LIMITED WARRANTY

The Marlec Engineering Company Limited Warranty provides free replacement cover for all defects in parts and workmanship for 24 months from the date of purchase. Marlec's obligation in this respect is limited to replacing parts which have been promptly reported to the seller and are in the seller's opinion defective and are so found by Marlec upon inspection. A valid proof of purchase will be required if making a warranty claim.

Defective parts must be returned by prepaid post to the manufacturer Marlec Engineering Company Limited, Rutland House, Trevithick Road, Corby, Northamptonshire, NN17 5XY, England, or to an authorised Marlec agent.

This Warranty is void in the event of improper installation, owner neglect, misuse, damage caused by flying debris or natural disasters including lightning and hurricane force winds. This warranty does not extend to support posts, inverters, batteries or ancillary equipment not supplied by the manufacturer.

No responsibility is assumed for incidental damage. No responsibility is assumed for consequential damage. No responsibility is assumed for damage caused by user modification to the product or the use of any unauthorised components.

No responsibility is assumed for use of non "furling" versions of the Rutland Windcharger where Marlec or one of its authorised agents finds that a generator incorporating a furling device should have been used.

Manufactured in the UK by
Marlec Engineering Co Ltd

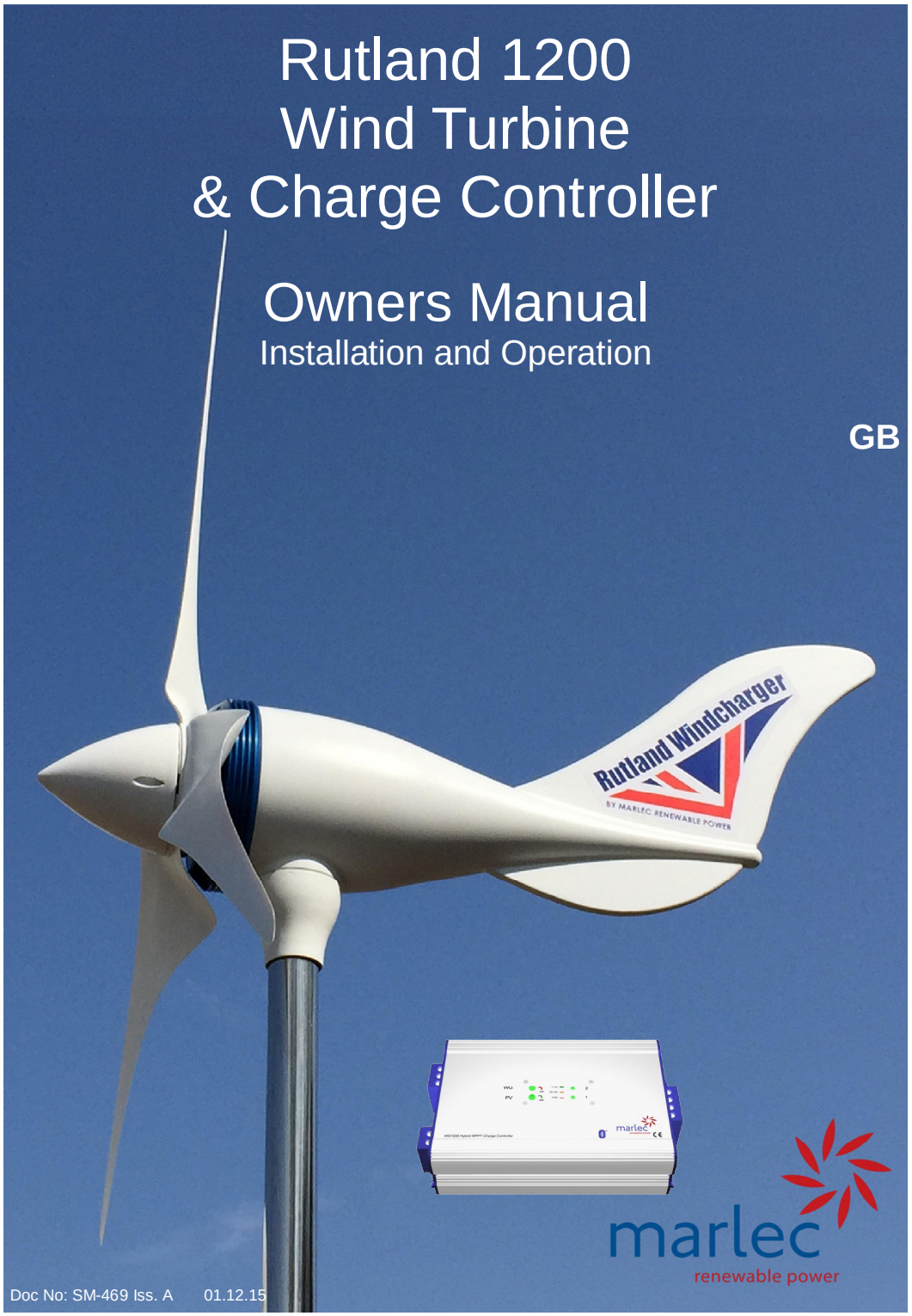
marlec
renewable power

Rutland 1200 Wind Turbine & Charge Controller

Owners Manual

Installation and Operation

GB



Contents

Rutland 1200 Wind Turbine & Charge Controller Owners Manual

For Your Records

For your future reference we recommend you note the following:

Serial Number of Wind Turbine:

Serial Number of Charge Controller:

Date of Purchase:

Purchased from:

Date of Installation:

Notes:

Support

Visit www.marlec.co.uk/ for support and spare parts to ensure you get the best out of your Rutland Wind Turbine. Many repairs are simple enough to carry out yourself, and require only basic equipment, but we also offer a full testing and repairs service. Contact Marlec for further information.. For maintenance demonstrations and further advice see www.marlec.co.uk or watch our videos at MarlecTV on YouTube.

Contact Details

Address: **Marlec Engineering Co Ltd**
Rutland House
Trevithick Road
Corby, Northants
NN17 5XY
UK

Tel: **+44 (0)1536 201 588**

Skype: **marlecengineering**

Email: **sales@marlec.co.uk**

Opening Times:
Mon-Thurs **08:30-17:00**
Fri **08:30-15:00**

Thank You

Introduction

Congratulations and thank you for purchasing your Rutland 1200 Wind Turbine and Hybrid MPPT Charge Controller. Our range of Rutland Wind Turbines are well known as simple, reliable, quiet and efficient wind turbines that have been used worldwide by sailors, farmers and off-grid power specialists since 1978.

The utmost of care goes into the manufacture of all our products in our ISO9001 approved factory. To ensure you get the very best out of the Rutland 1200 we recommend that you read this manual and familiarise yourself with its contents before installing and operating the wind turbine and charging system.

Rutland 1200 Wind Turbine Features and Uses

- The Rutland charge system provides a direct current (DC) to charge a battery bank and power low voltage equipment connected to the batteries.
- Our Maximum Power Point Tracking (MPPT) technology continuously adjusts the turbine speed to achieve its optimum power performance. This increases the genetrator efficiency and delivers more ampere hours to your battery.
- Aerodynamically efficient aerofoil blades for a powerful and quiet turbine.
- Sleek design that ensures a smooth and stable operation.
- Low wind speed start up maximises power generation in the most common winds.
- The Rutland 1200 uses rare earth magnets with an ironless core to create an efficient axial flux generator with no cogging torque.
- Electronic High Wind Current Protection Mode.
- High grade construction materials for durability in the harshest environments.
- Sealed long life bearings & stainless steel fasteners.
- Designed for domestic uses such as on board sailing yachts, motor caravans, static caravans and remote living, as well as professional applications such as navigation, pumping, lighting and sensing equipment, etc, at remote sites where off grid power is required.
- Ideally mounted on the Rutland Marine Mounting Kit and the Land Tower Kit - see product catalogues.

Rutland 1200 Wind Turbine & Charge Controller Owners Manual

Charge Controller Troubleshooting

1. Charge Controller Not Powered - BAT 1 LED dark.

- Check polarity.
- Check all fuses, switches and connections on the battery cables.
- Check battery voltage is sufficient. It must be over 9V for the charge controller to function.

2. Charge Controller showing BAT 2 not connected. BAT 2 LED dark.

- Check the connection of Battery 2 as above.
- Shutdown the wind and solar using the WG and PV buttons. They show solid red when shutdown.
- Disconnect, then reconnect Battery 1 to restart the controller. BAT 2 LED will light with BAT 1 LED. Restart the wind and solar to resume charging.

3. Charge Controller WG and PV buttons Flashing Red

- The controller is in a managed shutdown due to over temperature, or is operating in High Wind and Solar Current Protection Mode. It will resume charging automatically when conditions permit. (for Solar current overload manual reset is necessary)
- Check that the solar array connected is not too large, <20A.
- Check that the charge controller is in a well ventilated area, and that the fan and the vents on the controller are free from dust or blockage.

4. Charge Controller Constantly Regulating

- Battery capacity is too small for the level of charge current or there is no load.
- If operating a 24V system, the battery may have been discharged below 20V when the charge controller was connected and automatically detected the system voltage as 12V. Externally recharge the battery and then reconnect the charge controller.
- External charge source (e.g. alternator) raising battery voltage. Disconnect external charge before testing the charge controller.
- Is voltage sensing cable fitted? This will give a the charge controller a more accurate reading of battery voltage.
- Is the external temperature sensor connected?

6. No Charge To Batteries

- Ensure that the batteries are not fully charged and causing regulation.
- Check that there is sufficient wind and/or solar available for charging.
- Perform the Rutland 1200 & Solar Troubleshooting steps to ensure the charge sources are performing correctly.
- Test the charge current by series connecting your multimeter.

If in doubt, refer to your dealer or the manufacturer.

4. Open the Nacelle if further inspection is required.

- Remove the 4 screws connecting the bottom of the nacelle to the post adaptor.
- Remove the 5 larger screws towards the nacelle front.
- Then gently prise open nacelle halves, and slide off the generator hub and post adaptor.

5. Check for a short circuit or damage to the cables inside the nacelle.

6. **Check the brushes and slip rings for wear or damage.**

- There are 2 sets of black plastic brush holders (3 brushes in each).
- The brushes and slip rings can then be inspected by removing the four self-tapping screws holding the black plastic brush holder assemblies in place.
- Remove any black deposits from slip ring with fine emery paper. Heavy deposits and reduced power indicate a possible reverse connection to the battery. Check brushes for undue wear and replace if necessary.

If the above checks have identified a need for spare parts or failed to identify the problem you should contact Marlec who can advise you on further tests, or recommend your nearest distributor in their world wide network.

Solar Troubleshooting

Warning! Solar panels generate electricity when exposed to light. Always cover the solar array before changing any connections.
Carry out the these tests with the panel(s) in direct sunlight!

1. Test V_{oc}

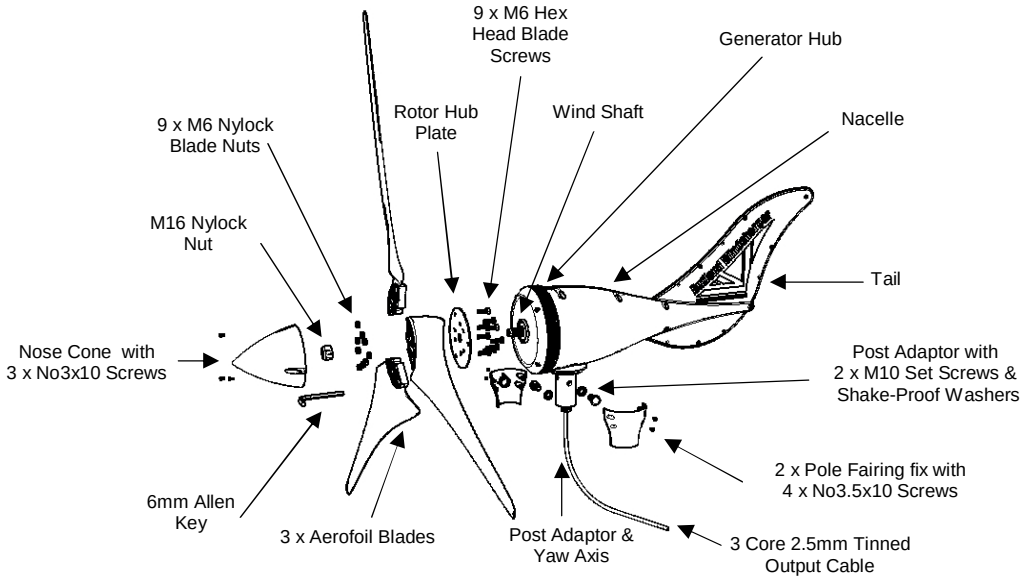
- Disconnect the solar cables from the charge controller.
- Clip your multimeter to the cables and set to DC volts. Uncover the solar panel(s).
- Check the polarity of the solar panel.
- Check the reading is close to the V_{oc} of the panel. (usually found on the label on the rear)
- The reading must be above battery voltage to allow charge.
- If the reading is much below V_{oc} there is an internal fault in the solar panel.
- If the cables ay the charge controller show no voltage there is a problem with the module, blocking diodes or the wiring.

2. Test I_{sc}

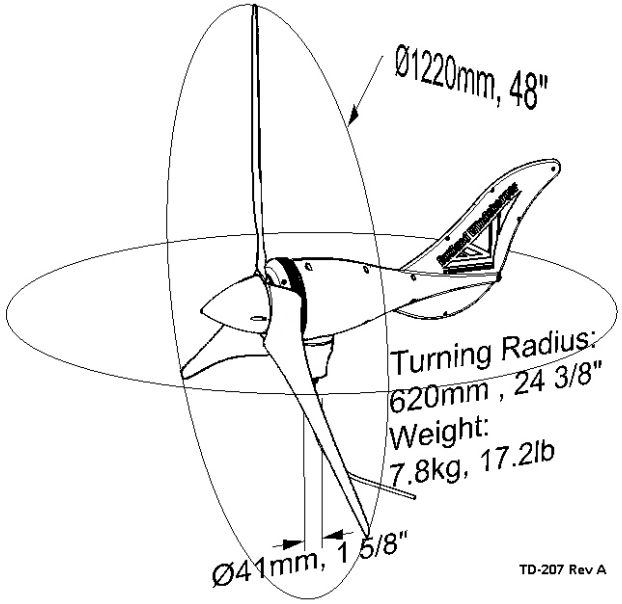
- Disconnect the solar cables from the charge controller.
- Clip your multimeter to the cables and set to DC current. Uncover the solar panel(s).
- Check the reading is close to the I_{sc} of the panel. (only in direct sunlight and at optimum tilt angle!)

If in doubt, refer to your dealer or the manufacturer.

Overview of Rutland 1200



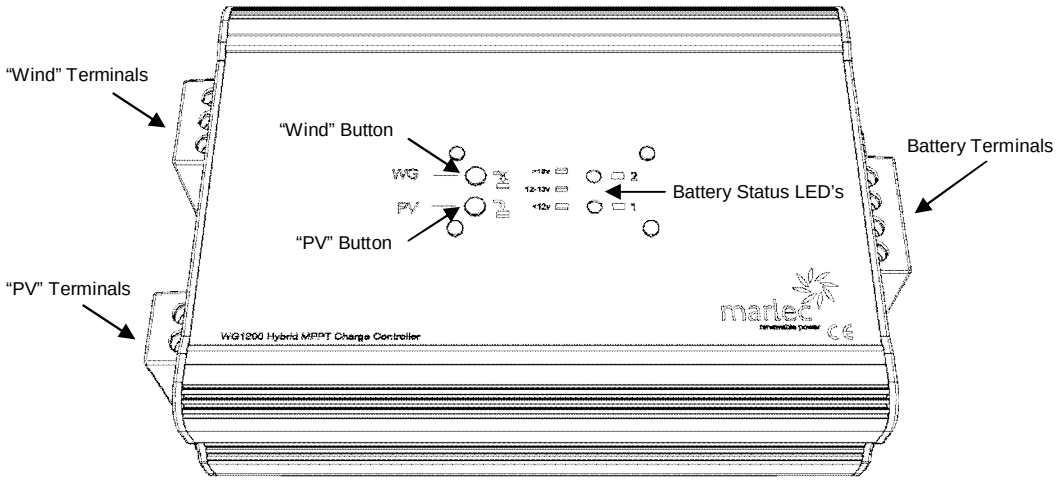
Rutland 1200 Dimensions



Hybrid MPPT Charge Controller Features and Uses

- Hybrid MPPT Charge Controller for Rutland 1200 and up to 20 Amps of Solar (250W@12V or 500W@24V).
- Separate MPPT Control of the Wind Turbine and Solar PV increases energy yields.
- Multi stage battery charging for an optimum charge regime. PWM voltage regulation protects batteries from overcharging and increases lifetime.
- Designed for use with lead acid batteries, Wet, AGM and Gel.
- Automatic 12 or 24 Volt battery bank detection.
- Built in Charge Splitting for use with single or dual battery banks.
- Temperature compensated for optimum charge with remote sensor.
- Remote voltage sensing. Negates battery cable volt drop for precise regulation.
- Built in charge stop switches for independent shutdown of wind or solar.
- Controlled cooling fan for efficient operation.
- Optional remote display via serial cable.

Charge Controller Overview



Troubleshooting

In the unlikely event that your system develops a defect, the turbine should first be made safe. If the stall button is not functioning the turbine can be slowed by turning it into the wind and then tied off, or lowering the tower. Follow the below troubleshooting in order. Take care that all test equipment used is suitable.

1. Read the ***Electrical Connection*** and ***Up & Running*** sections and be satisfied that your system complies. Check for mechanical obstruction to the turbine.
2. **Is there sufficient wind?:** The Wind Turbine needs approximately 4-5 knots wind speed to start charging. The actual wind speed at the turbine blades may be greatly reduced when compared with weather reports. As a guide the blades will appear as a blur before charge starts to be delivered.
3. **System Tests:** Is the battery in good condition? Check the voltage and electrolyte level of each battery. Check electrical continuity throughout the system, especially corrosion and poor connections in cable joins and connector blocks.

Rutland 1200 Troubleshooting

1. **Mechanical Inspection:** Lower the Rutland 1200 for the following tests.
   - With the tower lowered disconnect the wind turbine from the charge controller.
   - The turbine should rotate freely with no noise or vibration.
   - Noise or vibration under rotation suggests a bearing change is required.
   - If the hub does not rotate freely, check for a possible short-circuit in the wiring from the charge controller to the turbine.
2. **Remove the Rutland 1200 from the pole:** for further inspection.
   - Remove the Pole Fairing by removing the 4 screws.
   - Unscrew the 2 M10 screws with shake-proof washers from the Tower.
   - Gently pull the Post Adaptor free from the tower and disconnect from the tower cable and charge controller.
3. **Rutland 1200 Tests:** Check for power output from the Wind Turbine whilst the turbine is lowered, follow this procedure:
   - With the outputs open-circuit check the turbine wind shaft for free rotation. Noise or vibration under rotation suggests a bearing change is required.
   - If the hub fails to rotate freely with no short-circuit check inside the nacelle.
   - Set your multimeter to AC Voltage. Clip between two of the output phases and turn the generator by hand noting the reading. Make three readings between the different phases to check there is no open-circuit.
   - Set your multimeter to AC Current. Clip between two of the output phases and turn the generator by hand. You should feel a smooth resistance to rotation. Make three readings between the different phases.
   - Otherwise there is no fault on the Rutland 1200, and the problem is in the charge controller or the wiring to the controller.

Maintenance and Troubleshooting

Inspection and Maintenance

The Rutland Wind Turbine requires no scheduled maintenance except an annual inspection to monitor the general condition of the system to ensure the electrical and mechanical integrity and safety of the system.

For maintenance demonstrations and advice see www.marlec.co.uk or watch our videos at MarlecTV on YouTube. We also offer a full testing and repairs service, contact Marlec for further information.

WARNING! Before inspection, the turbine should be stalled and lowered to the ground or tied to be prevented from turning to avoid injury.

To stop the turbine from turning proceed as follows:

1. Press the shutdown switch on the Charge Controller. The turbine will slow down. It may turn slowly but will not accelerate with the wind.
2. Tie a blade to the mounting pole to prevent it from rotating.

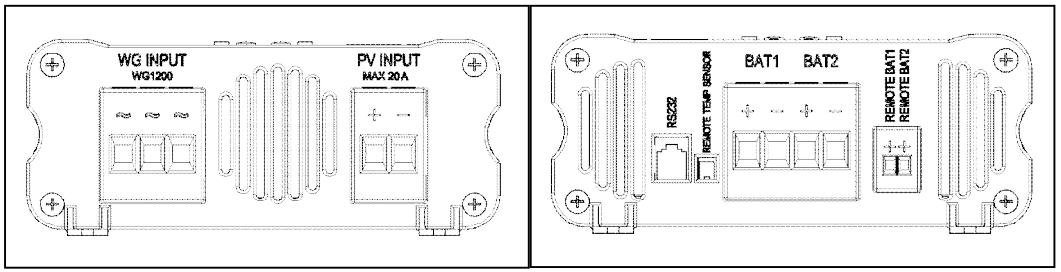
The following routine checks should be performed whilst the turbine is stationary:

1. Check the blades for damage, eg chips or nicks. Replace any damaged blades. The turbine should not be operated with damaged blades as this may cause imbalance resulting in premature wear and possible failure. Check the blade screws for tightness.
2. Check all other nuts, bolts and screws for tightness.
3. Check the yaw axis for free rotation.
4. Check tower assembly for good condition.
5. Check the tension of any guy wires if applicable. The tension of guy wires should be checked frequently during the first year.
6. The Rutland 1200 can be wiped with a mild detergent and rinsed with water to remove dirt and debris.
7. Ensure that the solar array is clean and has not become shaded over time.
8. Check that the charge controller is in a well ventilated area, and that the fan and the vents on the controller are free from dust or blockage.
9. Ensure that all terminal connections are secure.

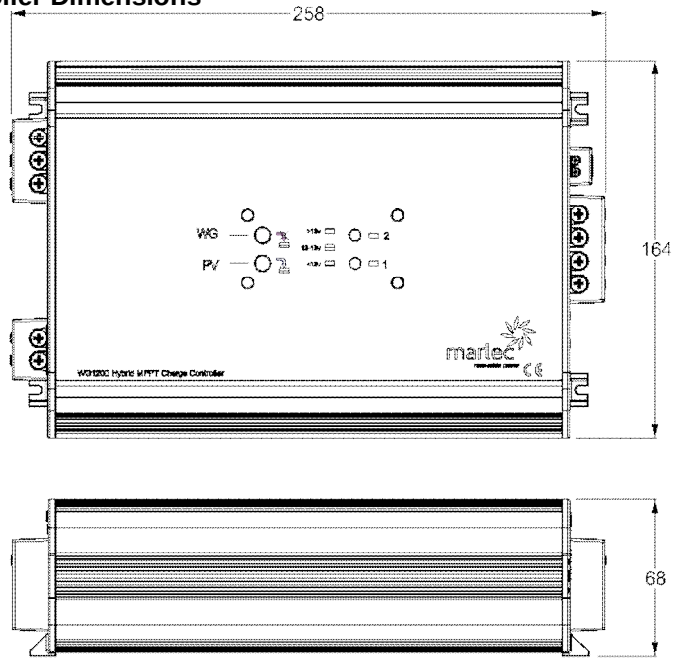
Note: The Rutland 1200 is designed for continuous running to achieve maximum resistance to water ingress into the bearing and generator.
Should you wish to take the unit out of service for an extended period it is recommend that the unit be removed from the mounting and stored in a dry location, or well covered and secured if removal and storage is not possible.

Left Side - Inputs Connections

Right Side - Outputs Connections



Charge Controller Dimensions



Weight 1.3kg

General Guidelines and Warnings

· *Follow the instructions for the Rutland 1200, Solar Module and Batteries when installing your system. Always perform the operations in this manual in the order specified.*

· *When turning the Wind Turbine is capable of generating voltages in excess of the nominal voltage. The turbine must never be allowed to rotate unless it is electrically connected to the Charge Controller and the Charge Controller connected to the batteries. Connecting an open circuit running turbine to the electrical system can cause serious damage to the system components owing to excessive voltage. Solar PV Panels can also generate voltages in excess of the nominal voltage whenever they are exposed to light. Always cover panels during installation. Caution must be excercised at all times to avoid electric shock.*

· *Stopping the turbine—this may be necessary to undertake battery maintenance for example. If possible this should be done in low wind speed conditions. Use the shutdown switch on the Charge Controller to stop the turbine. Alternatively the turbine can be slowed by rotating or orienting the tail fin upwind, this will slow the turbine sufficiently for it to be safely secured to the pole with rope. Avoid leaving the turbine tied up for any extended period of time. We recommend that the turbine either be covered to protect from the weather or removed and stored in a dry location.*

· *Choose a calm day to install the equipment and consider other safety aspects. No attempt to repair the system should be made without restraining the turbine from turning and the PV panels being covered.*

· *The Wind Turbine is fitted with permanent magnets which can be damaged by heavy handling. The main generator assembly should be treated with care during transit and handling.*

· *It is essential to observe the correct polarity when connecting the Wind Turbine, Charge Conrtoller and all other components into an electrical circuit. Reverse connection will damage the Wind Turbine and/or the Charge Controller and incorrect installation will invalidate the warranty.*

· *Do not open the case of the Charge Controller. Do not connect the Charge Controller in the event of damage. Live components operate at potentially harmful voltages.*

· *Ensure the area of installation of the Charge Controller is adequately ventilated. Maintain at least 5cm of clearance around the charge controller to allow air circulation.*

· *Ensure all connections to the Charge Controller are permanent.*

· *The Wind Turbine mounting pole outside diameter should not exceed 48.5mm for at least the top 0.6m to avoid blade strike. Note that an unsupported tower will experience lateral movement, particularly in high winds, which can cause damage to the Wind Turbine. It is essential for effective performance that the mounting pole is vertical.*

· *High winds – The Rutland 1200 Wind Turbine is suitable for marine and land based applications. When storm winds are forecast the turbine can be restrained to minimise wear and tear.*

If in doubt refer to your dealer, a competent electrical engineer or the manufacturer.

Siting the Solar Array

PV panels are easy to install, have no moving parts and are virtually maintenance free.

They are usually mounted on brackets from a pole, wall or a roof which inclines the module at a fixed angle. They are also suitable for mounting flat, which is often safer and more convenient on a boat deck or caravan roof .

To provide good year round operation of an off-grid battery system they should be orientated towards the equator and inclined at an angle relative to latitude.

To provide good year round operation of a fixed inclination off-grid battery system they should optimised for winter yields with the steeper angle of 65-75° used. In the UK (or areas of similar latitude) a steeper angle in winter (65-75°) and a flatter angle in summer (20°) will improve seasonal output. A system where the angle can be manually altered seasonally will generate more yield through the year.

If panels are mounted at less than 15° they should be cleaned more often as flatter angles do not take full advantage of the cleansing effect of rainfall.

Careful siting is important to ensure maximum exposure to sunlight for the longest possible time. If panels are shaded their charge output will be reduced. To compensate for this loss in charge a larger solar array is required.

As module cell temperature affects the power it is recommended to mount framed modules so that airflow underneath the backsheet is allowed. Laminated semi-flexible modules are suitable for mounting flush to a surface.

Land Based Systems

For good performance the Rutland 1200 should be mounted a minimum of 6m from the ground to ensure the affect of wind shear is minimised.

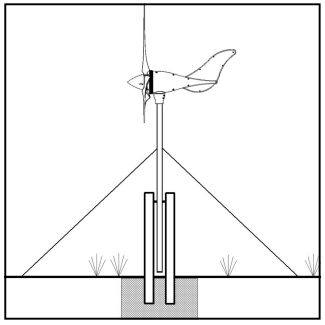
The Marlec Land Tower Kit & Tower Rigging Kit (Part No. CA-12/08 & CA-12/07) are available for mounting our range of wind turbines on land. They come as a complete kit ready for assemble and permanent installation with a concrete base.

We also offer a range of non-guyed pivoting towers that can be customised and towers for a range of professional applications. *Please contact Marlec for further details*.

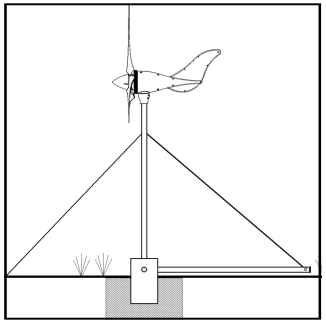
Alternatively a suitable mounting pole can be erected using a 6.5 metre (21 feet) galvanised (medium) tube. The tube must be supported by a minimum of four guy lines.

- The attachment points for the guy lines to the tower should be securely fixed to the tower.
- The guy wires should be a minimum of 4mm in diameter.
- The shackles should be a minimum of 5mm in diameter.
- Rigging screws should be a minimum of 5mm in diameter.
- All items should be galvanised or stainless steel for protection against corrosion.
- Where guy lines are looped, the loop must incorporate a thimble and be fitted with a minimum of three rope grips.
- All ground fixings must be made suitable according to the terrain and loads.

Pivot type towers are recommended as these allow for easier installation and lowering for access to the wind turbine. Two forms of pivot tower are suggested below.



Centre pivoted pole



Base pivoted with gin pole

NB:*See the warnings section regarding the tower. It is essential that the tower is maintained vertically to minimise unnecessary yawing which may cause a loss of yield.*

Check You Have Received

1 x Main Generator Assembly
1 x Hybrid MPPT Charge Controller and External Temperature Sensor
3 x Aerofoil Blade
1 x Rotor Hub Plate
1 x M16 Nylock Nut
9 x M6x20mm Hex Head Screw
9 x M6 Nylock Nut
2 x M10 Hex Head Screw
2 x M10 Shake Proof Washer
2 x Pole Fairing
4 x No3.5x10 Plastech Screw
1 x Nose Cone
3 x No3x10 Plastech Screw
1 x Allen Key 6mm
1 x 3 Way Terminal Block

In the event of loss or damage, consult your dealer or the manufacturer.

Tools Required

- 10mm and 17mm Spanner
- PZ1 Crosshead Screwdriver
- PZ2 Crosshead Screwdriver
- Terminal Screwdriver
- Wire Strippers
- Multimeter (useful)

Other Items you may require

- Tower/Mounting pole
- Tower, Battery and Solar Cables
- Deep Cycle Batteries
- Battery Terminals
- Connector Blocks
- Solar PV Panels
- Blocking Diodes
- Controller Wall Mounting Screws

Other Items available from Marlec

Marlec can provide many quality products to complete your installation, some are listed below. See ***www.marlec.co.uk*** *for more details.*

- Optional Remote Display - (CA-11/121)
- Rutland Marine Mounting and Stays Kit - Options Available
- Land Tower and Rigging Kit - (CA-12/08 & CA-12/07)
- Pre-drilled stainless steel tube(1200/600mm) - (CA-12/03 or CA-12/04)
- Cable 3-core 2.5mm² tinned - (902-037)
- Cable 2-core 2.5mm² tinned -(902-036)
- Battery Cable - Options available
- Solar Cable - Single Core 4mm or 6mm - Options available
- Deep Cycle Batteries - AGM & Gel options available
- Battery Terminals - (901-039)
- Plug and Socket Connectors - Options available
- Solar PV Panels - Framed or Flexible options available
- Blocking Diodes - Options available

Quick Start Guide - Charge Controller

The sequence of connections is critical to the safe setup of the charge controller. Make sure no connections are live during installation.

1. Select a covered, dry, flat vertical wall in a ventilated area within 1.5m of the batteries. Attach the controller to the wall allowing 5cm of clearance for ventilation .
2. Select all cables according to your installation and the ***Cable Specification*** Guidelines (Page 12). You will require:
   - Battery Cables and voltage sensing wire(optional)
   - 3 core wind turbine tower cable to be threaded through the tower
   - Solar cable to connect the solar panel to the controller
3. **Do not make live connections to the controller.** Before any connections are made ensure that the battery cables are disconnected from the battery, all other battery charge sources are off and cover any solar panels.
4. Strip back the power cable ends to be connected to the charge controller by 10mm. All power cable terminals should be tightened with a PZ2 Crosshead Screwdriver.
5. Connect the battery cables to the charge controller observing correct polarity. If the system has only one battery then it must be connected to BAT 1 as this provides the internal power for the controller. **Do not connect to batteries at this stage.**
6. Connect the remote temperature sensor to its port. Connect the voltage sensing wire (optional) to the REMOTE BAT terminals. **Do not connect to batteries at this stage.**
7. Connect the 3 core cable from the wind turbine and tower to the WG INPUT.
8. **Keeping the solar panels covered.** See ***Solar PV Guidelines*** (Page 14) for suitable solar arrays. Observing correct polarity connect the solar panel to PV INPUT terminals.

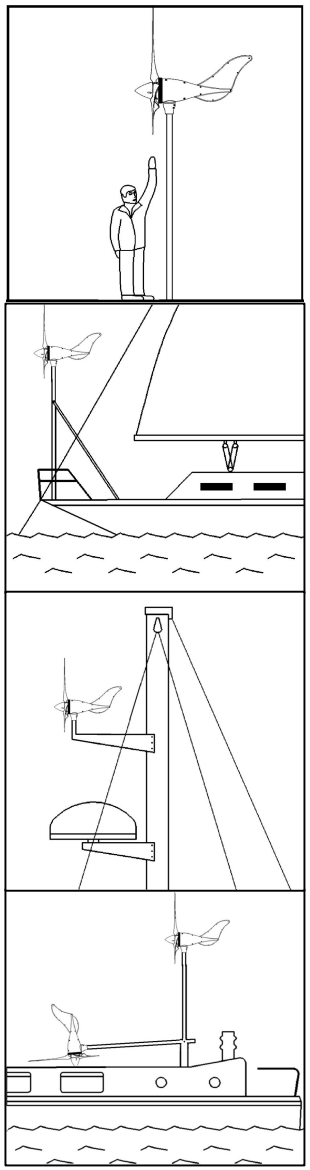
Quick Start Guide - Rutland 1200 Wind Turbine

1. Choose an open site that exposes the Wind Turbine to a clear flow of wind and avoids obstructions. On board mount the Wind Turbine at least 2.4 metres above the deck and on land at least 6 m high. See ***Siting the Wind Turbine*** (Page 26).
2. Choose a mounting pole with an internal diameter of 41mm and external diameter of no greater than 48.5mm for the top 0.6 m to ensure secure fixing to the tower. See ***Mounting the Wind Turbine*** (Page 27).
3. Drill the mounting pole, if required, in preparation to accept and secure the Wind Turbine. *See* ***Assembly and Installation*** (Page 18-20).
4. Join the cable threaded through the pole to the Wind Turbine output cable using the connector block provided and wrap with insulating tape. Alternatively use a latching plug and socket. *We recommend looping back the cable and securing with a cable tie to provide strain relief to the joint.*
5. Carefully push the cables down the pole whilst sliding the Post Adaptor into the pole.

Mounting The Wind Turbine

The Rutland 1200 is designed to fit inside an aluminium or stainless steel tube with an internal diameter of 41mm (1⅝"). The external diameter **MUST NOT** exceed 48.5mm (2") for the top 0.6m of the tower to avoid blade strike. Any play between the tower and the post adaptor must be taken up with a shim.

Suitable tubes: Stainless Steel $1^{3}/_{4}$"16 SWG, Galvanised Steel 40mm and Aluminium $1^{7}/_{8}$" 10 SWG.



On Board Systems

The Wind Turbine should be mounted in a safe position, a minimum of 2.4 metres above the deck and away from other obstacles which could interfere with the blades or tail assembly.

The Rutland Mounting Kit & Stays Kits are available for deck mounting, or use our short sections of pre-drilled stainless steel tube, 1200mm (47") & 600mm (23"), for your own fabrication.

We suggest the following mountings according to preference and site conditions:-

Push Pit

A suitable pole mounted to the deck with deck plates and solid guys is the most popular method of mounting the Wind Turbine on yachts, eg. Rutland Marine Mounting & Stays Kit.

Mizzen

Mizzen mounting is suitable on larger yachts, taking advantage of greater wind flow the higher the wind turbine is mounted.

River Boats

A pivot pole is ideal for riverboats as the Wind Turbine can easily be raised and lowered.

Siting the Wind Turbine

The location and height of the mounting pole or tower for your wind turbine will be the major factor in the overall performance and lifetime of your system. The smooth flow of wind over land and water is often interrupted by a multitude of obstructions causing wind sheer and turbulence.

Wind Sheer is the frictional affect of the ground on the wind, the amount that it reduces wind speed by depends on the terrain and your height above ground. The interference between the fast moving upper air and the slow moving air closer to the ground can also creates turbulence and eddy currents.

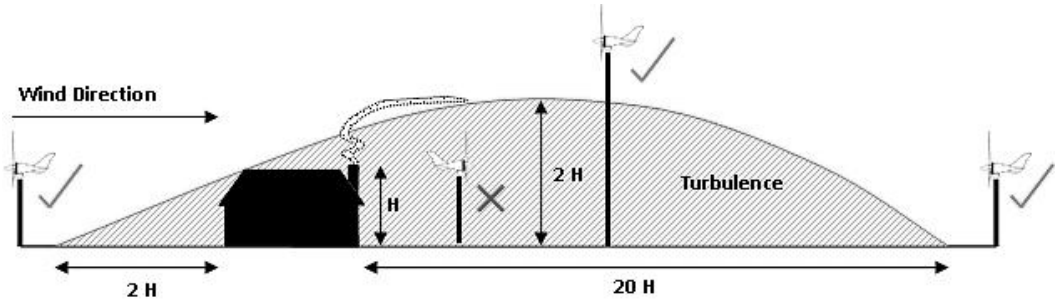
To negate the effect of wind shear we recommend a minimum mounting height of 6m above the ground for land based machines. On yachts this is often not practical to achieve, but as the shear affect of water is much less than land so a lower turbine height can still give good yields.

Turbulence is the effect of obstructions creating eddy currents, swirling the wind in different directions and changing the velocities of the air particles, in their wake.

The effects are greatest downstream of the obstruction so the direction of the prevailing wind needs to be considered for your site, but turbulence also occurs above and in front of an obstruction. As a general rule a tower can raise a turbine out of the turbulent wind, but it is often more practical to move the turbine further upstream or downstream of the obstruction as shown below.

Wind speeds decrease and turbulence increases where obstructions exist so the sitting of the turbine is very important to avoid unnecessary turbulence in order to ensure good yields and turbine lifetime.

Both wind sheer and turbulence diminish with increasing height and can be overcome simply by putting the turbine sufficiently high above them as shown.



Line up the holes and secure in place with the M10 screws and shake-proof washers.

6. Fit the Pole Fairing. Cut the tab off to suit your pole diameter, place the Fairing over the Screw Head and screw together using the No3.5x10 Plastech Screws and PZ2 Screwdriver (Page 19).
7. Assemble the Turbine. Fit the Aerofoil blades to the Rotor Hub Plate, using the M6 fasteners provided. Place the M16 nut in the centre of the blades before you tighten the fasteners. It is essential that 3 screws are fitted per blade (Page 19).
8. Fit the Turbine to the Generator. Screw the turbine on to the Wind Shaft by turning the Turbine in a clockwise direction, to tighten hold the Wind Shaft in place using the 6mm Allen Key provided (Page 20).
9. Fit the Nose Cone using the No3x10 Plastech Screws and PZ1 Screwdriver(Page 20).
10. Ensure connections to the charge controller are permanent. The Wind Turbine should **NEVER** be operated without a connection to the controller.
11. Raise and secure the Tower and Wind Turbine. The charge controller will hold the turbine in stall at this stage.

Quick Start Guide - Up and Running

5 Point Final Checklist

1. Check that all cables are secure and safe, and the tower is not trapped.
2. Check that all electrical connections are permanent and safe.
3. Check for free rotation of the hub and yaw axis. Release the turbine.
4. The wind turbine can now be raised into position. When raised, secure the structure firmly in an upright position. The charge controller will hold the turbine in stall.
5. The solar array can be uncovered. The controller will prevent any current.

Electrical Connection

Connect the charge controller to the batteries. If a second battery bank is to be used connect this first to BAT 2, then connect BAT1.

Connect the voltage sensing wire (if used) to the battery positive.

When connected the battery status LED's will light and the controller will auto configure to 12V or 24V. The Wind and PV buttons will light red to show they are shutdown.

To enable charge press the Wind Button to release the turbine and the PV Button to switch on the solar. The LEDs will light according to the charge status.

The charge controller has now been enabled

and will automatically charge your batteries.

The ***General Guidelines and Warnings, Cable Specifications***, ***Assembly and Installation*** and **Operation** sections expands on the above points.

System Requirements

Cable Specification

The cable used for connection of the Wind Turbine to the Charge Controller and to the batteries should be chosen in accordance with tables shown. The use of a smaller cable than recommended will reduce the performance of the charging system and is a potential fire hazard. Always use flexible, stranded, insulated copper cables.

Battery Cables

The battery cable must be rated to 35A DC minimum if the Rutland 1200 is the only input used. If the full solar input is also used the cable must be rated to 55A DC minimum. See the table below for recommended battery cable sizes up to 1.5m cable length.

Charge Source Connected	Minimum Cable Size	
	mm²	AWG
Rutland 1200 Only - 35A DC	6	10
Rutland 1200 & 20A Solar - 55A DC	10	8

It is recommended that the optional remote voltage sensing should be utilised if the battery cable exceeds 1.5m. This negates the battery cable volt drop from the voltage sensing for charge and regulation points. This gives a more precise charge regime.

The voltage sensing cable only requires 1 length of conductor per battery bank. This is a signal, not a power connection so does not need to be more than 0.75mm².

Wind Turbine Tower Cables

The Rutland 1200 has a 3 phase AC output. A 3 core cable of at least 2.5mm² cross sectional area is required to connect the Wind Turbine to the Charge Controller.

Tower Cable Run	3 Core Stranded Cable Size	
	mm²	AWG
0-50 m	2.5	14
50-100 m	4	12

Solar PV Cables

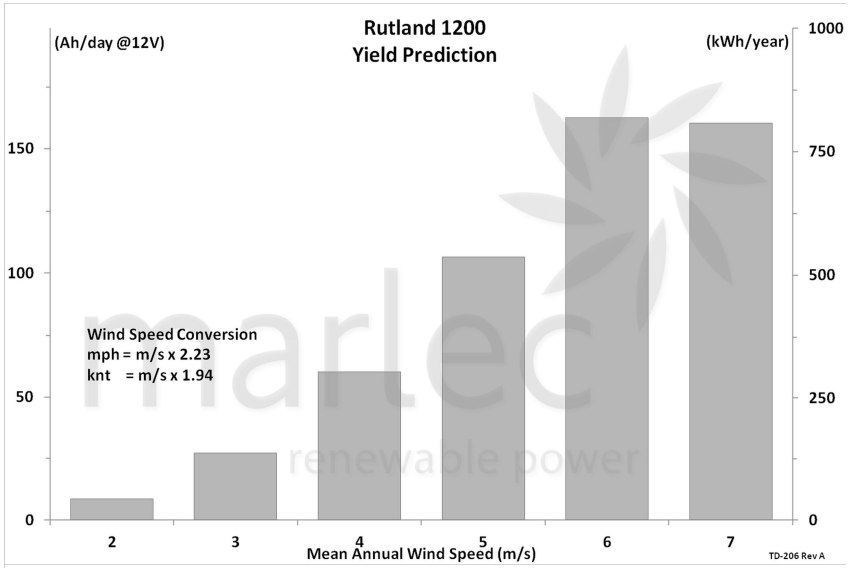
Solar PV generates a DC. This requires a positive and negative conductor that is rated to the current generated by your array. It is recommended that the volt drop along the cable does not exceed 5%.

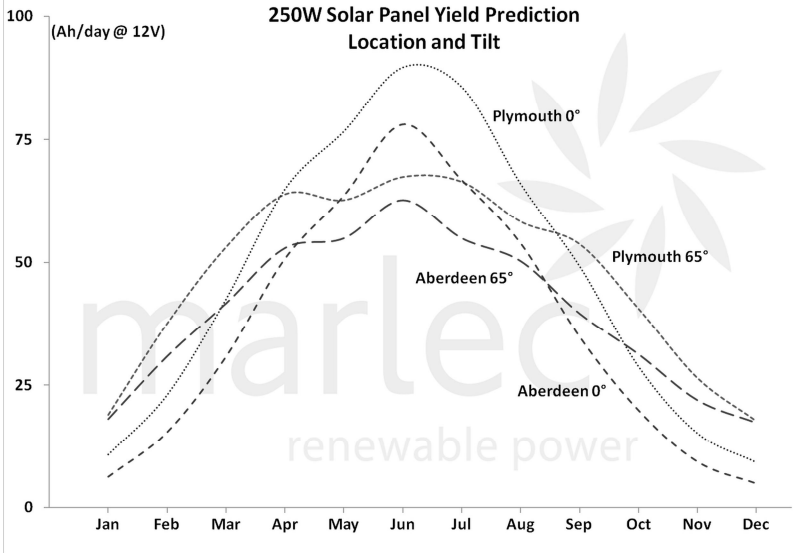
Up to 10A DC Solar - Cable Run	Stranded Cable Size	
	mm²	AWG
0-5 m	4	12
5-10 m	6	10

Up to 20A DC Solar - Cable Run	Stranded Cable Size	
	mm²	AWG
0-5 m	6	10
5-10 m	10	8

Rutland 1200 Wind Turbine & Charge Controller Owners Manual

Wind and Solar Yield Prediction

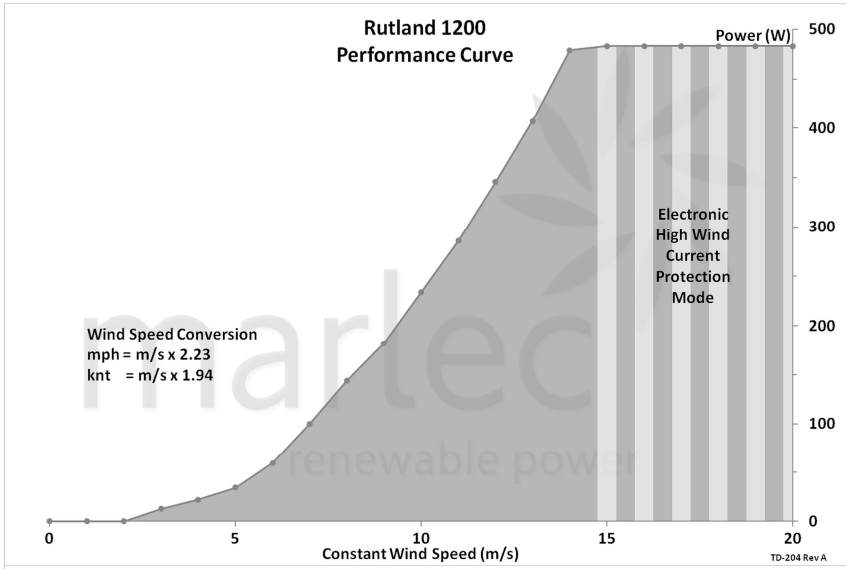


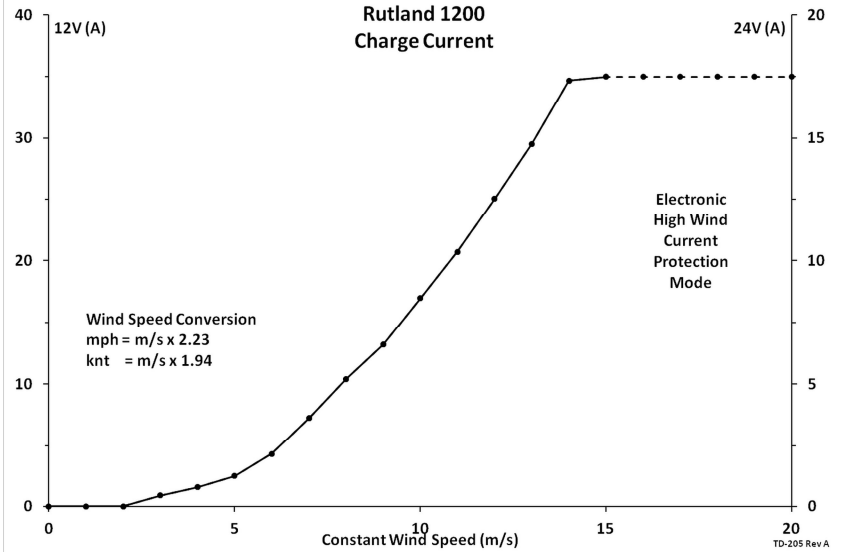


Please Note: These predictions are for typical sites with the yields over time. For this reason sufficient battery backup is needed to guarantee power to your load. It does not guarantee that this much energy will be produced every day, and for poor sites you should expect lower yields and design your system accordingly.
We recommend that an average wind speed of 4m/s is used for yield predictions unless you have accurate wind speed data for your site.

Performance and Yield

Wind Performance Curve





Please Note: The curve shown is for clear, non-turbulent wind conditions; this may not be achieved for some installations. Refer to ***Siting the Wind Turbine*** to optimise performance at your site. Due to wind shear and turbulence the wind experienced by the wind turbine will be different to wind speeds measured at the top of a mast or those reported by the Met. Office.

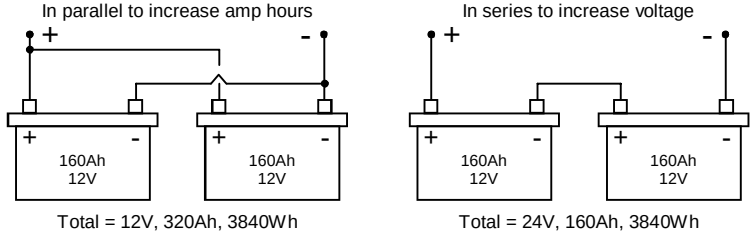
Battery Specification

Leisure / Deep Cycle batteries are specifically designed for good performance in terms of charge / discharge cycles. Batteries are the most important part of the renewable energy battery charging system and should be sized according to the load requirements to provide at least 3 days reserve capacity. This will reduce cycling, prolong the life of the battery and ensure system reliability during periods of low wind or solar.

- Always use the WG1200 Charge Controller to connect to your batteries. The controller prevents batteries becoming overcharged and protects your system in strong winds.
- The controller is designed for use with lead acid batteries. Wet, AGM and Gel.
- Permanent connections should always be made to the battery terminals. Never use crocodile clips or similar devices. Battery terminals should be clean and well greased.
- When connecting a 24V battery it must be charged to 20V or higher to be recognised by the automatic 12 or 24 Volt battery bank detection.
- It is essential to observe correct polarity.

Brown/Red is + Positive & Grey/Black is - Negative

Batteries may be linked as follows:



Battery Bank Capacity

Due to the potentially high charge currents produced by the Rutland 1200 it is recommended a minimum battery capacity following the table below is used. Smaller capacities may used but may result in a loss of charging performance as the battery voltage can quickly rise to the regulation level under the potential rate of charge.

Charge Source	Minimum Battery Capacity	
	12V	24V
Rutland 1200 Only	175Ah	85Ah
Rutland 1200 & 10A Solar	225Ah	110Ah
Rutland 1200 & 20A Solar	275Ah	135Ah

Additional parallel charge sources will also affect the battery capacity required.

Solar PV Specifications

A maximum solar array charge current of 20Amps can be connected to the charge controller. This is equal to approx 250W for a 12V system, and 500W for a 24V system.

The maximum open circuit voltage (V_{oc}) of the array must not exceed 50V over the entire operating temperature range.

The operating voltage of the solar array must be greater than battery voltage throughout the range of expecting operating conditions. A minimum, maximum power voltage at STC (V_{mpp}), of 15V/30V in normal operating conditions is recommended for a 12/24V system.

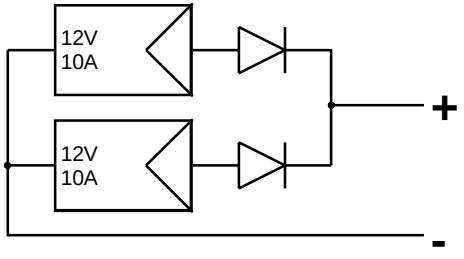
Types of Solar Modules

Off Grid PV modules are designed for battery charging and have nominal voltages of 12V or 24V. Grid connect PV modules have a higher operating voltage and come in modules of higher nominal power.

- If using multiple 12V modules connect parallel for 12V, or series for 24V operation.
- If using multiple 24V modules connect in parallel.
- Only connect grid connect modules alone or in parallel up to 20A charge current.

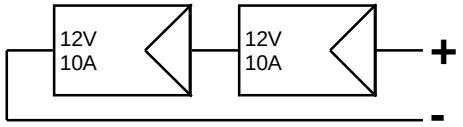
Parallel & Series Connection

Most framed 12V panels have an opening IP54 junction box that can be used to wire panels in series or parallel and allows easy connection of blocking diodes. External junction boxes can also be used. Always refer to the module instructions.



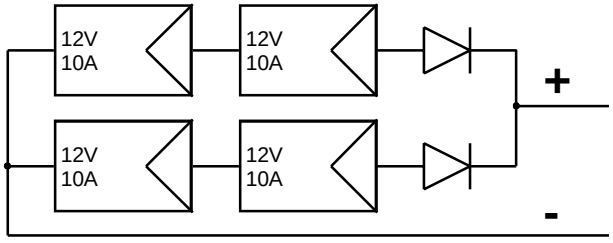
Connect parallel to increase current whilst maintaining voltage.

Total = 20A at 12V



Connect series to increase voltage whilst maintaining current.

Total = 10A at 24V



Both parallel and series connections can be used to match your array to the system requirements.

Total = 20A at 24V

Temperature Compensation

The charge controller uses temperature compensation to adjust the voltage regulation settings according to deviation from 25°C. A colder battery requires charging to a higher voltage level, a warmer battery to a lower voltage level. The external temperature sensor supplied increases the accuracy of the charge controller and should be fitted as close to the batteries as possible.

Electronic High Wind Over-Current & Temperature Protection

This protection mode monitors the charge from the wind turbine. If excessive currents are reached the turbine is stalled by the charge controller. The turbine will be automatically released after approximately 5 minutes to resume charging. The charge controller is also protected against over temperature conditions and should this occur the wind turbine will be also be temporarily stalled. Under both these conditions the "Wind Button" will flash red.

Electronic PV Over-Current & Temperature Protection

The over-current protection condition should only occur if the current rating of the system's PV modules is exceeded (i.e. 20 Amps (I_{pm})). If this does occur check the rating of the PV and downsize if necessary. In this condition the controller needs to be manually reset with the "Solar Button". If the over-temperature condition is activated the charge controller will reset itself. Under both these conditions the "Solar Button" will flash red.

Maximum Power Point Tracking

Wind

All wind turbines have a characteristic relationship of output power to blade speed. Our Maximum Power Point Tracking (MPPT) technology continuously adjusts the turbine speed to achieve its optimum power performance. This increases the generator efficiency and delivers more ampere hours to your battery.

Solar

"Off Grid" PV modules are designed for battery charging and have nominal voltages of 12V or 24V. They are designed so their V_{mpp} is slightly above battery voltage so that they are operating near their maximum power. MPPT will still increase their efficiency.

"Grid Connect" PV modules have a higher V_{mpp} and so when used on a traditional 12 or 24V system are unable to generate their nominal power as they are limited by the battery voltage..

MPPT detaches module voltage from battery voltage allowing module operation towards V_{mpp}. This has several advantages:

- Higher voltage grid connect modules can be used which are often more economical.
- Increased yields as the full I-V curve can be used up to the modules V_{mpp}.
- Higher voltage on the solar input reduces cable losses.

LED Indicators

The two Battery Status Lights are tri colour LED's that show the voltage level of each battery. The BAT 1 LED is always lit if the charge controller is connected to a battery.

Blank	- Battery not connected, (or too low to power the controller)
Flashing Red	- Battery voltage below 11V (22V) - Disconnect loads.
Solid Red	- Battery voltage below 12V (24V)
Amber	- Battery voltage between 12-13V (24-26V)
Green	- Battery voltage above 13V (26V)
Flashing Green	- Battery fully charged. Controller is in regulation mode.

The Wind WG Button and Solar PV Buttons are also LED's that show:

Solid Red	- Manual Shutdown.
Flashing Red	- Controller Managed Shutdown.
Blank	- No charge source output voltage.
Flashing Green	- Standby Mode, currently insufficient output for charging.
Solid Green	- Charging by renewable power.

Further functionality and system indicators are added with the use of the optional remote display.

Operating Characteristics

The pre-programmed settings are suitable for lead acid, AGM and most Gel batteries.
If in doubt refer to your dealer or the manufacturer.

Multi-Stage Charging

Bulk Charge -	All available wind and solar power is used to charge the battery as quickly as possible up to 13.8V.
Absorption -	Constant voltage regulation is used to fully charge up to 14.4V.
Float Charge -	Holds the battery up to 13.8V and maintain this with a trickle charge minimising gassing and prolonging battery life.

If the battery is discharged below 12.5V the charge cycle recommences.

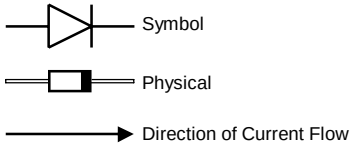
The remote voltage sensing should be used to negate battery cable volt drop for precise regulation set points. This will improve battery maintenance and rate of charge.

Blocking Diodes

Blocking diodes must be fitted if connecting solar modules in parallel strings to prevent backflow of current due to shading. If fitting a single solar module or a single series string a blocking diode is not needed as this is incorporated in the charge controller.

Check the rating (Amps) of blocking diode(s) is suitable for the solar module(s).

Always connect the blocking diode into the positive conductor.



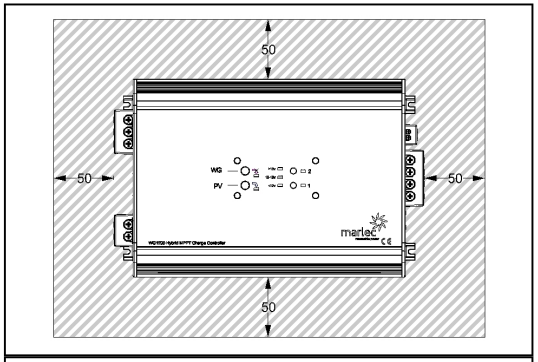
Voltage and Temperature Relationship

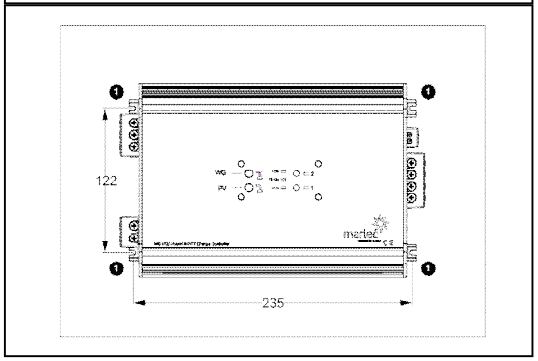
As module cell temperature increases the operating voltage of the solar module drops, this relationship follows a linear temperature coefficient that is provided in the module datasheet. It is therefore recommended to check:

- V_{oc} is below 50V at the lowest expected operating temperature.
- V_{mpp} is above battery voltage at the highest expected operating temperature.

In the UK typical cell operating temperatures are: -10°C min, 50°C typical, 70°C max.

Charge Controller Installation



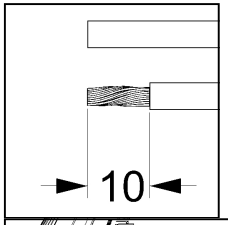


Mounting the Charge Controller

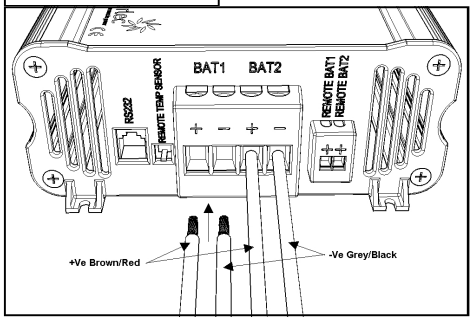
1. Select a covered dry flat vertical wall within 1.5m of the batteries.
2. Ensure the area of installation is adequately ventilated. Maintain at least 50mm of clearance around the charge controller to allow air circulation.
3. With the screws appropriate for your substrate use the 4 mounting points to securely attach controller to the wall with the inputs on the left, and the outputs on the right.

Connecting the Charge Controller

Do not make live connections to the controller. Before any connections are made **restrain the wind turbine from turning** and **cover any solar panels**. **Ensure that the battery cables are disconnected** and other battery charge sources are off.



1. For all power cables that are to be connected strip the insulation back 10mm. All power terminals should be tightened with a PZ2 crosshead screwdriver.



2. Observing correct polarity connect the ends of the battery link cables to the charge controller. If a second battery bank is to be used connect this first to BAT 2 so that it is recognised by the charge controller.

   Please Note: It is essential that there is a BAT 1 connection as this provides internal power to the controller.

Up and Running

5 Point Final Checklist

Before releasing or raising the wind turbine, uncovering the solar panels or connecting the link cables to the batteries:

1. Check that all cables are secure and safe, and the tower cable is not trapped.
2. Check that all electrical connections are permanent and safe.
3. Release the turbine and check for free rotation of the wind shaft and yaw axis.
4. The wind turbine can now be raised into position. When raised, secure the structure firmly in an upright position. The charge controller will hold the turbine in stall.
5. The solar array can be uncovered. The controller will prevent any current flowing at this stage.

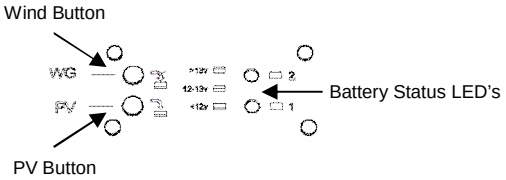
Electrical Connection

Connect the charge controller to the batteries via the link cables. If a second battery bank is to be used connect this first to BAT 2, then connect BAT 1.

When connected the battery status LED's will light and the controller will auto configure to 12V or 24V.

Operation

The charge controller will automatically operate a charging regime for your batteries and display the state of charge via the LED's. You can manually shutdown the wind and solar to stall the turbine and independently stop charging from each source. For more information on the charging regime see ***Operating Characteristics***.



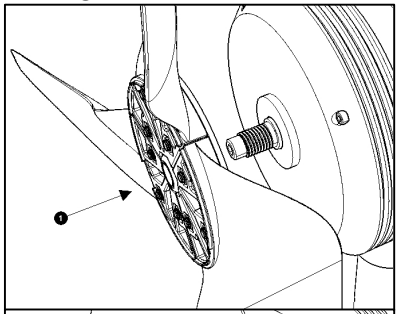
Buttons

To Release the Electronic Stall and begin charging press the "Wind Button". The button will change from Solid Red to show charging by wind power is enabled, the button be lit according to the status of the wind turbine input.

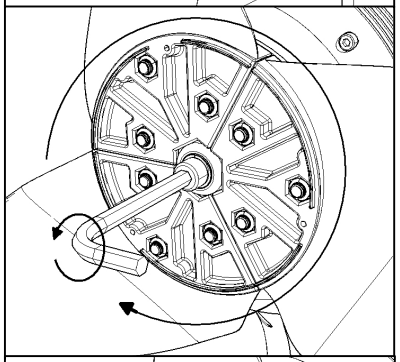
To switch on the solar and begin charging press the "PV Button". The button will change from Solid Red to show charging by solar power is enabled, the button be lit according to the status of the solar input.

Note: The charge controller has now been enabled and will automatically charge your batteries.

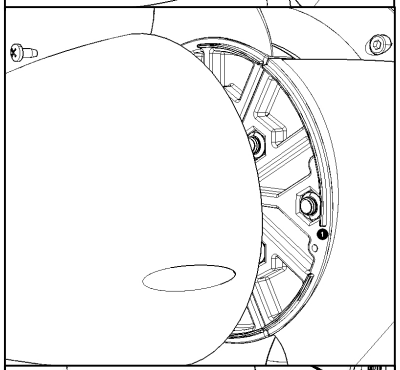
Fitting the Turbine to the Generator



1. Place the M16 Nut held in the Turbine over the Wind Shaft.

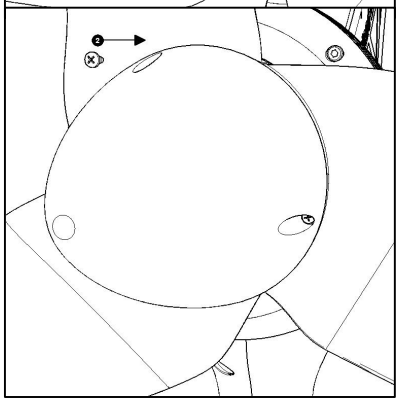


2. Screw the Turbine onto the Wind Shaft by turning the Turbine clockwise, to tighten hold the Wind Shaft in place using the 6mm Allen key provided. Hold the blades near the root to avoid damaging the aerofoil. Ensure that the Rotor Hub Plate is squarely located on the shoulder of the Wind Shaft.

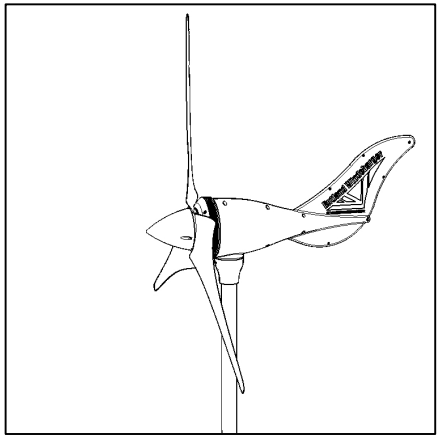


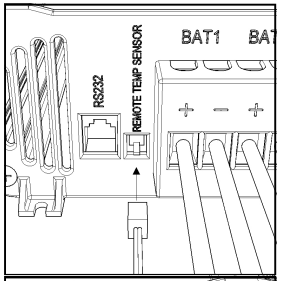
Fitting the Nose Cone

1. Locate the Nose cone over the rib on the Turbine and align the 3 screw holes.
2. Secure the nose cone using the 3 No3x10 Plastech Screws (supplied) and a PZ1 Screwdriver.



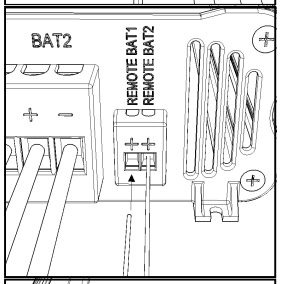
You have finished your Rutland 1200 Assembly





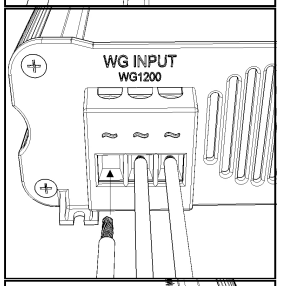
3. Place the end of the remote temperature sensor next, or as close as possible, to the batteries and secure in place. Plug the sensor into its port.

   Please Note: If the remote temperature sensor is not connected temperature compensation is disabled.



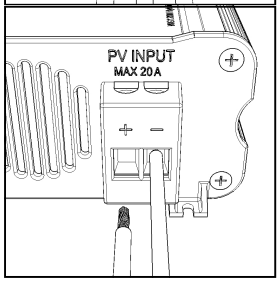
4. Using a terminal screwdriver connect the sensing wire to the REMOTE BAT terminals.

   Please Note: If the remote voltage sensing is not used the controller will use the voltage of the power cables for all calculations. This has a volt drop associated which will reduce the accuracy of the charging regime.



5. Connect the 3 core wind turbine tower cable to the WG INPUT on the charge controller. The order is not important.

   Please Note: The Rutland 1200 must be connected directly to the charge controller with no switches or fuses.

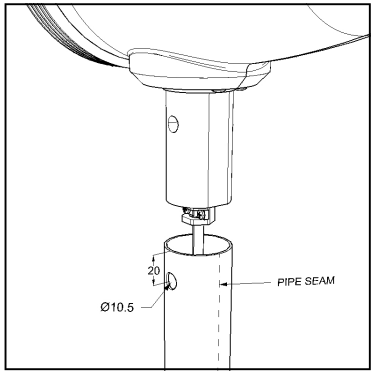


6. Ensure the solar array is covered. Observing correct polarity connect the cables from the solar to the PV INPUT on the charge controller. Do not uncover the solar array at this stage.

7. Ensure all connections are permanent and that cable runs are secure and safe from tripping or any sources of strain or damage.

You have finished installing your charge controller

Wind Turbine Assembly



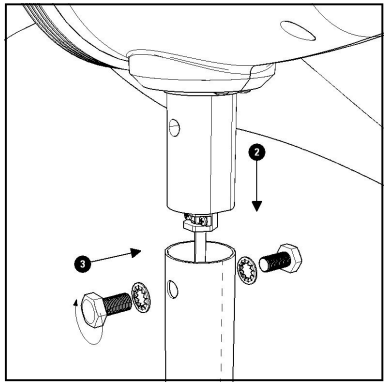
Tower Preparation

1. Select a suitable pole from the suggested guidelines in ***Mounting The Wind Turbine****.*

Note: The post adapter fitted to the Rutland 1200 is designed to fit inside a standard 41mm (1⅝") internal diameter tube and is provided with a flat on one side to clear any tube weld seam.

Items 2 & 3 can be ignored if using a pre-drilled Marlec pole.

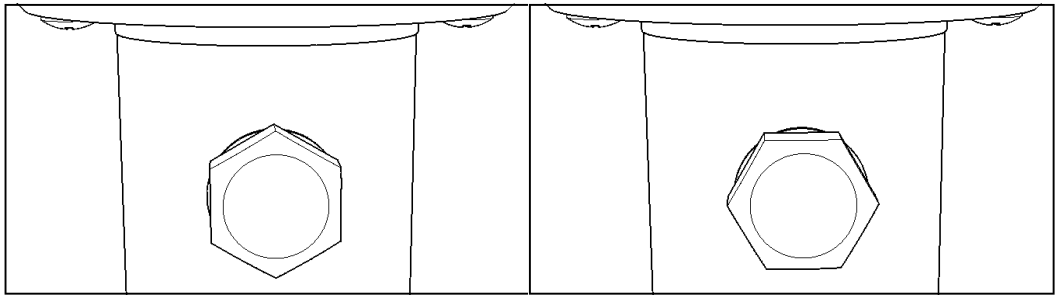
2. 20mm from the top, mark and centre-punch two positions diametrically opposite at 90° to any seam.
3. Pilot drill then drill two 10.5mm holes on centre-punch positions.
4. Thread your tower cable through the pole and securely position your tower following instructions ***Siting the Wind Turbine & Mounting the Wind Turbine*** (Page 26/27)



Fitting the Rutland 1200 to the Tower

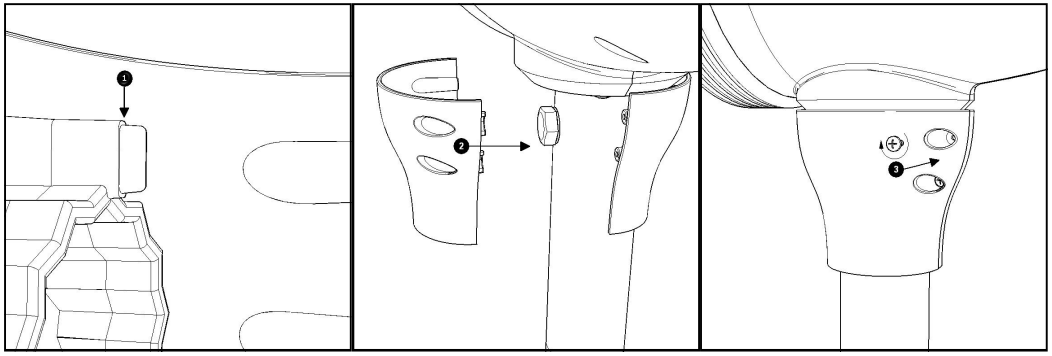
1. Strip the Wind Turbine and Tower Cables 10mm and join using the 3-way connector block provided. Wrap the connection with insulation tape to secure/protect from environment. We recommend looping back the cable and securing with a cable tie to provide strain relief to the joint. *Alternatively join the cables using a plug and socket.*

2. Carefully push the cables down the pole then slide the post adaptor into the pole whilst keeping the screw holes lined up.
3. Secure in place with the M10 screws and shake-proof washers (supplied). Using a 17mm spanner tighten the M10 screw against the shake-proof washer ensuring the head is secured in a upright or horizontal position as shown below. This allows the fitting of the pole fairing.



Fitting the Pole Fairing

1. For thin wall stainless steel poles proceed to Step 2. For thicker wall galvanised steel the Tab on the inside of the Pole Fairing will need trimming to the step.
2. Push the Pole Fairing over the M10 Hex Head. This also acts as a locking device.
3. Screw together the pole fairing using the 4 No3.5x10 Plastech Screws (supplied) and a PZ2 Screwdriver.



Turbine Assembly

1. Place a M6 Nylock Nut (supplied) into the nut recess in the aerofoil blade**.**
2. Align with a hole in the Rotor Hub Plate and partly tighten a M6 Screw (supplied) in from the back of the plate. Repeat with 3 fasteners on all 3 blades. Measure between the blade tips to check equal spacing.
3. Fit the M16 Nylock Nut (supplied) into the recess created by the 3 blades.
4. Finish tightening the M6 screws using a 10mm spanner from the back of the Rotor Hub Plate. Hold the blades near the root to avoid damaging the aerofoil. Check tightness of all screws but do not over-tighten.

Caution - All 9 screws must be fitted!