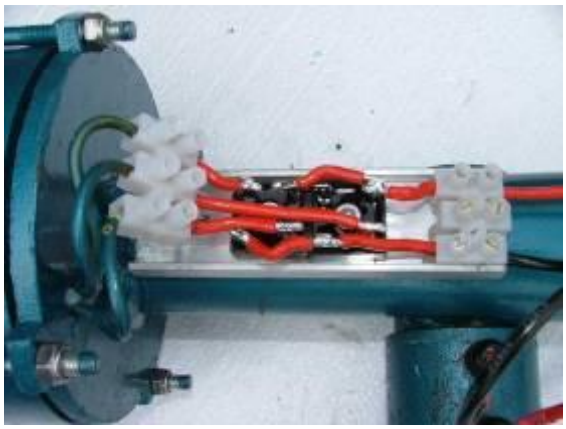
Dismantling your wind turbine:

- To open the fairing cut the banding as shown
- Remove the rear pin

- Remove the rear rubber tail stop fixings as shown


- Knock out the tail pin hardened bushings as shown
- Pull open the casing and remove the fairing


- Views of rectifier and slip ring brush holders

To change the main generator shaft bearings you will need to remove the 4 x 8mm bolts and tap (with a soft mallet) to open the generator casing. You can then extract the magnetic rotor and bearings. Replace the bearings if required.

To change the swivel assembly bearings, remove the brushes from the brush holder.

Remove the circlips that hold the swivel shaft into the body of the turbine. Tap (with a drift) the swivel shaft from the top downward and it will come out. You will need to remove the copper slip rings in order to replace the lower swivel bearing.

For detailed pictures of the MK2 machine refer to The Shed Magazine article for July 2007. This should also be available from our web.

Kit-set back-up Gen set:

EcoInnovation can supply the parts in a kit for you to make you own 12/24/48 volt back-up generator. This is far more economic than buying a large charger to run from a 230 vac generator.

Guarantee:

EcoInnovation guarantees the wind turbine for 12 months (only if wholly assembled by EcoInnovation and the full retail price paid. The 12-month warrantee does not cover parts, kits and trade customers). Damage caused by incorrect connection, incorrect blade fixing, incorrect tower assembly or winds above 120 km/hr are not covered by this Guarantee. If winds above 120 km/hr are forecast you should lower the turbine to the ground (only if safe to do so at the time).

EcoInnovation reserves the right to refund, replace or repair the items at its discretion. In all cases the wind turbine will have to be returned to EcoInnovation at the customers' expense for service. You can extend the guarantee period for an extra $200 per annum for up to 3 years within NZ.

The terms and conditions on our website override the terms listed here. You should check the site for the latest offers and terms.

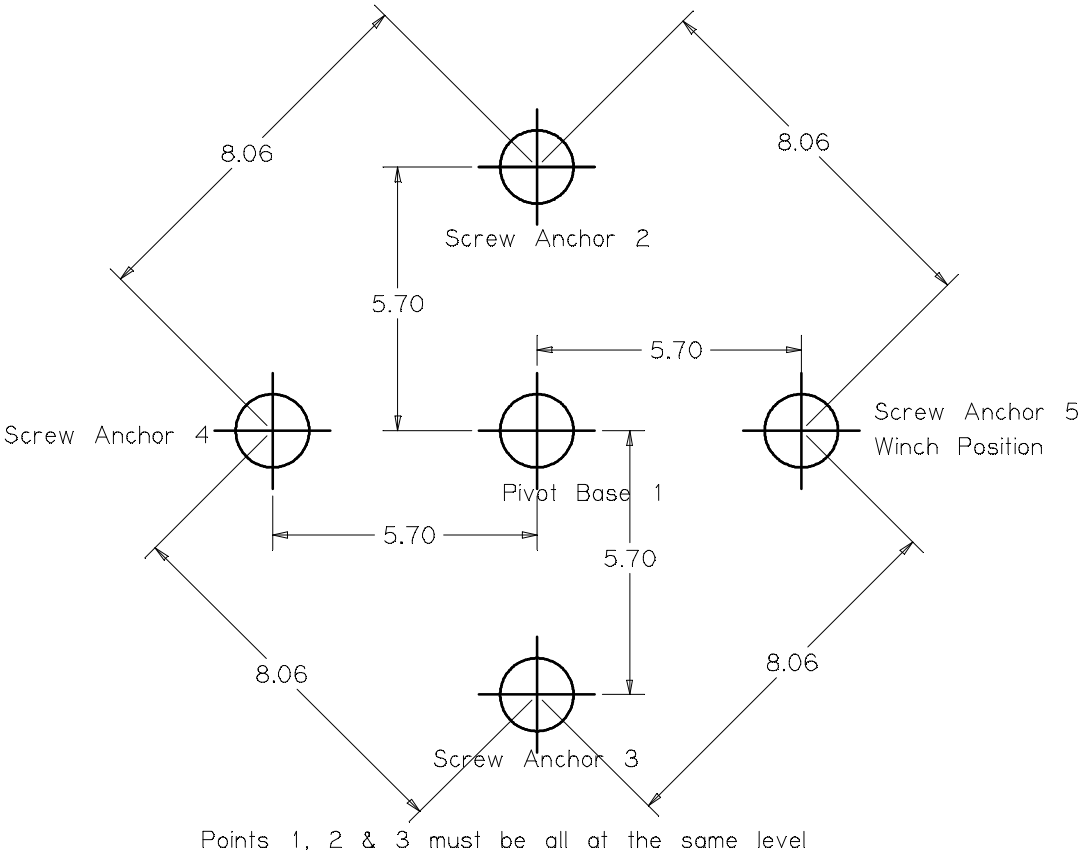
EcoInnovation tilt up 12m-tower kit:

EcoInnovation manufactures a 12m high tower kit for NZ customers. Note this is hot dipped galvanized with the option of zinc coated or stainless steel cable

Raising a wind turbine tower is potentially dangerous. Ensure that no people are within a 15m radius of the tower base while raising it. Ensure you position the tower at least 15m away from buildings, roads, overhead power lines and other people's property. We recommend you situate the turbine at least 50m from your own dwelling.

Do not rush and check that all guy wires have been attached to the tower before lifting.

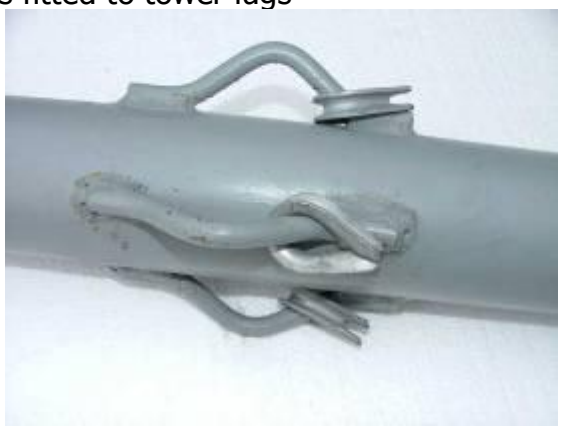
Wind turbine tower plan dimensions:



The kit comprises of the following items:

1 x top tower section, 10mm bolt for wire fixing, 50NB internal pipe for turbine fitting and 4 x cable eyes fitted to tower lugs.


1 x middle tower section - 4 x cable eyes fitted to tower lugs

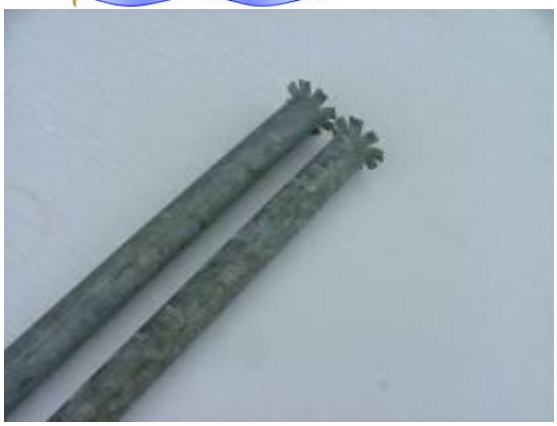
4 x 2m tower sections - one section with 16mm hole at end to mount into thrust pad pivot bracket.

4 x turnbuckle sets (includes 1 x 16mm D shackle, 2 x 12mm turnbuckles, 2 x cable eyes fitted). Second picture shows set attached to ground anchor

(optional)

Ground anchors:
These are optional and supplied as an extra with the tower kit. Either 4 x 1.2 or 1.8m long. Clients may use alternative methods of ground anchoring depending on site and materials to hand. 1.2m anchors must be concreted into a hole 400mm x 400x 1000mm deep. The 1.8m screw anchors can be used without concrete in firm undisturbed clay soil.

2 x thrust pad anchor pegs



4 x 1.5m gin pole sections, 1 section with 12mm hole at end for fitting into thrust pad pivot bracket, one section as per picture below for attachment of winch and rear tower guy wires.

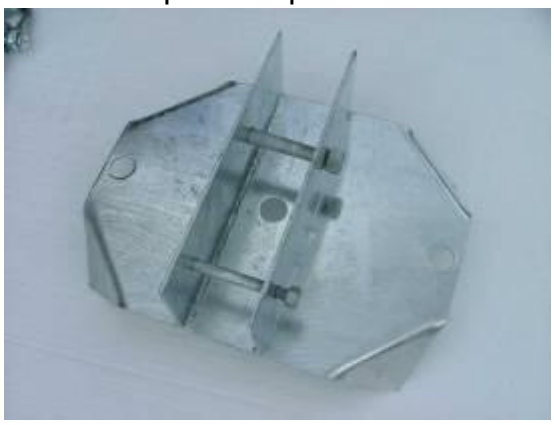
50 x 6mm cable cleats (use 3 per wire connection) – fasten as shown

1 x winch

1 x 90m of 6mm cable
(4 x 13.5m and 4 x 9m)

1 x 11m winch wire

1 x thrust pad and pivot bracket



Tower assembly instructions:

Mark out the position of anchors as shown on the plan dimensions.
Position the thrust pad pivot bracket and peg into position with the two anchor pegs. This pad has to take a downward thrust of up to 1000 kg. If the ground is soft you should dig down to firm ground and pour a concrete base 500mm x 500mm and peg the base into this concrete footing. Drive the anchor pegs to ground height with a sledgehammer.

Mark out positions 2, 3, 4 and 5. It is very important that points 1, 2 and 3 are at the same height. This ensures that when raising the tower the side guy wires hold the tower square to the ground, if points 1, 2 and 3 are at different levels there is a tendency for the tower to go sideways, this pulls on the gin pole and can cause gin pole collapse and resulting tower collapse. Do not erect this tower

with points 1, 2 and 3 at different levels.

With the base plate in place and pegged down, next insert the base tower tube and fasten in place with the 16mm bolt. Stack on top of this 2 plain tower tube sections, the middle tower tube section, and another plain tower tube section then the final top section. All sections should be lying on the ground, all firmly pushed together.

Repeat the about for the 4 gin pole sections.
Screw in the 4 screw anchors at an angle of 30 degrees from the vertical position, top pointing towards the base of the tower. The ground must be suitable and each anchor must be capable of holding 750 kg when installed.


On level ground, the wires to the top bracket should be cut to 13.5m long and the lower brackets cut to 9m long. You have been supplied with a 90m roll of 6mm cable which is enough if cut into 4 x 13.5 and 4 x 9m lengths. Leave plenty of tail at the ground end so that the cable can be adjusted for correct length later and secure with 3 cable cleats. The cable lengths should be set to the approximate length and after raising the tower for the first time (without turbine attached) adjustment for correct cable length can be made so that the tower stands vertically. Install all the guy wires to positions 2, 3 and 4. Leave position 5 for now.


Thread your power cable up inside the tower. Secure the cable by attaching it to the bolt that secures the top bracket so that the weight of the wire is taken on the 10mm bolt.

We advise you drill a hole 300m from the bottom of the tower and bring out the cable from the side of the tower tube rather than the bottom. The power cable can be cut when the tower is raised and lowered if it comes out of the bottom of the tower, side exit is preferred. Sleeve with plastic pipe where the power cable exists through the hole in the tower to protect the cable.

Connect the two rear guy wires to the gin pole end as shown above. Connect the winch wire to the gin pole as shown. Shackle the winch to the ground anchor (position 5), several D shackles or a short length of chain can be used so that the winch is slightly off the ground. It can be awkward to operate the winch from this position, as the winch body wants to turn while you are trying to raise the tower. Bolting a stabilizer arm to the bottom of the winch for an assistant to hold will make it easier. Alternatively you will need to mount the winch on a suitable mounting. The winch supplied will need to be mounted at about 45 degrees so that the cable from the winch does not rub on the winch body.

With the gin pole bolted into the thrust pad pivot bracket, pull the gin pole up off the ground until it is 90 degrees with the main tower pole, and then connect the guy wires to the main pole. Note that the gin pole is not very stable in this position and strong winds can blow the pole over. It is advisable that two lengths of rope are attached to the end of the gin pole before rising. These ropes can then be tied to the two side screw anchors making the gin pole very stable if it is to be left in this position.

To summarize:

- The tower is on the ground and bolted to the pivot bracket with all 9 wires in place.
- The gin pole should be sticking straight up in the air connected to the winch, tower base and tower.
- All guy wires should be in place and secure.

Start to winch the tower up and as you do smear a heavy layer of grease onto the cable. The winch should be set up so that the ratchet works on the way up, you can let go of the handle and rest if required with the tower held on the ratchet.

When lowering the tower the ratchet should be held off with one hand and lowered with the other. In the event that you need to rest engage the ratchet before letting go of the handle. Ensure everybody present is standing behind the winch person and at least 15m from the base of the tower.

We advise you stand on the gin pole at this stage to ensure the tower cannot fall over.

Prior to removing the winch and gin pole (to put into storage for use when you need to lower the tower) you need to make up a safety strap and connect the top turnbuckles to the ground anchor at position 5. Remove the winch and gin pole and connect the turnbuckles directly to the ground anchor. You can now remove the safety strap.

Adjust the length of all the guy wires and tighten the turnbuckles. Grease the threads of all the turnbuckles. Vibration and animals can undo the turnbuckles by rubbing on them; it is advisable to wire the two turnbuckles at each anchor together with a short length of soft wire to prevent this from happening. Alternatively you can use an 8mm D shackle to lock the 2 turnbuckles (at all four positions) together to prevent animal and vibration from undoing them.

Conclusion:
We here at EcoInnovation hope that you get fantastic results from your turbine. You are to be commended for considering the environment. Remember that generation is only a part of the bigger picture, and that your efficient consumption can have even a greater impact than your generation of electricity.