PowerMax+

INSTALLATION MANUAL
5000W Low-Speed

A&C GREEN ENERGY
Renewable Energy for Life

Contents

Prior to installation and operation, it is important that you thoroughly read this manual to ensure proper performance and safety.

1. Statement from A&C Green Energy

For contents described in this specification, A&C Green Energy can not ensure its completeness and accuracy. For the any installations which lay beyond normal installation sites, A&C Green Energy will not make any instruction or guarantee.

A&C Green Energy is not responsible for any damage and/or injury caused under the following situations:

* Damage caused by any inappropriate operation
* Damage caused by lightning, typhoon and other force majeure
* Damage occurred after the warranty has expired

Notice: All installation instructions & drawings are valid only within the warranty period.

Note: Proper installation depends on the safety precautions and attention of the installer. Please follow common sense guidelines for correct operation, technique and installation. A&C Green Energy will not be responsible for any inappropriate operation which may cause any property damage or personal injury. All risks will be assumed by the end-user and his designated installer.

Please note: the annual electricity output from the wind generator is determined by the local wind resources and other factors, such as the installation elevation of wind generator, environmental temperature, maintenance, terrain and density of periphery buildings. A&C Green Energy can not make any guarantee for the actual power output and energy generated by the wind generator.

This product specification is a general installation guide only and cannot be used as a special maintenance guide.

2. Summary

2.1 Information

We have improved this product specification, but at the same time, A&C is improving its products unremittingly. There may be some undocumented differences between the product you received and this specification.

Please use original PowerMax+ parts. Do not refit the original assembled wind generator; otherwise it may void the repair warranty.

2.2 Mark Illustrations

Within this guide, please pay close attention to the following tips and warnings:

Warning： means there are risks that may cause personal injury, or perhaps death.

Caution: means there are risks that may cause wind turbine, equipment or property damage.

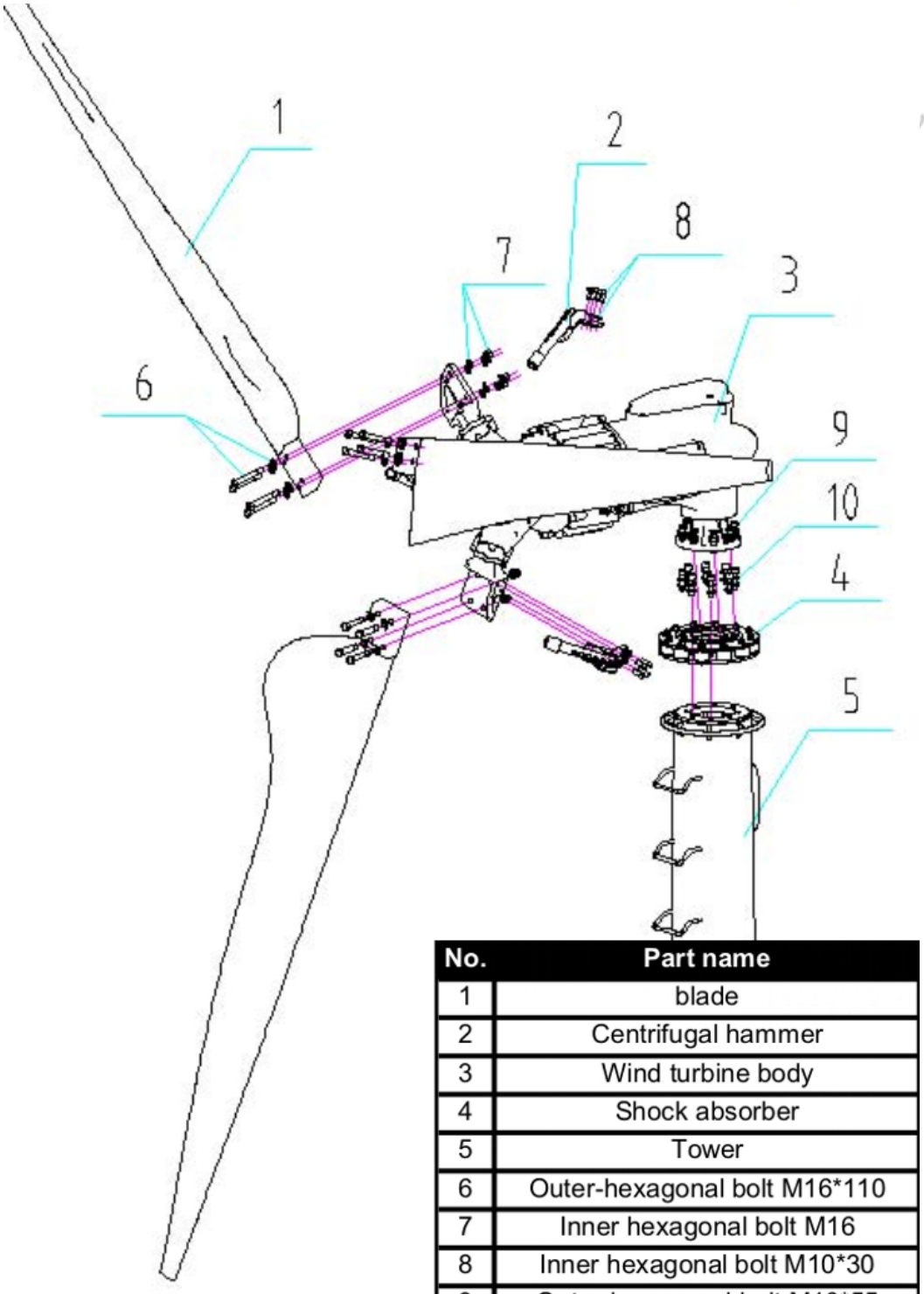
Advice: helpful installation & maintenance hints from the manufacturer.

2.3 Applications for Use

- Off-grid application: The electricity generated by the wind turbine can be stored into batteries. Through an off-grid inverter, the DC can be changed into stable AC for off-grid power supply.
- On-grid application: The electricity generated by the wind turbine can be rectified into DC. Through an on-grid inverter, the DC can be converted into stable AC and feed the local utility grid.

2.4 Structure and Main Property

This turbine is composed of pitch blade, permanent magnet generator, rotary body (including the slip ring and mechanical braking device), tower, braking switch, electric controller, battery bank, inverter, cable, etc.



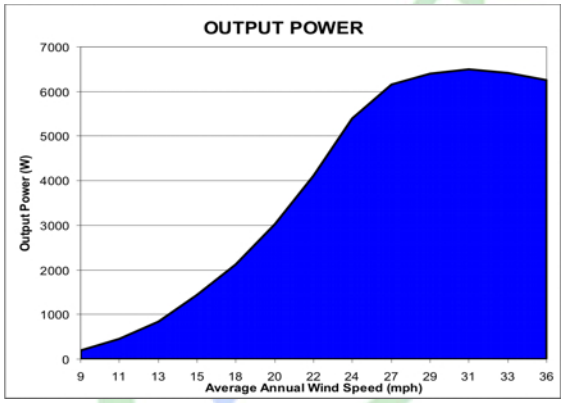
No.	Part name
1	blade
2	Centrifugal hammer
3	Wind turbine body
4	Shock absorber
5	Tower
6	Outer-hexagonal bolt M16*110
7	Inner hexagonal bolt M16
8	Inner hexagonal bolt M10*30
9	Outer-hexagonal bolt M16*55
10	Inner hexagonal bolt M16*55

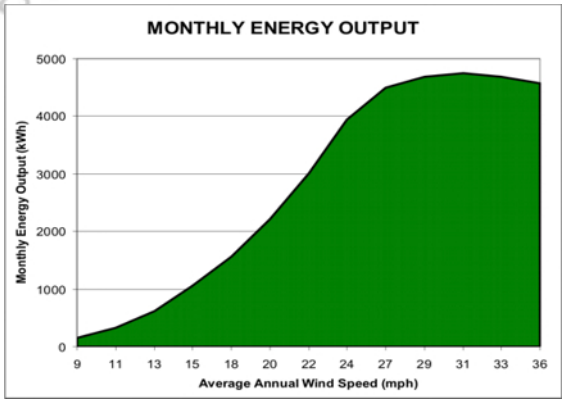
2.5. Technical Specifications

TECHNICAL SPECIFICATIONS

Blade Diameter	18.37 feet
Blade Material/Quantity	FRP/3
Rated Power	5,000 W
Rated Wind Speed	24.6 mph
Start-Up Wind	6.7 mph
Working speed(m/s)	9-56 mph
Survival Wind	112 mph
Rated rpm (r/min)	240
Working Voltage (v)	Standard DC240V /non-standard AC120-500V
Generator Type	Three-phase AC PM
Power Supply Method	3-phase whole-wave bridge rectifier constant DC voltage charge with output voltage of AC220V/380V, it can feed the grid through an inverter.
Speed Regulation	Variable blade pitch method(mechanical).
Shut Down Method	Hand/Electric Winch
Turbine Main Body	750 lbs
Generator Lifespan	15 years

2.6. Output Power and Performance Curves





Wind Speed (m/s)	4	5	6	7	8	9	10	11	12	13	14	15	16
Wind Speed (mph)	9	11	13	15	18	20	22	24	27	29	31	33	36
Output Power (W)	200	450	850	1450	2130	3030	4120	5400	6150	6405	6500	6415	6250
kWh	146	329	621	1059	1556	2213	3010	3945	4492	4679	4748	4686	4566

2.7 Wind Turbine Features

2.7.1 Blades: With high tip-speed and lift-over-drag ratios, and a noise of lower than 65db, the blades have been aerodynamically optimized for better performance. The blades have passed extensive wind tunnel tests. Made of special purpose gel-coat resin and reinforced FRP, each PowerMax+ blade set is highly durable and will guarantee safe operation under a wind speed of up to 2 times the rated wind speed. When static, it can resist a wind speed of up to 60m/s. Its wind power efficiency is higher than 0.4.

2.7.2 Generator: Made of strong magnet material, and a good quality shaft, the generator housing has adopted the F-grade insulation and IP54 protection, as well as a maintenance free design. All this has contributed to over a 30,000 hour lifespan. The motor shell has been aluminum coated with power generating efficiency of over 90%.

2.7.3 Nacelle: Made of a welded steel plate with high durability and strength, the nacelle surface has been galvanized to protect it under such harsh environments as humidity, sand storm, and salty mist.

2.7.4 Blade Pitch Technology: The mechanical variable blade pitch technology allows the generator to be started more easily. When the wind reaches a speed of 7 mph, the rotor will begin to rotate. Within the wind speed of 9-25 mph, driven by the centrifugal force, each blade will change its position gradually, tracking the relative high lift-over-drag ratio for better operating efficiency; When the blades are rotating fast, each blade's centrifugal hammer will draw the blade backward towards its original position. This action ensures that the generator safely maintains its intended operation speed range, with a maximum rotation speed of no more than 280 rpm.

3. Safety Rules

- Do not allow the turbine to run without a load, or at continual high speeds.
- If applicable, check the guyed tower and guy wires regularly to ensure proper tension.
- Do not stand under a wind turbine during high winds.
- When the wind speed is over 24m/s, manually shut down the wind turbine.
- If there is an unprecedented vibration or strange noise being detected during turbine operation, stop the wind turbine for inspection.
- When wiring the wind turbine system, connect the battery bank first, then the output cable of the generator; in disassembling the turbine system, please disconnect the output cable of the generator before cutting off the battery line. （See appendix 5）
- The switch on the breaker panel should be in the "on" position. This should only be turned off when the batteries have been fully charged or to protect the system from devastating gusts. This switch should be touched only when the turbine is rotating slowly.
- The battery bank should be kept away from fire, heat, and direct sunlight. Any harmful gasses from the battery charging and discharging should be exhausted on a timely basis.
- Keep the rotor balanced to eliminate any vibration: In the case that the blades become unbalanced, the wind generator must be shut down for a check. Once the trouble has been eliminated, the unbalanced torque should be no larger than 0.02N.m.

CAUTION Do not touch the "off" switch on the breaker panel when the wind turbine is rotating fast. The electric breaker can only be turned off when the turbine is stopped or rotating slowly!

WARNING Keep the battery far away from heat or fire. All harmful gas emitted during the charging process should be discharged outdoors. To prevent a short circuit, please use a well insulated tool to wire the batteries.

4. Preparation

4.1 Foundation Construction for Guy Tower (as shown in Appendix 2)

1. Dig a hole that is 20”x20”and 28” deep for the tower base piling. Dig four triangular holes that are 3’x3’x3’ and 3’ deep for the guy support pilings (ABCD) all evenly spaced from the center hole. The crossing point of line A-C and B-D should be the center of the first square pit).
2. A suggested concrete mixture ratio is 1 : 2.2 : 3.5 (cement : sand : pebbles)
3. Fix the tower base plate with the four foundation bolts and screw on M16 screw nuts (until about $^1/_2$ inch of the bolt head gets through the nut). Set the base plate level about 1 $^1/_2$ inches above the ground with its pins aligned with the A-C or B-D line. After this, fill the hole with concrete until the foundation is flat and level.
4. Put a ground anchor into the outer most position of the triangle pit with the chain link inclined towards the center. Pave a layer of crushed stone onto the bottom of the pit, and cast one layer of concrete, pile up a layer of stone (unit weight of about 5-10 lbs) on to the first layer of concrete then add another layer of concrete. Repeat this alternating process until the pit has been filled. Then, pull the chain link towards the center of the ground so as to let the chain link form a 50°-60° angle with the ground.
5. Wait around 100 hours to allow the foundation to set. During this period do not touch it or attempt to install the wind turbine.

4.2 Foundation Construction far Free-Standing Tower or Monopole (as shown in Appendix 3)

1. Dig a 9’×9’ square hole that is 4’ deep
2. Construct a steel frame grid basket as shown in appendix 3. The proper construction of this reinforcement is crucial to the strength of the tower base.
3. Fill the hole with a 4” concrete base and put the steel frame grid basket into the bottom.
4. Fix two layers of boxed boards into the pit and put the steel frame in, fix the position of ground bolts by upper and lower hole plates at a stipulated depth.
5. Pour the concrete
6. Wait around 100 hours to allow the foundation to set. During this period do not touch it or attempt to install the wind turbine.
7. Refill the soil and stone. Tamp it.

4.3 Installation Preparation

1. Check the components with the packing list. If you encounter any packaging discrepancies, contact your PowerMax+ reseller immediately.
2. To protect against wind and rain, place the charge controller and inverter into a weather-resistant box.
3. Have φ4mm (for braking) and φ12mm (for guy tower) steel or galvanized rope (it is adjustable based on the tower height.)
4. Prepare a suitably long cable that is 6㎡ in cross section with a current intensity of around 4A/m ㎡. If the cable is rather long, enlarge the cross section properly.
5. The distance between the turbine and controller, inverter, and battery bank should be no longer than 50m.
6. The turbine should be installed when the wind is not strong.

5 Installation

5.1 Tower Installation

5.1.1 Assembly of a Guy Tower

1. Set the base plate horizontally over the protruding anchor bolts. Then put the washers onto the bolts. (Fig 1) Tighten the nuts with a proper torque (see Appendix 1). Fit together the upper and lower tower segments. Lay down the tower beside the anchor pit A (Fig 1B). Connect the tower bottom with the base plate by a φ30 gemel, then put on the washer and insert the slip pin.
2. Pull the guy wires toward the four separate anchor bases ABCD. Hook the ferrule (on each end of the guy wires) over the hanging ear.
3. A turnbuckle with O-ring on both ends should be used to allow for any future cable adjustments.
4. The turnbuckle should be adjusted to have a middle length at first. Wrap one end of the ring with steel wire (the lapping part of the rope should be no shorter than 6 inches), fixing them by a rope clasp temporarily. Connect the turnbuckle of the anchor pits ABD with their respective ground anchors. Erect the tower then hook up the last ground anchor with the turnbuckles of the anchor C. Erect the tower vertically by adjusting the length of the wires. There should be a wire block on each end of the wires, fixing it at last.
5. Tighten all the screws.
6. Put a bracket (3 feet in height) at the pit A. Tighten the turnbuckles of anchor pits B & D properly (around 2 inches). Release the connector link between the turnbuckles of anchor pit C and ground anchor. Lay down the vertical bar slowly and support it by the bracket.

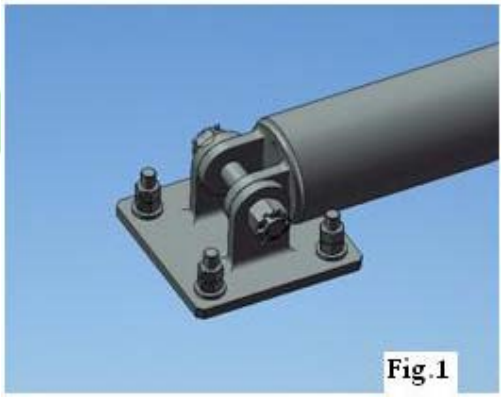


Fig.1

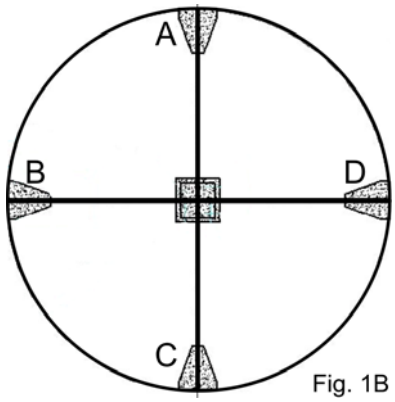


Fig. 1B

5.1.2 Assembly of a Free-Standing Tower

1. Connect the upper and lower tower rod together by plug-in or butt-joint; tighten the flange bolts.
2. Lay down the tower rod with the base near the foundation; put a bracket beneath the tower about 1 $^{1}/_{2}$ feet from the tower top to support it.
3. Insert the cable and steel rope of the winch into the tower bottom and draw at least 18 inches of them out from the tower top by using a steel wire (ϕ 2~3 mm).

5.2 Wind Turbine Body Installation

5.2.1 Assembly of a Generator with a Rotary Body

1. Fix the attached patch board inside the top end of the tower rod, wire the exposed power cable from the vertical rod with three terminals on one side of the patch board and tie three turbine output cables onto the terminals on the other side of the patch board respectively; pull the power cable outside the tower rod and connect it with the controller.
2. Take the vibration isolator out, align the flange holes of the vibration isolator with the flange hole of the tower top, and tighten the eight M16×60 inner hexagonal bolts (including the spring washer and flat washer). Lift the wind turbine main body to align the flange of the vertical shaft with the flange of the vibration isolator, finally connect the turbine vertical shaft with the vibration isolator by another eight M16×60 inner hexagonal bolts.

Fig.2

Fig.3

5.2.2 Rotor Assembly

1. Lift the turbine body which has been connected to the tower rod with the blade hub being upward. (figs 4 and fig 5)
2. Short connect the three output cables to lock the rotation of the blade hub.
3. Assemble the three blades onto their respective positions of the blade hub by 12 M16×110 hexagon bolts (with big washer, spring washer and nuts). The blades should match the hub, so follow the A, B &C that are on these pieces. The torque of the bolts should be 180~210Nm.

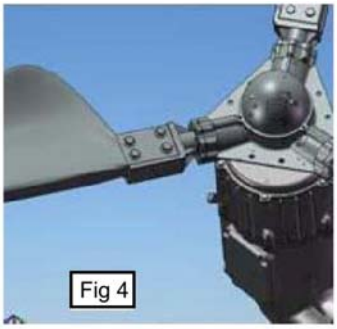


Fig 4

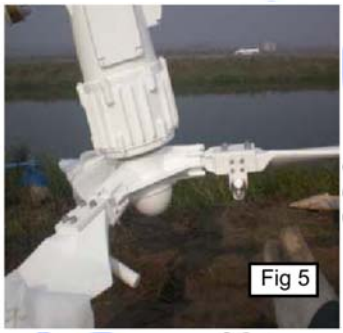


Fig 5

⚠ WARNING

Short connect the cables first to prevent blade rotation.

5.2.3 Assembly of the Centrifugal Hammers

Hold the centrifugal hammer downward and fix it onto the blade hub each by four M12×20 hexagon bolts and spring washer. (as shown in figs 6,7,8)


Fig.6


Fig.7

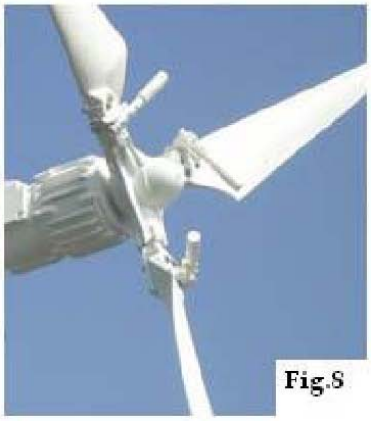


Fig.8

5.2.4 Winch Installation

Install the winch at the tower bottom with the provided bolts. Connect it with the steel wire from the turbine main body. (see fig 9,10)

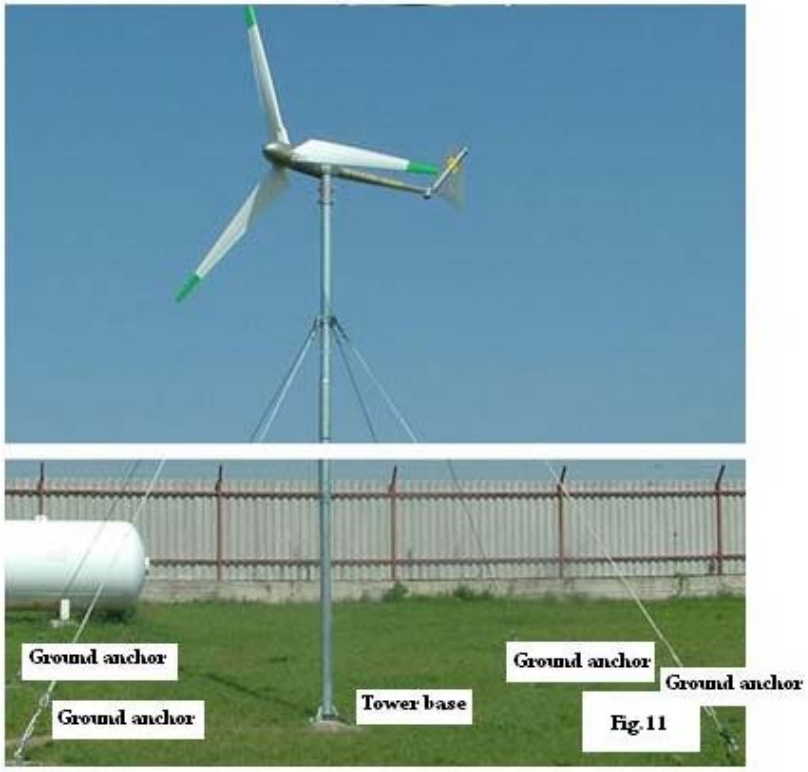
Fig.9

Fig.10

5.3 Erecting the Wind Turbine

5.3.1 Erecting a Guy Tower

1. Connect the steel guy wires to their positions. Use a crane and a flexible lifting belt to lift the turbine and tower. Carefully align the tower with the base plate and connect them by stud-bolt, while lifting the turbine, fix the turbine by using a rope. Adjust the tower position to let it stand against the ground as vertical as possible, tie the steel guy rope with the ground earth anchor and adjust the perpendicularity of the tower by screwing and adjusting the four turnbuckles.
2. Have an overview on the rope clamp, turnbuckles and all the fasteners, if they have all been fixed firmly, lock them by a galvanized iron wire, and spread anticorrosion grease around the turnbuckles silk pole, connecting pin and rope clamps.



5.3.2 Installation of a Free-Standing Tower

1. Screw two positioning pin into the feet bolts diagonally.
2. Lift the rotary body and the tower top by a flexible hanging belt, aiming at the positioning pin, move the belt to let the tower sit onto it's foundation accurately, put on the flat washer and spring washer, screw on the M24 nuts. (See fig 12)
3. Screw off the positioning pin, put the flat washer, spring washer and screw onto the nuts.
4. Adjust the perpendicularity of the tower against the ground into 0.002×height（m）by screwing the 24 nuts of the tower base flange, keep this perpendicularity and tighten all the nuts diagonally with each upper and lower nuts of the same pair being tightened simultaneously.(See figs 12, 13, 14)

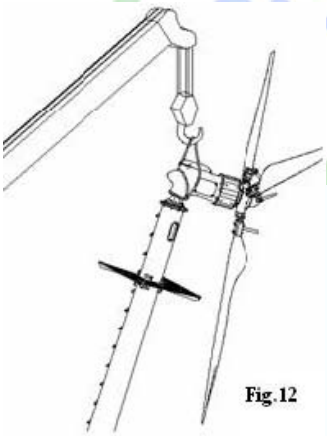


Fig. 12

Fig.13

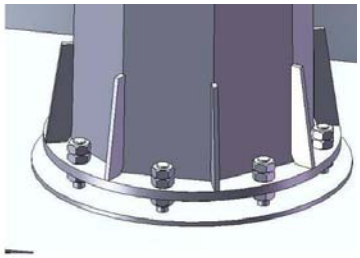


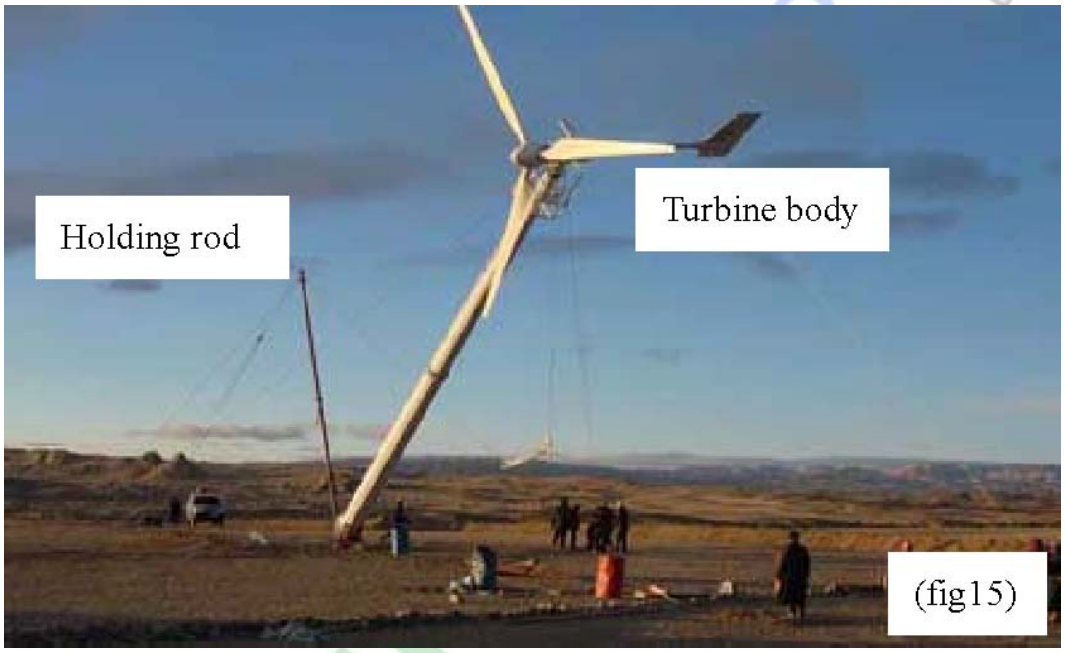
Fig.14

⚠ WARNING

During the installation, please short connect the three output cable first in order to prevent the rotation of blade, fix the turbine by rope.

5.3.3 Using a Jin Pole

If a crane is not available for the tower installation, a jin pole or holding rod method should be considered. For detail please refer to a tower consultant in your area.



6. Assembly and Connection of the System

WARNING The wiring diagram for different types of turbines may vary. The wiring diagrams attached in appendices 4 and 5 are only valid for the turbine controller and inverter from A&C Green Energy.

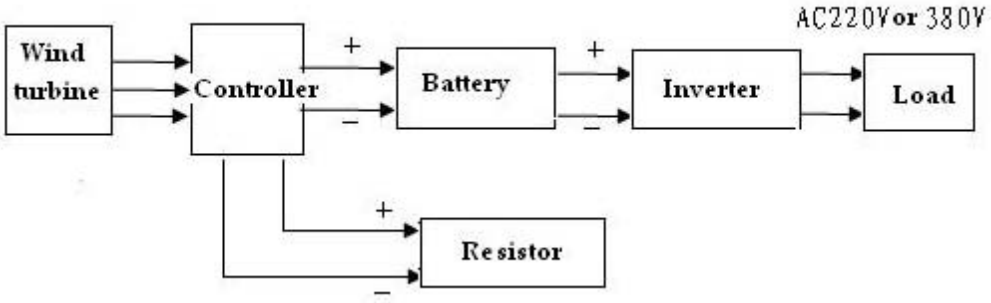
6.1 Off-Grid System with Batteries

1. Battery bank combination: combine the batteries into a battery bank by using copper cable to connect batteries. Mark the "＋" pole with red paint, the"－" pole with black, yellow or blue paint. Fix the wire connecting part by clasp to guarantee strong conductivity. Spread a grease layer around the terminal and wire clasp to prevent corrosion. Connect the three power output cable with the three terminal of the electric box.
2. Connect the three turbine output cables with the three terminals on the controller respectively.
3. Connect the output cable of the controller with the "+""-" poles of the battery bank.
4. If the dump load box is separate from the controller, connect it with a 6mm² wire.

6.2 Off-Grid Supply System

6.2.1 System Diagram (see appendix 4)

6.2.2 System Brief



The off-grid wind generator powers the load through a battery bank, and the electricity will be stored in the batteries after being converted into DC by the controller. When there is enough wind blowing, the generator will generate electricity and charge the batteries, thus the electricity from the batteries will be converted by an inverter before it can be used by the load.

1. Wire the turbine, controller, battery bank and dump load following the depiction in Section 6.1. Connect the input terminal of the inverter with the "+" "-" of battery bank. Connect the load with the output (AC220V) terminal of the inverter. For details, refer to the controller and inverter users manuals.
2. The off-grid turbine system will be available for use after the completion of the wind turbine system assembly. Please start the turbine to charge the batteries before the inverter has begun to power the load.
3. Much of the electricity from the off-grid turbine will be stored into the batteries. Periodically refill the batteries to maintain their lifespan. Adjust the load consumption based on the local

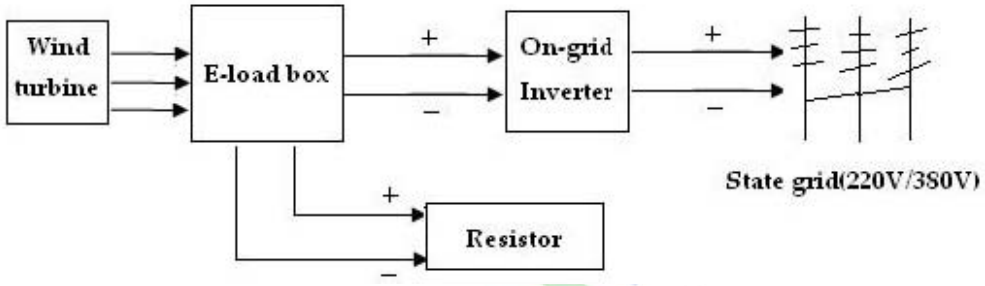
wind condition and power generation status.

4. The voltage level of the batteries should match those of the wind turbine. The inverter output voltage level should also be consistent with that of the wind turbine's voltage. The inverter capacity should satisfy the peak power of the load.

6.3 On-Grid Supply System

6.3 1 System Diagram (wiring diagram see appendix 5)

6.3.2 System Brief



An on-grid turbine system consists of a wind turbine, on-grid controller, dump load box, inverter and utility/electric system (the "grid"). The turbine will convert the kinetic power of wind into unstable AC, which is then rectified into DC by the on-grid inverter. It will be converted into stable AC. Then it can either be used by the load (appliances and household electronics) or fed back into the power grid.

6.3.3 Wiring of an On-Grid Wind Turbine System

1. Wire the turbine system based on the turbine controller and inverter manuals.
2. The on-grid inverter efficiently feeds the AC220V/AC380 grid, but it needs a dump load, a power-off automatic shut-down, etc.
3. For safety, the capacity of the controller's dump load should be 2-3 times that of the rated capacity of the turbine and load.

7. Operation Manual

7.1 Testing Examination

1. Check the tightness of the blades, turbine rotor, nose cone, generator, rotary body and centrifugal hammers.
2. Check to see if the installation angle of each blade and centrifugal hammer is proper.
3. Check the connection of the tower and base bolts
4. Try to turn the turbine to see if the generator is sticking.

7.2 Checking the Generator Output Line

1. Open the nacelle window to see if the output cable and brush have a good connection.
2. Using a multimeter, check for good conductivity between the terminals and slip ring.
3. Check the tightness between the three turbine output cables and power cable to see if the terminal has been fixed or whether the cables or steel wires have become twisted.

7.3 Check Blade Pitch and Braking Mechanism

1. Check the tightness of the steel rope and winch connection.
2. Stop the turbine by hand, hand-crank the winch by 2-3times to tighten the steel rope, and then check the blade position.
3. Start the machine and slowly hand-crank the winch until the steel rope is loose. Watch for the turbine to begin rotating.

7.4 Checking the Turbine's Electric System

Check all electrical equipment including: controller, battery bank, inverter and dump load. Make sure they have been properly connected and are in good working order.

7.5 Trial Operating

1. The turbine should be static before the trial test.
2. Start the turbine and check the flexibility of how the turbine tracks the wind direction: when the wind speed reaches 4m/s, the turbine should be able to track the wind direction.
3. The turbine will begin to rotate when the wind speed has exceeded 4m/s, the rotation speed of the turbine will be a slightly higher during the first several startups, becoming gradually normal.
4. During the trial running period, the turbine should remain stable with little vibration. The voltage of the three output cables should be identical. The blade will change its position when the wind speed has exceeded the rated speed. The peak output power of the turbine should be no larger than 1.5 times that of the rated power.
5. During the trial running of the turbine, maintain and operate the turbine following the depiction of the operating manual, the controller, batteries, inverter should be able to power the load or feed the grid normally.
6. If the turbine has passed the above trial run, it is ready normal operation.

7.6 Normal Operation

1. The turbine system should be put into service only after all of all its components have passed the trial test.
2. The turbine should be serviced only by an authorized professional. Call your PowerMax+ reseller should you need help finding a technician.

7.7 Shut Down Methods

1. **Automatic shut down**: The controller will detect the signal from the turbine system, including the output voltage of generator and working time of the dump load box. If either of the two signals exceeds the normal range, the controller will shut down the turbine automatically.
2. **Manual shut down**: The turbine can be shut down by the braking switch on either the controller or the electric/manual winch, if necessary, for maintenance, approaching storm, etc). After the braking switch has been triggered, the turbine blades will change angles gradually, slowing the rotation of the turbine.
3. During the normal shut down of the turbine, there is no need to turn off the turbine controller and inverter. When the turbine is being shut down for a long time, the controller and inverter should be turned off, in order to save the power of the batteries and protect the turbine.
4. **Restart**: The wind turbine should be restarted by an electric winch, regardless if the turbine is stopped by either manual or automatic braking method.

⚠ WARNING

When turning off the controller and inverter, shut down the controller before the inverter. When starting up, follow the same procedure.

8. Examination and Maintenance Manual

8.1 Routine check

1. If there is abnormal vibration or noise, shut down the turbine for further inspection.
2. Check if the yawing is stable and smooth when there is over-speed wind.
3. Check if the 3 phase output is stable, making sure its load dumping is smooth and reliable.
4. Check if the batteries have been fully charged, and which is in good state.
5. Open the nacelle window; check if the spine shaft has been well lubricated and clean.
6. Open the nose cone, check if the joint bearing is clean and has been lubricated.

8.2 Maintenance after first 1,000 hours

8.2.1 Check all nuts and bolts, and tighten them in accordance with the stipulated torque. Checking emphasis is as follows:

- Tower foundation/base bolts
- Linkup flange bolts of tower rods
- Bolts between the vertical shaft flange and the tower top
- Rotor hub nuts
- Blade bolts
- Air flow diversion cover bolts
- Bolts between the generator and nacelle
- Round nut on the vertical shaft bearing
- Main tail pin bolts

8.2.2 Check welding positions of the tower rod to ensure that there are no cracks of flaws. Checking emphasis is as follows:

- root part
- linkup flanges
- tower top flange
- rotor hub
- tail beams

8.2.3 Check hand-turning and winch-driving tail folding action (tail fold to 45°～60°) to see whether there are any blocking phenomena. Check whether the tail vane can retract easily after releasing. If there are any unusual conditions, please ascertain the reasons and eliminate the breakdowns.

8.2.4 Check whether the blade bolts are loose or missed. Check whether the bolts to the air flow diversion cover are loose or missing. Tighten if necessary.

8.2.5 Generator output cable check

8.2.5.1 Check to see if the three power output cable has been fixed firmly inside the nacelle, if the sheath has been damaged.

8.2.5.2 Check if the wire has been connected firmly with the brush, and in good touching.

8.2.5.3 Check if the contact of six electric brushes with slip ring is firm and smooth, is there any overheat damage.

8.2.5.4 If the three phase voltage of the generator is balanced.

8.2.6 Lubricate the Key Position

8.2.6.1 Open the nacelle window, cleaning the spine shaft and lubricate it.

8.2.6.2 Open the nose cone, cleaning the joint bearing and lubricate it.

8.3 Checking After Heavy Winds

After strong wind (**>**25m/s), repeat those checks in 8.2.1, 8.2.2, 8.2.3, 8.2.4, 8.2.5 again.

8.4 Routine Maintenance (every 3,000 hours)

8.4.1 Repeat every check and maintenance process detailed in section 9.2.
8.4.2 Check the technical conditions of the rotor.
8.4.2.1 Checking the contour of the blades, with emphasis on the tips and front edges, to see whether there are any cracks or damage.
8.4.2.2 Check the blades to detect any changes which can result in unbalanced deformation, translocation or change of setting angle.
8.4.3 Clean the electricity conveying slip ring and electric brushes, polishing the conducting contact face. Any worn electric brush should be replaced by a new one. The contact area between the brush and slip ring should reach 95% or more.

8.5 Maintenance

8.5.1 Lubricate the blade hub, joint bearing and spine hub every year.
8.5.2 The spring position inside the rotary body should be checked every year, replacing any damaged springs.

8.5.3 Check the fasteners and brushes regularly.

8.5.4 Check the steel rope regularly, replacing any damaged rope.

9 Troubleshooting

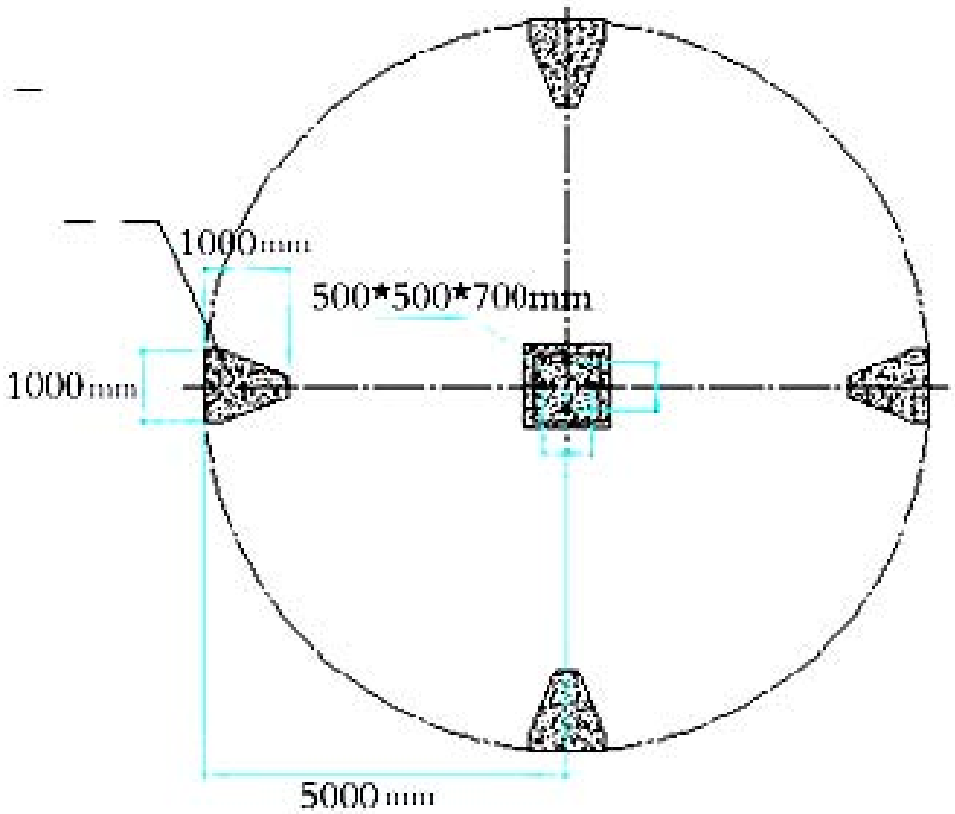
Problem	Possible Reasons	Possible Solutions
Wind speed is bigger than 4m/s, but the rotor does not rotate	1. Setting angle of blades is too small 2. Rotor has not passed a balance test, or one blade is overweight and sagging 3. Starting resistance torque of generator is bigger 4. Short cut occurred in the output circuit of generator, or load has been accepted in advance 5. Braking mechanism is blocked and the tower rod is not in vertical state or the bearing of vertical shaft is too tight and making the rotor not face the wind direction	1. Adjusting according to the design 2. Balance blades in accordance with technical requirements 3. Check the resistance torque of generator, ascertaining the reason and eliminating the problem 4. Ascertain the short cutting positions; Postponing the acceptance of load 5. Ascertain the friction positions and eliminate the friction phenomena 6. Adjust the tower rod to its vertical state; if the bearing of vertical shaft is too tight, it should be adjusted to a rather loose state
Direction adjustment (facing the wind) is not nimble	1. Bearing rotating resistance of vertical shaft is bigger 2. Tail vane does not retract	1. Adjust the clearance of bearing or replace the bearing 2. Ascertain the reason and restore the tail vane to its normal position.
The rotating speed of rotor is obviously rather lower	1. Setting angle of blades is too big 2. Resistance of generator bearing is bigger, or the bearing is damaged 3.There is a shortcut in the output circuit of generator 4. Load is not matched 5.The friction of the braking mechanism has not been released	1. Adjust in accordance with the design requirement 2. Check and replace it with a new one 3. Eliminate the shortcut 4. Adjust working voltage, load adding work point 5. Ascertain the reasons of the friction & blocking, and then eliminate the problem.
Vibration of wind turbine	1.The blade bolts are loose 2.Water entering the blade, freezing, rotor lost balance 3. There is damage to blade, causing power and gravity lost balance 4. Generator, power output circuit (including electricity conveying slide ring) is losing electricity current and phase. 5. The vertical shaft bearing of nacelle is loose or damaged. 6. The bearing of the tail vane is loose or damaged. 7. Braking mechanism is blocked intermittently. 8. Wind turbine is rotating in high speed at yawing state. 9. Wind turbine is rotating in over-speed state	1. Replace with new bolts and tighten them in accordance with stipulated torque. 2. Eliminate accumulated water or ice, adjusting the rotor to balanced condition 3. Repair the blades and rebalance 4. Check whether the three phase output is balanced; check wire connecters of breaker box to output wires of generator. 5. Tighten in accordance with the requirement or replacing it with a new one. 6. Ascertain the friction or blocking positions; repair and eliminate. 7. Check branch braking pump, braking disk and braking slices 8. Check braking device and the size of yawing angle 9. Check the load of controlling box (including shunt), adjust and track, increase the load properly

Unusual noise	**1. The rotor bolts are loose** **2. The three-phase power output is not balance** **3. Generator bearing is loose or damaged** **4. The bearing of vertical shaft is loose** **5. There is friction in braking mechanism** **6. Parts inside the nacelle are loose** **7. The tail vane bearing is loose** **1.The fixing parts of framework and tail vane are lose** **2.Causing resonance owing to over speed rotating of the rotor**	**1. Find the loose part, then tighten or replace with a new one** **2. Check generator, control circuit and load; Ascertain the reason of stoppage and eliminate it.** **3. Ascertaining the damaged bearing and replaced it by a new one** **4. Adjusting the clearance** **5. Checking and repairing the mechanism, so as to eliminate the frictions** **6. Tightening them to eliminating the loosen phenomena** **7. Replace new parts** **1. Tighten them and eliminating the problem** **2. Stop the wind turbine, ascertain the reason; After eliminating the problem, start the wind turbine again**
Rotating speed of the rotor is too high, even exceeding the limited rotating speed	**1. Operating without any load** **2. Load is too small** **3. Yawing action of the rotor is difficult, adjusting & controlling action is slow** **4. The tower rod is not vertical to horizontal plane, so as to effect the normal action of yawing mechanism** **5.Yawing angle is not enough** **6.The tail vane bearing is blocked and causing the tail vane to not fold freely**	**1. Stop the wind turbine, eliminate the problem** **2. Adjust the matching relationship between output power of wind turbine and load** **3. Adjust the inclination angle to suit the local wind conditions** **4. Adjust the vertical degree in accordance with the requirement of specification** **5. Adjust tail folding angle to 75°～80°** **6. Check & repair to eliminate the problem; or replace it with a new bearing**
There are breakdowns in electricity supply circuit, the wind turbine cannot be stopped	**1. There are breakdowns in controller, it can not shunt and unload when wind turbine is over powering or over speeding** **2. Energy consumption capacity of the shunt—unload device is not sufficient** **3.Yawing mechanism, braking system are out of order**	**1.Eliminate the breakdowns of the controller** **2.Increase the energy consumption capacity properly** **3.Ascertain the reasons, repair and eliminate the problem, braking torque must bigger than 350Nm**

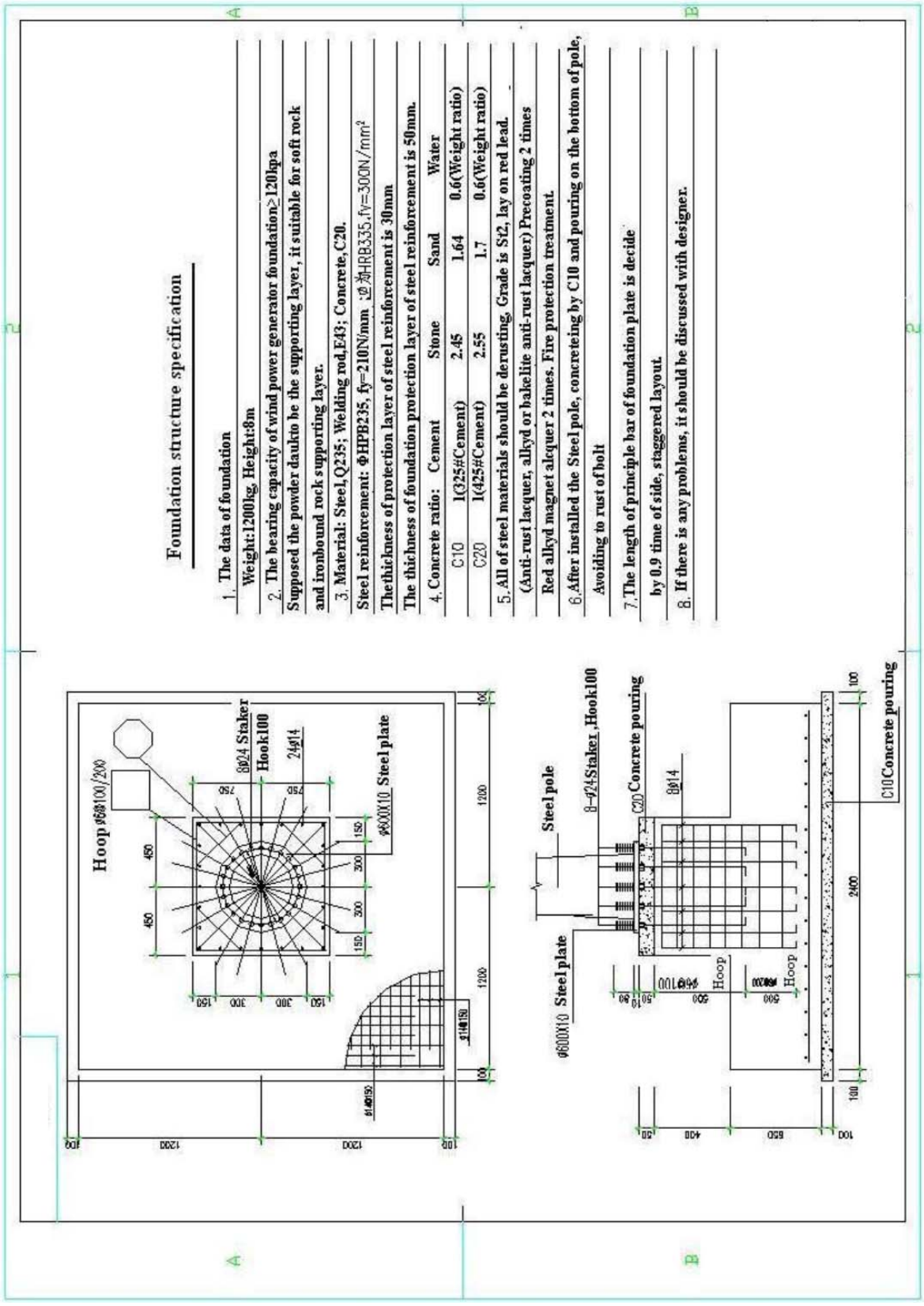
Appendix 1 Bolt Torque (Nm)

Grade	**35、45** HB101 ~ 207 5.6 (σ_s = 300MPa)	**16MnVB、45** HB285 ~ 321 8.8 (σ_s = 640MPa)	**40Cr、40MnB** HRC35 ~ 40 10.9 (σ_s = 800MPa)
M6	4 ~ 6.5	6 ~ 12	
M8	8 ~ 15	16 ~ 30	
M10	18 ~ 30	36 ~ 63	
M12	30 ~ 47	70 ~ 110	90 ~ 135
M16	85 ~ 127	180 ~ 210	220 ~ 300
M20	167 ~ 250	350 ~ 410	440 ~ 520
M24	300 ~ 460	580 ~ 650	820 ~ 900

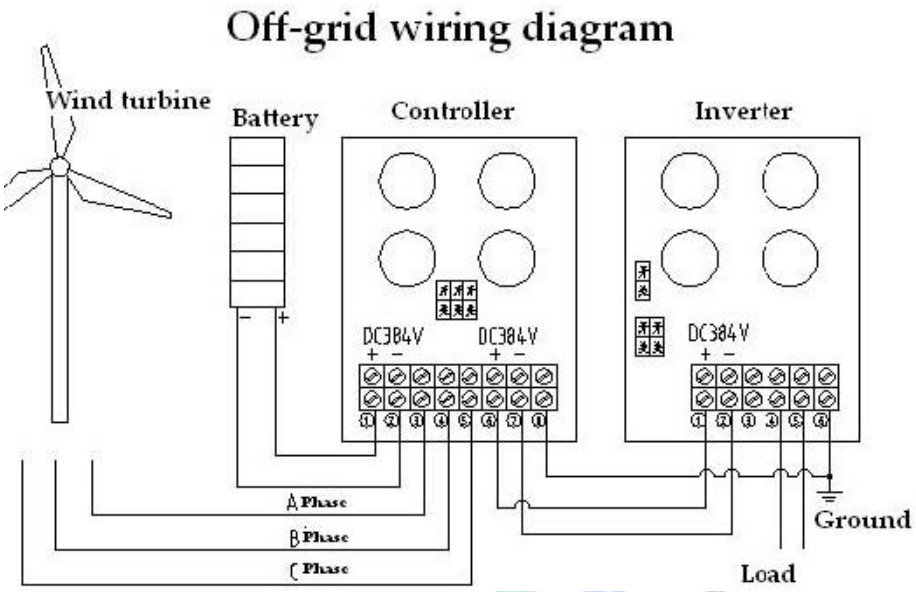
Appendix 2 Guyed Tower Foundation



Appendix 3 Free-Standing Tower Foundation



Appendix 4 Off-Grid Wiring



Appendix 5 On-Grid Wiring