

Aerogenerador Bornay 3000

Manual de Usuario

Montaje
Operación
Mantenimiento

ESP

Owner's Manual

Installation
Operation
Maintenance

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| Nº Serie / Serial # | Voltaie / Voltage |
|---------------------|-------------------|
| | |

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Welcome to the world of the wind



Valued Customer,

We want to thank you for purchasing your new **Bornay 3000** wind turbine and we hope it will meet all the needs for which you have acquired it and for which we have produced it.

Warranty conditions are located at the end of this manual. They are dependent on the proper installation of your wind turbine as this will ensure the correct functioning of the apparatus and, of course, correct servicing.

We are fully available for consultation should you need any type of information about your wind turbine or its installation.

Once again, we welcome you to the World of the Wind.

Most sincerely

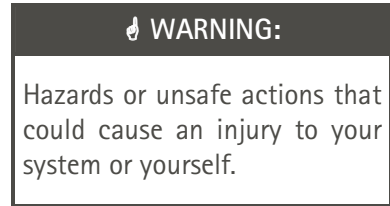
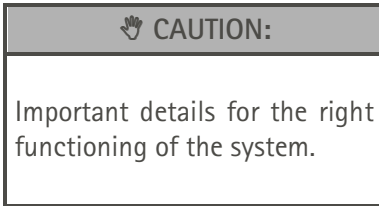
Bornay Wind turbines

A blue ink handwritten signature, appearing to be "A", written over the printed name "Bornay Wind turbines".

Interesting information

In this manual you will find all the information needed to install and maintain your windmill. We strongly recommend that you read this manual thoroughly and understand it before beginning assembly.

At several points in this manual you will find special notes highlighted. These notes are to be observed with special care because they have critical importance. Please pay special attention to those points marked with the following example notices:



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Identification

Each windmill is labeled with its model, voltage and serial number data as it follows:

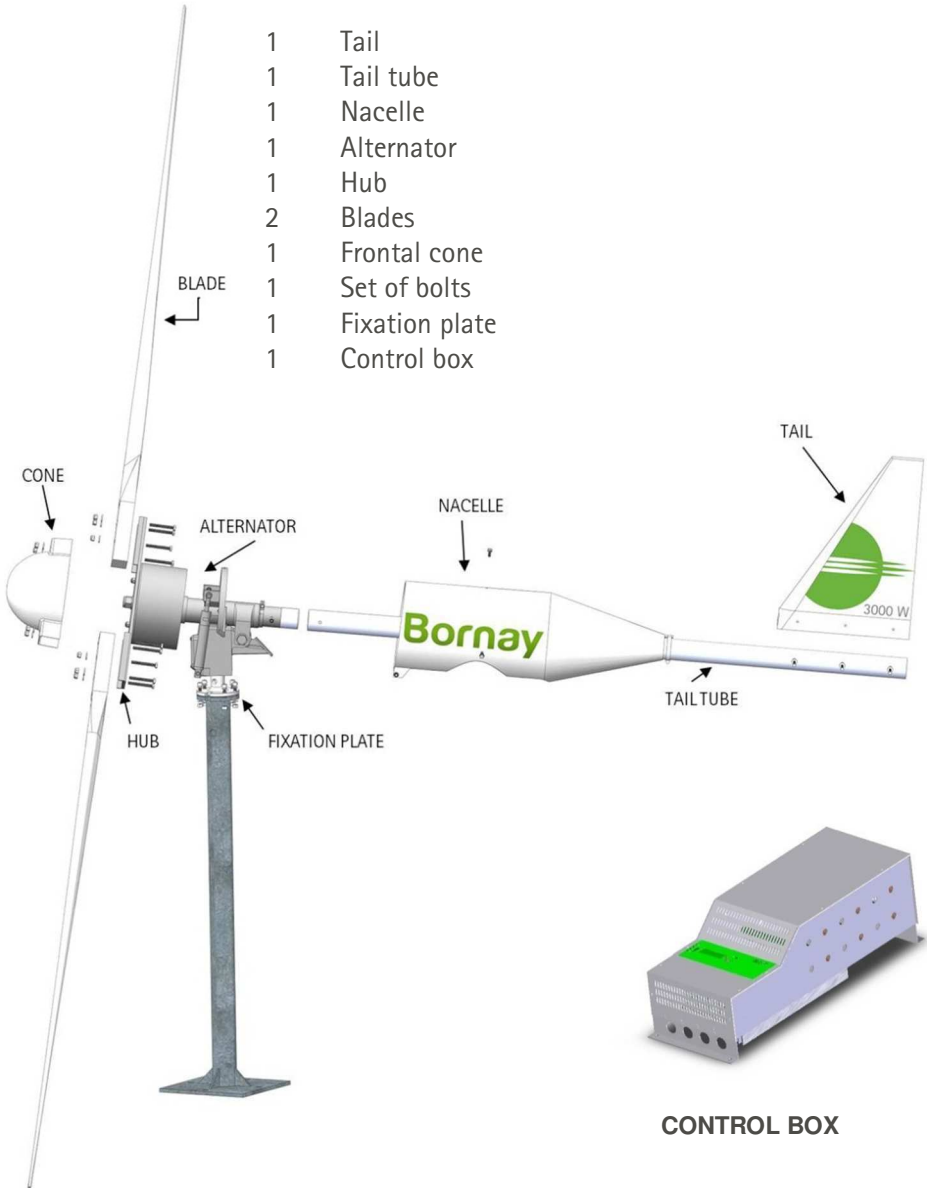
- Manual: Labeled on the cover of this manual.
- Alternator: The wind turbine model, voltage and serial number can be found on the face of the alternator housing above the brushes cover.
- Regulator: On the right side of the control box, there is a sticker indicating the characteristics, regulator model, windmill model, voltage, and serial number.

Keep a note of your serial number as this will be useful when you have to order replacement parts and ask for technical assistance.

Wind Turbine Components

Next to this documentation, in the original box, you will find the components listed below. Some items may already assemble:

- 1 Tail
- 1 Tail tube
- 1 Nacelle
- 1 Alternator
- 1 Hub
- 2 Blades
- 1 Frontal cone
- 1 Set of bolts
- 1 Fixation plate
- 1 Control box



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Technical data

Bornay 3000

Technical specifications

| | |
|-----------------------|-----------------------------|
| Number of blades | 2 |
| Diameter | 4 mts. |
| Material | Fiberglass and carbon fiber |
| Direction of rotation | Counterclockwise |

Electrical specifications

| | |
|---------------|---|
| Alternator | Three phases permanent magnet |
| Magnets | Neodymium |
| Nominal power | 3000 W |
| Voltage | 24, 48, 120 v. |
| RPM | @ 500 |
| Regulator | 24v 150 Amp 48v 75 Amp 120v Grid connection |

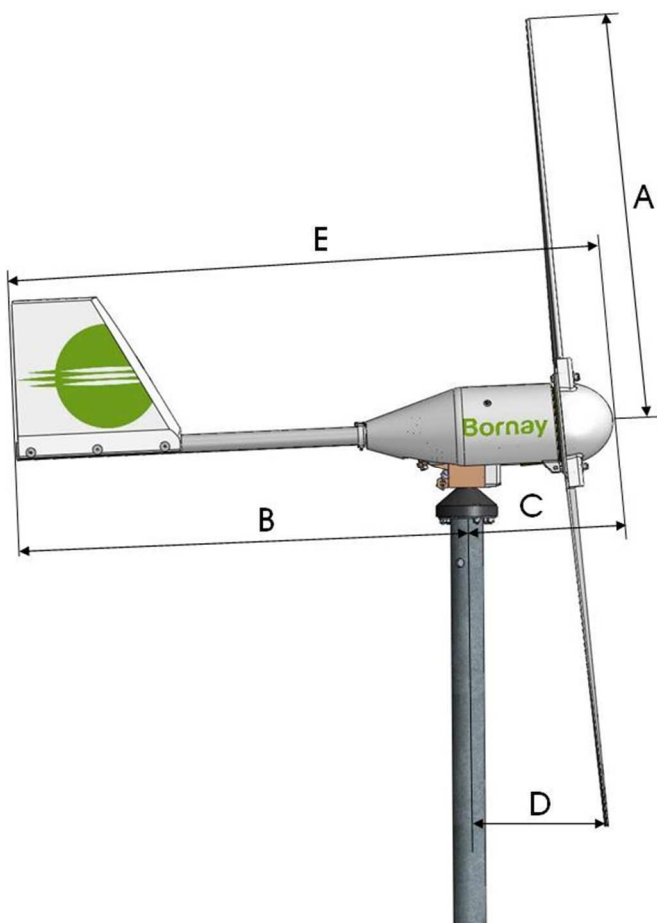
Performance, windspeed

| | |
|----------------------------|---------|
| For turn on | 3,5 m/s |
| For nominal power | 12 m/s |
| For automatic brake system | 14 m/s |
| Survival | 60 m/s |

Physical specifications

| | |
|---------------------|-------------------------------|
| Windturbine weight | 93 Kg |
| Regulator weight | 14 Kgr |
| Packaging | 1200 x 800 x 800 mm. – 135 Kg |
| Dimensions – weight | 2200 x 400 x 150 mm – 6,8 Kg |
| Total | 0.9 m ³ – 154 Kgr. |
| Warranty | 3 years |

| Model | A (mm) | B (mm) | C (mm) | D (mm) | E (mm) |
|-------------|--------|--------|--------|--------|--------|
| Bornay 600 | 1000 | 1120 | 350 | 360 | 1470 |
| Bornay 1500 | 1430 | 1670 | 370 | 470 | 2040 |
| Bornay 3000 | 2000 | 2140 | 470 | 645 | 2610 |
| Bornay 6000 | 2000 | 2640 | 495 | 645 | 3135 |



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Placing your wind turbine

The energy we can take from the wind is proportional to the cube of its speed. This basically means that when the wind doubles its speed, the power we can produce is up to eight times higher.

CAUTION:

For more information on obstacles affecting wind turbines, see Annex 2.

Therefore, the best site to install a windmill will be a place where it is exposed to the most constant and highest wind speed possible. Wind speed depends enormously on the landscape the air moves over. In almost all locations the wind speed increases, as you get higher off the ground; vegetation, landscape, nearby buildings, etc. stop the wind and produce turbulences.

The best place for a wind machine, is an obstruction-free area, and at the maximum height available.

Installation

Before you begin, run through the steps to follow in order to correctly assemble your wind turbine and take a series of important precautions.




The precautions to follow should be:

- Don't plan to carry out installation on windy days.
- Do not leave the generator running freely.
- With the generator running freely, the automatic leaning brake system does not work; this could cause irreparable damage to the wind turbine.
- Use the correct wiring.

The tower

It is recommended to install the windmill on an Independent tower, and not next to the house to avoid turbulences.

Anchoring the tower is carried out according to the type for installation, and must be fixed securely to the ground, normally with concrete foundations. It must be totally vertical and leveled to avoid poor wind turbine functioning.

| |
|---|
|  CAUTION: |
| Check constantly to ensure that the tower is vertical and level. |

In the case of shorter-based towers requiring tensile guy cables: once the base is anchored and the tower is in place, 3 or 4 tensile guy cables are applied, their supports firmly anchored to the ground, generally in concrete foundations.

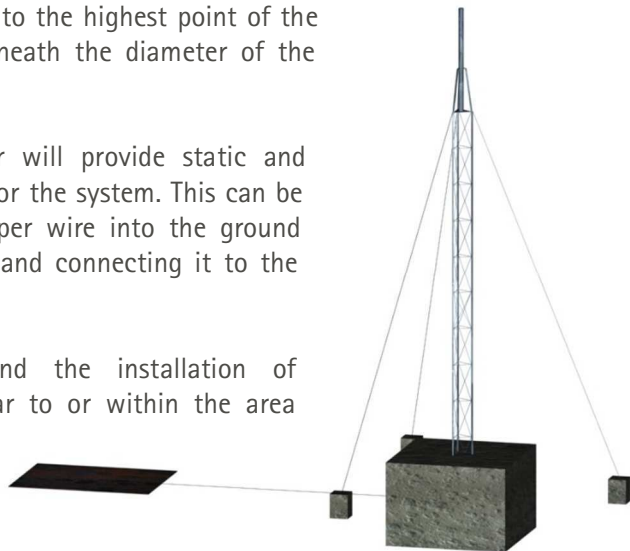
Check at all times that your tower remains perfectly vertical.

The guys ropes have to absorb all tower bend in windy conditions. Therefore, they must be 6-10 mm diameter steel cables.

Attach the guy wires to the highest point of the tower but always beneath the diameter of the blades.

Grounding the tower will provide static and lightning protection for the system. This can be made by driving copper wire into the ground near the tower base and connecting it to the tower with wire.

We don't recommend the installation of lightning arrestors near to or within the area occupied by the wind turbine.



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CAUTION:

The wind turbine must be able to turn 360° freely with no obstacles in its way.

WARNING:

Any object touching the blades in movement, will break them and will unbalance the system causing major problems.

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Once the wind turbine has been installed on the tower, check that it can turn freely and that there are no obstacles within the diameter of the blades.

Under wind pressure, the blades can have up to 15cm of torsion, so there must be a minimum distance of 20cm between the blades and the nearest point.

WARNING:

Any object making contact with the moving blades can damage and unbalance them.

Electrical wiring

Full electrical wiring installation must be carried out prior to the installation of the wind turbine and once the tower has been installed.

CAUTION:

Never install the wind turbine if the regulator and batteries are not properly connected.

WARNING:

Never invert polarity.

Use appropriate sized cables.

The first step in the electrical configuration is to place the correct battery bank, with its correct connection configuration and connected according the manufacturer's specifications, thus obtaining the right voltage and capacity for the installation to be carried out.

Different types of batteries exist. In the case of domestic hybrid wind energy/solar energy installations, open lead-acid batteries are recommended and, to meet the installations charge capacities, certain minimum installation requirements are essential to assure correct running and durability of the installation.

The minimum installation recommendations and battery-to-regulator cable recommendations are the following:

| Model | Battery Cable | Minimum battery size |
|-------------------|--------------------|--------------------------|
| Bornay 600 / 12V | 16 mm ² | 550 Ah C ₁₀₀ |
| Bornay 600 / 24V | 16 mm ² | 250 Ah C ₁₀₀ |
| Bornay 600 / 48V | 10 mm ² | 150 Ah C ₁₀₀ |
| Bornay 1500 / 24V | 25 mm ² | 660 Ah C ₁₀₀ |
| Bornay 1500 / 48V | 16 mm ² | 350 Ah C ₁₀₀ |
| Bornay 3000 / 24V | 35 mm ² | 1100 Ah C ₁₀₀ |
| Bornay 3000 / 48V | 25 mm ² | 600 Ah C ₁₀₀ |
| Bornay 6000 / 48V | 50 mm ² | 1200 Ah C ₁₀₀ |

 **CAUTION:**

The use of stationary open lead-acid batteries is recommended.

 **WARNING:**

Use of the wrong battery can cause irreparable damage to your wind turbine.

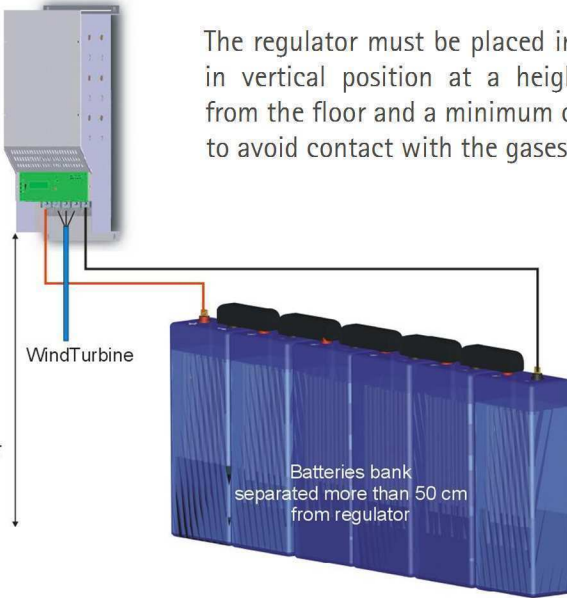
With the correct battery selected and assembled in the installation, the regulator must now be installed on the wall. This is fixed using the four holes (two upper and two lower) located in its metallic casing. Fixing is achieved using long screws and plastic plugs.

The regulator has dissipation through internal resistances. The upper part of the regulator can heat up on windy days once batteries have been charged.

Do not cover the upper part of the regulator – the holes on the top cover must be unobstructed for correct ventilation.

WARNING:
The regulator has internal resistance. Do not cover upper part.
Install in a well-ventilated area.

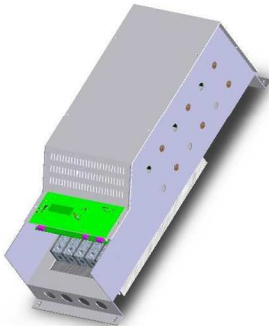
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The regulator must be placed in a well ventilated area and in vertical position at a height of approximately 1.20m from the floor and a minimum of 50cm from batteries so as to avoid contact with the gases these produce.

The regulation control box, batteries and possible converter must be allocated a central location near to the point of use and as near as possible to each other.

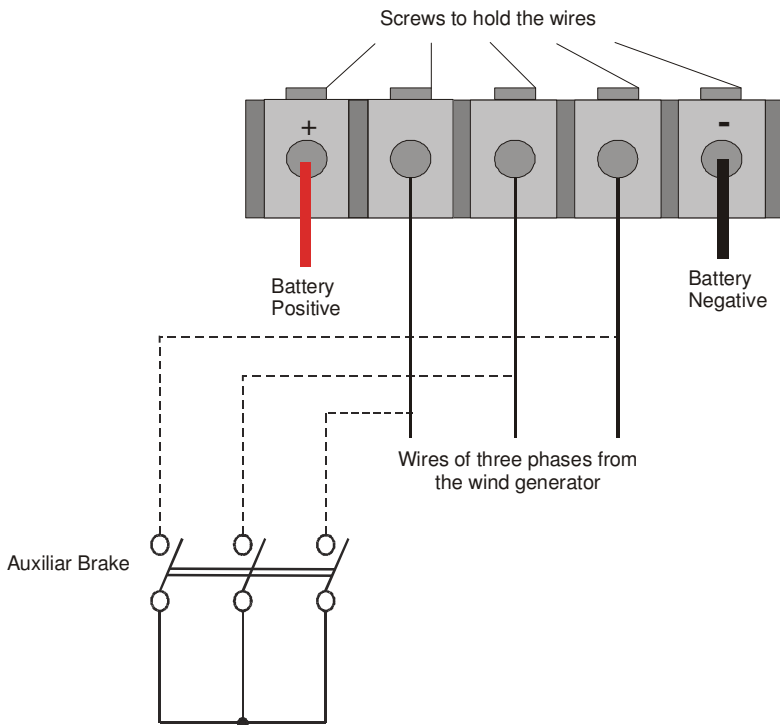
To install the regulator, lift the lower cover from the regulator (only the small cover which forms a 90 degree angle) by removing the four screws that hold it in place. This way, the regulator will be positioned as in the following illustration:



WARNING:
DO NOT invert polarity.
A change in polarity can damage the regulator.

When you come to connect the regulator, follow these steps:

- Connect the negative terminal of the battery to the regulator (ensure correct polarity).
- Connect the positive cable from the battery to the regulator (ensure correct polarity).
- Connect the wind turbine's three-phase wires to the regulator.
- As this uses an alternating three-phase connection, the order of the wires does not matter. This connection is carried out prior to the assembly of the wind turbine; if connected otherwise, the wind turbine must be in braked mode.



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If, for any reason, the regulator needs to be disconnected, either during installation or during the useful life of its installation, the following steps must be observed:

- Short circuit the wind turbine, bringing together the three base connection wires, leaving the wind turbine in braked mode.

- Double check that the wind turbine is totally braked and disconnects the wires from the wind turbine.
- Disconnect the positive cable from the battery.
- Lastly, disconnect the negative cable.

Once the batteries have been installed and connected to the regulator, we will move on to the wiring between the regulator and the tower top of the tower where the wind turbine will be installed.

To minimize wire loss, the distance between the wind turbine and the regulation control box must be as short as possible. Never longer than 100 meters.

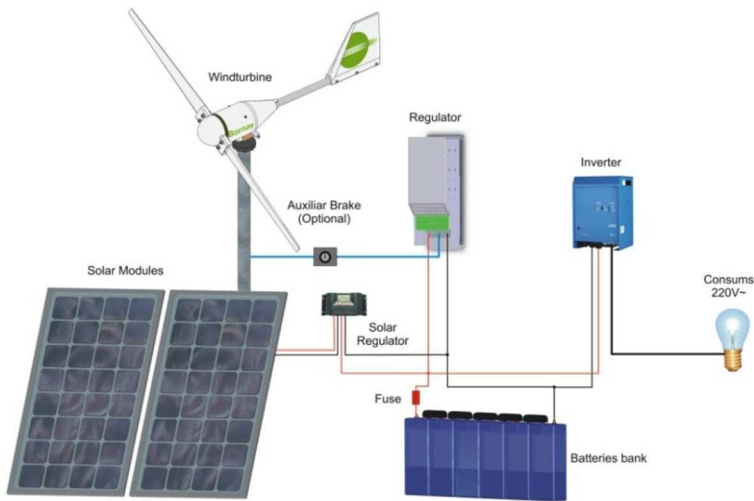
To determine the base connection cable gauge for use in line with the characteristics of the wind turbine and its distance from the control box, see the following table for copper conducting wire:

| Model | Iac x fase (A) | 0-20 mts | 20-40 mts | 40-60 mts | 60-80 mts | 80-100 mts |
|-------------------|----------------|--------------------|--------------------|--------------------|--------------------|--------------------|
| Bornay 600 / 12v | 17 | 10 mm ² | 16 mm ² | 25 mm ² | 35 mm ² | 50 mm ² |
| Bornay 600 / 24v | 8.8 | 6 mm ² | 10 mm ² | 16 mm ² | 25 mm ² | 35 mm ² |
| Bornay 600 / 48v | 4.5 | 4 mm ² | 6 mm ² | 10 mm ² | 16 mm ² | 25 mm ² |
| Bornay 1500 / 24v | 22 | 10 mm ² | 16 mm ² | 25 mm ² | 25 mm ² | 35 mm ² |
| Bornay 1500 / 48v | 11 | 6 mm ² | 10 mm ² | 16 mm ² | 25 mm ² | 35 mm ² |
| Bornay 3000 / 24v | 42 | 10 mm ² | 16 mm ² | 25 mm ² | 35 mm ² | 50 mm ² |
| Bornay 3000 / 48v | 21 | 4 mm ² | 6 mm ² | 10 mm ² | 16 mm ² | 25 mm ² |
| Bornay 6000 / 48v | 42 | 6 mm ² | 10 mm ² | 16 mm ² | 25 mm ² | 35 mm ² |

The following table shows conversions between gauges in mm² and AWG, as well as the corresponding diameters for these gauges in mm and inches.

| | | | | | | | |
|-------------------------|-------|-------|-------|-------|-------|-------|-------|
| mm ² section | 4 | 6 | 10 | 16 | 25 | 35 | 50 |
| AWG section | 11 | 9 | 7 | 5 | 3 | 1 | 0 |
| Diameter (mm) | 2.26 | 2.76 | 3.57 | 4.51 | 5.64 | 6.68 | 7.98 |
| Diameter (in) | 0.088 | 0.108 | 0.141 | 0.178 | 0.222 | 0.263 | 0.314 |


In a hybrid installation, with the water heater option, the installation should match the following scheme:




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Regulator

The function of the regulator is firstly to transform the alternating energy generated by the wind turbine into the appropriate DC current to charge the battery bank. Secondly, the regulator will control the state of the battery, avoiding battery overcharge and controlling the running of the wind turbine.

| |
|---|
|  CAUTION: |
| In strong winds, stop the wind turbine, by switching the brake on and off several times. |

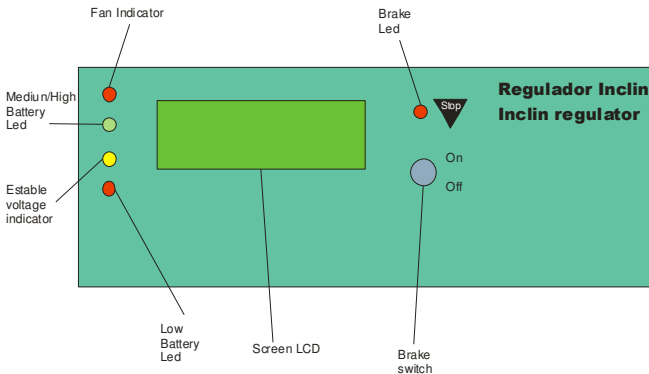
| |
|---|
|  WARNING: |
| Never force the rotation of the turbine while the brake switch is on. |

The regulator, has been specially designed to work with the wind turbines. The regulator is provided with the following connection switches:

- 1.- Three phases input from the wind turbine
- 2.- Batteries output +/-

Visual Guide to Control Panel features:

The Control panel looks like the example in the following illustration, in which the function of each feature can be recognized:



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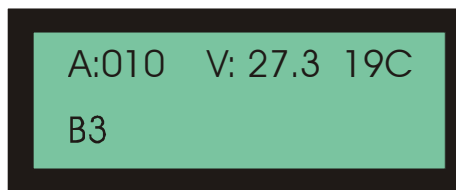
System functioning:

Basic functioning:

The regulator uses the energy it obtains from the wind turbine to charge batteries and create electrical energy for the user's consumption. While batteries are uncharged, and with weather conditions allowing, the regulator supplies energy to the accumulators.

When the batteries are charged to the pre-programmed setting, the regulator will cause the wind turbine to go into braked mode to achieve perfect battery performance and to avoid their deterioration. The way it enters braked mode is via electrical impulses, i.e. by sending controlled charges to the wind turbine.

The voltage regulator is preset in manufacture and is indicated by the letter B and a number, as in the following illustration:



System reset:

On connecting the apparatus, or if it is reset for any reason, the regulator will show a screen, as follows, depending on which model it is:



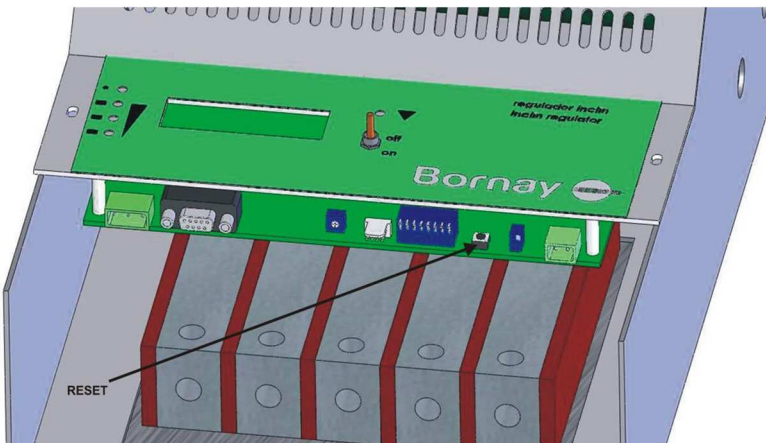
The topmost line on the screen shows the regulator model. From left to right it shows: the wind turbine power; the wind turbine voltage; and the maximum current it accepts. The bottom line on the screen shows the system version.

NOTE:

If the batteries have become excessively run down for any reason or if regulator malfunction is detected, RESET can be used to check if the equipment returns to normal functioning.

To use RESET, there is a printed circuit board micro switch located on the regulator's control card, i.e. under the regulator cover.

If the error persists, contact the manufacturer.

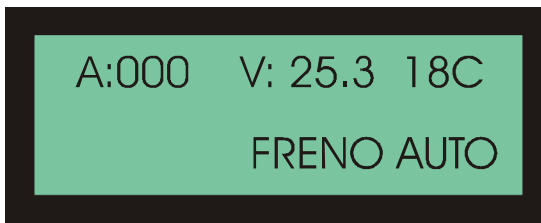


Fixed safety braking for wind turbine:

The wind turbine can be braked in a fixed position for several reasons:

Automatic safety braking: This is a function designed to increase the safety of the equipment and to lessen wear suffered by the system's mechanical elements, and it works through using an internal counter by which the wind turbine reduces its turning speed automatically when, over an uninterrupted 120 minute period, at least 1500 braking impulses have been affected. When this occurs, the system deduces that the battery is completely charged and the wind turbine is not freed from the fixed braked mode until the voltage has lowered to under 12.5v - 25v - 50v.

When this situation arises, and the automatic braking is active, the status message appears at the end of the second line on the screen, as in the following image:



If the wind is very strong, the wind turbine may not stop completely, although the energy generated is diverted to the brake resistors.

NOTE: if the equipment is in AUTOMATIC BRAKING mode and we require the wind turbine to return to its charge position without waiting for the battery voltage to fall below the deactivation level, simply turn the switch (manual braking) to ON position and then back to the OFF position, thus erasing the automatic braking mode. The equipment will immediately generate energy again if the wind is favorable, while the time and impulse counters will re-initiate.

Manual braking: When the switch is in ON position, a sequence of impulses is initiated to brake the wind turbine until it stops completely or, in the event that the wind is strong, until it slows to a minimum of revolutions.



When the manual braking switch is activated, this is indicated on the screen at the end of the second line and the brake indication LED is also illuminated.

If the switch is put back to the OFF position, the wind turbine is immediately freed and newly set to generate energy. The brake indication LED goes off.

This operation must be carried out periodically to verify the correct status of the braking elements: if, in low wind conditions, the wind turbine does not brake completely, the electric control box must be checked.

Reserve brake option: To guarantee safety in the installation, an auxiliary brake can be incorporated in the regulator which would brake the wind turbine when you need to leave it deactivated for some reason. This braking system involves uniting the wind turbine's three phases.

| |
|--|
| ⚠ WARNING: |
| In strong wind, never leave the wind turbine turning in braked position. |

Warning signs:

The regulator detects the voltage at input to the batteries and it carries out auto-configuration as long as this voltage is permitted within the power programmed. If the battery voltage is not permitted for the power programmed, a message appears stating that the voltage is not correct.

CONFIGURACION INCORRECTA

For example, if the regulator is for a 6000W wind turbine, it can only work with 48V batteries, so if it detects that the battery voltage is 12V or 24V, it will show an error message. This also occurs if the batteries are very run down.

Installing the Wind Turbine

Before assembling the wind turbine on the tower, the electrical installation must be completed, as well as the interconnection between batteries and regulator.

Once we have the electrical wiring installed, we will proceed to assemble the wind turbine.

To ease installation of the wind turbine on the tower, a bracket and pulley system should be used.

This system must securely attach to the tower, with the pulley on top.

Using this method, the turbine can be hoisted up and secured while the electrical connection is completed and the turbine is fitted to the tower.

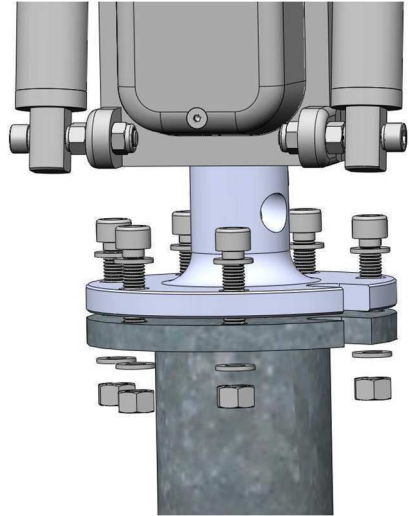


Fixation plate

This plate is provided to be attached to the tower. Another one is assembled on the wind turbine base.

Its function is to secure wind turbine, offering an ease of installation and removal from the tower at any moment.

The plates are made with slots to allow the cables to pass through without twists. They are attached with Allen bolts and six holes are provided for six M -10 x 40 Allen bolts, with M -10 washers on both faces and six M -10 nuts. The bolts set and tower plate are served in an independent plastic bag, if not mailed before.

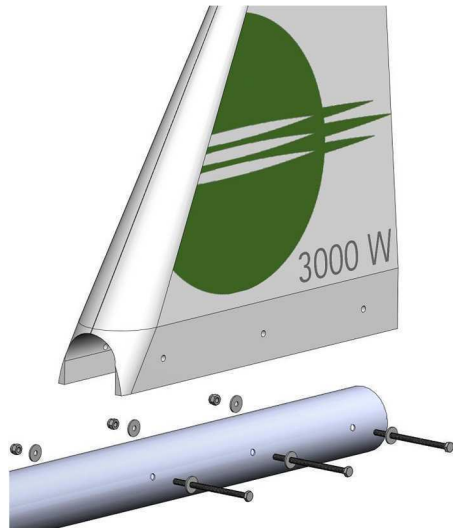


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Tail / Tube tail

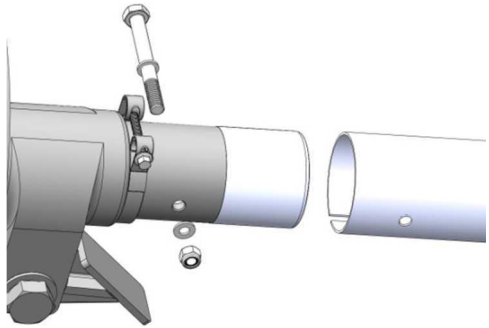
The tail is made to keep the windmill facing into the wind at any time.

The tail is made of two different pieces: a polyethylene vane and a steel boom. They are put together with three M-6 x 100 bolts, six wide-series M-6 washers on both sides of the vane, and three M-6 self-locking nuts.



Tail tube / Alternator

The tail is attached to the alternator at this point. Before bolting the tube to the alternator, pass the protective casing through the tail tube. (Once the tube is bolted, you will not be able to install the casting).



This joint has two different systems to secure, one has a bolt going through the tube, and the other one is a flange system. We first introduce the tail tube into the back side of the alternator, and match the holes in both pieces. We use now a hexagonal M-8 x 90 bolt, with two M-8 washers, one in each side and an self-locking M-8 nut. Tighten both to 2,5 Kgr.

Nacelle

The nacelle protects the alternator from the external climatologically agents. The nacelle is attached with five bolts; three of them are on the top, another one is on the back as a bridle, and the last one on the front underneath a new bridle:

On the top of the nacelle there are two holes ready for two M-8 x 20 bolts with their correspondent wide series M-8 washers and a grover washer, directly bolted to the alternator bridge. The assembly order is: bolt, grover washer and wide washer.



Next, the clamp bolt must be tightened at the back part of the nacelle.

Finally, on the lower front side, using the two flanges to anchor, we insert the brass tube (160 mm long x 12 mm exterior diameter), one M-8 x198 bolt, with an M8 wide series washer on each side, on the inner side of the nacelle, between the two flange-forming flaps. Finally, secure using a washer and auto-blocking nut M8.

Blades and frontal cone

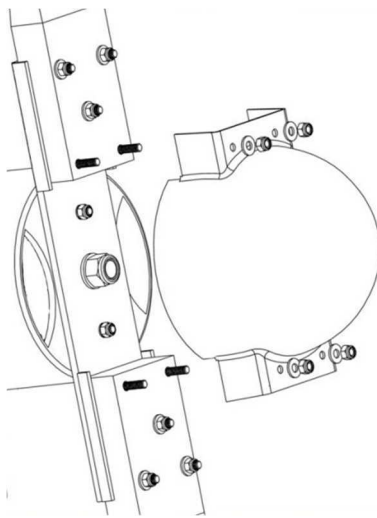
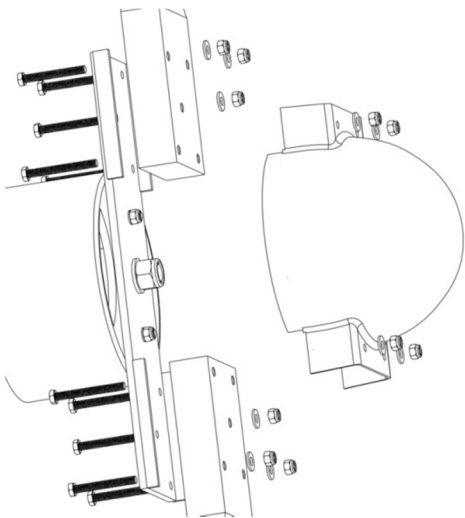
The blades, made reinforced carbon fiber/glass make direct contact with the wind. They are highly stressed. Their aerodynamics, specifically designed for Bornay wind turbines, makes the alternator turn faster or slower depending on wind speed.

Blade assembly is carried out by securing them to the hub, with **the relief logo towards the rear part**, i.e. facing the alternator. The two external bolts and the central one, will be M-10 x 70, while the two internal bolt will be M-10 x 75 (this ones will fix the nose cone also).

Once installed the blades, into the first three external bolts, to secure the blades we use the wide-series washers and auto-blocking nut M10. With the help of a dynamometric Allen key, all nuts must be initially tightened to 2 Kg. Once tightened, all nuts must be then be retightened to 2.5 Kg.

The next step, having retightened all nuts, is to install the frontal nose cone. Once installed, another wide-range washer and M-10 self-blocking nut are applied into the two internal bolts. With the help of a dynamometric Allen key, all nuts must be initially tightened to 2 Kg. Once tightened, all nuts must be then be retightened to 2.5 Kg.

Observe the next illustrations carefully.



CAUTIONN:

Double check that blades fit perfectly and that no obstacle will get in their way.

WARNING:

Check blades are correctly mounted in the right place; the Bornay logo must be to leeward, on the reverse side

PRECAUTION:

- Do not manipulate the windmill and its control panel on windy days.
- Do not leave the wind turbine run freely (disconnected from the batteries), this could damage the charging system. If you need to disconnect the windmill from the batteries, always brake it.
- With the windmill turning freely, the automatic braking system does not work, that could cause irreparable damages in your wind turbine.
- Do not manipulate the loads in the regulator.
- Do not invert the polarity in any case.
- Use the appropriate wiring

Maintenance

After the installation

One month after the installation of the wind turbine, we recommend checking that the bolts have the right torque and tightening, if necessary.

Periodic maintenance

To ensure long life for your wind turbine, we recommend the following maintenance schedule:

Each 6 months

- Checking and readjusting the torque required for every bolt.
- Checking state of wiring.
- Visual inspection of blades.
- Checking that the automatic breaking system works properly by tilting it manually.

The main wind turbine parts for maintenance inspections are:

Bearings

Bornay wind turbines are equipped with great quality sealed bearings which require no maintenance.. You can check to see if they turn freely or if the opposite occurs and some kind of friction or vibration is observed.

Bolts

The bolts used in Bornay wind turbines are **stainless steel**. If a bolt is missing or in poor condition, it must be replaced right away in order to avoid any breaking or further damage.

Wiring

All cable connections and switches must be properly checked in order to prevent any disconnection and to allow the wind turbine to run freely.

Blades

The reinforced carbon fiber/glass blades are covered by a protective tape made of abrasive polyurethane on the leading edges of the blades.

After years of use, this tape may be affected by weather conditions. If the tape is missing or partially missing, contact your local installation office to have the tape replaced. By failing to replace the tape, the life of the blade will be seriously reduced due to the strong erosion the blade is exposed to.

Shock absorber

The wind turbine has one hydraulic shock absorber installed that prevents abrupt shocks by promoting fast braking and slow return to its original position.

The shock absorber has a little slack at the beginning of its return movement, and this is normal. However, if this slack is observed to continue for over half the return movement, and if oil is leaking, the shock absorber must be replaced.

Lubrication

Bornay wind turbines have three moving parts:

The front shaft (blades-alternator) is equipped with sealed bearings and covered with lubricant. It does not need any special attention; its lubricant will last during its lifetime.

The yawing shaft (windmill-tower) is equipped with sealed bearings and covered with lubricant. It does not need any special attention; its lubricant will last during its lifetime.

The alternator shaft (alternator-yawing system) is a stainless steel tube covered with lubricant. It does not need any special attention. Its lubricant will last during its lifetime.

Frequently asked questions

1.- Can battery polarities be changed?

No, this would cause the regulator to break down.

2.- ¿Is the polarity of the wind turbine cables important?

No, the base connection cable of the wind turbine is an alternating three-phase type, so these can be connected in any order.

3.- Can the battery be disconnected with the wind turbine running?

Under no circumstances, since this action could cause irreparable damage to the regulator.

4.- ¿Can the regulator cause the batteries to lose their charge?

This is impossible due to the construction of the regulator.

If it occurs, check your installation because there must be an element that is discharging the batteries.

5.- The voltage measured by the regulator does not match with the battery level read by other equipment.

Each manufacturer or even each different apparatus uses different components, and for reasons of cost these are often not calibrated. Variations can exist between different equipment, although it is made by the same manufacturer.

6.- ¿How can I find out what energy the wind turbine is providing?

You simply need to multiply the voltage value and the current (in amps) shown on the regulator screen.

Energy (W) = Voltage (V) x Amps (A).

7.- ¿What is the power consumption of the regulator?

The power consumed by the regulator is miniscule compared to the power of the wind turbine and the batteries, and is in the order of milliamps.

8.- ¿How do you know if the wind turbine is providing charge to the batteries?

This shows on the regulator screen that indicates the charge current.

Keep in mind that there is a margin of error of several Amps, so if the charge is low, say 1 or 2 Amps, the screen may display 0 (zero).

9.- ¿Could the drilled holes in the blades be bad?

No, each wind turbine is assembled completely in production. If the drilled holes do not match up, try turning the blades round the other way. Some models have 3 and some have 5 holes drilled, and one of these is slightly off centre in order to define correct blade installation.

10.- ¿Will one of these wind turbines provide enough power for a home?

This kind of wind turbine is normally used together with other components to form a complete installation. These components are usually:

Solar panels: energy production.

Solar regulators: to control battery charge from the solar panels.

Batteries (accumulation of this energy): These installations are normally designed to give three full days of independence, in other words they can supply the installation for three days without sun or wind. They use direct current.

Wind regulator: This is included with the wind turbine and this is what controls battery life. It ensures that battery voltage does not surpass dangerous levels. At the same time, it will brake the machinery when this does occur.

Inverter/Charger: This is the equipment that transforms direct current from batteries into alternating current for consumption (230V).

Back-up generator: In remote installations, this is installed to guarantee complete independent functioning of the installation. Normally, the inverter handles the start-up and stopping on the motor according to installation needs. For example, if the battery runs the inverter will order the motor to start.

11.- ¿Can several wind turbines be set up in parallel?

Yes, several wind turbines can be run in parallel.

- 12.- ¿Can power consumption points be connected directly to the wind turbine?
No, because the energy they produce is not a controlled and regulated energy, so an intermediate stabilizer/controller is required. Without such a stabilizer/controller, our installation will not work correctly.

In the case of remote installations, this stabilizer/controller is the battery.

When the installation is for grid connection, the stabilizer is the grid connection inverter.

- 13.- ¿What kind of power is generated by the alternator?

The wind turbine provides an AC three-phase signal which, in remote installations, has a nominal voltage of approximately 15 Vac, 30 Vac, or 60 Vac depending on the voltage. When grid connected, the nominal voltage is 150 Vac.

These voltages are later rectified by the regulator passing the power to DC at 12 Vdc, 24 Vdc, or 48 Vdc to charge batteries, or 120 Vdc to supply the grid connection inverter.

- 14.- ¿Should some protection be installed between the wind turbine and the regulator or between the regulator and the battery?

No, never. The regulator is already carrying out these protective functions.

If you were to install intermediate protection and this disconnected the electrical connection, the wind turbine would lose its charge and this could cause irreparable damage to the wind turbine or the regulator.

Troubleshooting

GB

| Problem observed | Possible cause | Solution |
|--|--|--|
| The blades do not turn, even in strong wind | Incorrect wiring from wind turbine to regulator. | Check wiring. |
| | Reserve brake connected. | Disconnect reserve brake. |
| | Short circuit in wind turbine phases. | Disconnect wind turbine phases from the regulator. If this is not turning freely, the problem could be the wiring. Check possible joins in the wiring. If the problem persists, contact your supplier. |
| | Regular diode short circuit | Disconnect the wind turbine phases from the regulator. If this turns freely, its regulator could be malfunctioning. Contact your supplier. |
| Blades turn fast but with no charge | <p>Battery disconnected or defective.</p> <p>Voltage incorrect between batteries, regulator, and wind turbine.</p> <p>Wind turbine phases disconnected</p> | <p>Check battery voltage is correct.</p> <p>Check there is voltage in the input to the wind turbine and regulator. If there is no voltage, check wiring.</p> |
| Wind turbine brakes automatically in high wind | Batteries are charged by other element, such as solar panels or generator. | Functioning correctly. |

| Problem observed | Possible cause | Solution |
|--|--|--|
| Wind is strong and wind turbine does not brake with regulator brake activated. | The wind is so strong that the regulator brake cannot brake the machinery. | Activate intermittent brake until machinery is stopped, using moments when strong wind abates. |
| The regulator screen shows nothing. | Battery is disconnected. | Check wiring in continuous section and check power is reaching regulator. |
| The regulator is overheating | Defective printed circuit. | Check connections on printed circuit board. If fault persists, contact your supplier. |
| | Batteries too small and/or too little consumption. | Revise size calculations of your installation. |
| Battery voltage is too high. | Located in strong winds | Functioning correctly, but you can put wind turbine in braked mode if batteries are charged. |
| | Defective battery connection. | Check battery connection terminals/elements. Tighten screw connections. |
| Battery voltage is too high(continued) | The regulator is not functioning properly. | Contact your supplier. |
| Wind turbine vibrates | Loose bolts | Tighten bolts. |

| Problem observed | Possible cause | Solution |
|---|--|--|
| Intermittent mechanical noise | Blades uneven. | Check state of blades. Contact your supplier. |
| | Elements scraping one another. | Put nacelle bolts in place and tighten. |
| Wind is strong and wind turbine constantly loses orientation. | Internal noise. Check rotor is turning correctly or if bearings are damaged. | Contact your supplier. |
| | Turbulence. | Revise the location chosen for tower. |

Annex

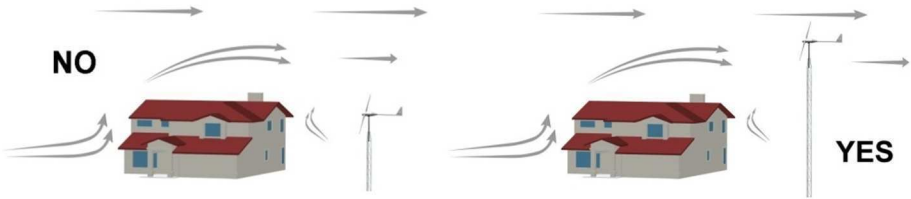
Annex I.- Wind types

Beaufort's table is the international reference to classify and define the wind depending on its speed.

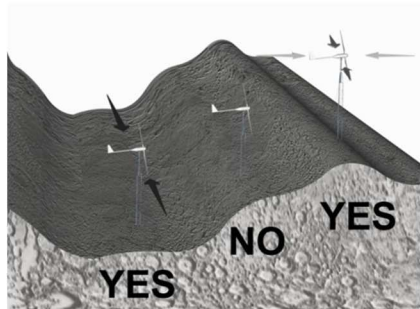
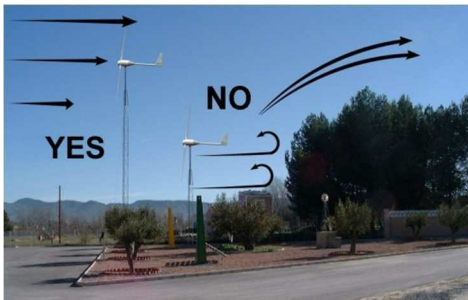
| Force | Wind speed (m/s) | Wind speed (km/h) | Denomination |
|-------|------------------|-------------------|-----------------|
| 0 | 0 - 0.5 | 0 - 1 | Calm |
| 1 | 0.6 - 1.7 | 2 - 6 | Light air |
| 2 | 1.8 - 3.3 | 7 - 12 | Light breeze |
| 3 | 3.4 - 5.2 | 13 - 18 | Gentle breeze |
| 4 | 5.3 - 7.4 | 19 - 26 | Moderate breeze |
| 5 | 5.7 - 9.8 | 27 - 35 | Fresh breeze |
| 6 | 9.9 - 10.4 | 36 - 44 | Strong breeze |
| 7 | 12.5 - 15.2 | 45 - 54 | Near gale |
| 8 | 15.3 - 18.2 | 55 - 65 | Gale* |
| 9 | 18.3 - 21.5 | 66 - 77 | Strong gale |
| 10 | 21.6 - 25.1 | 78 - 90 | Storm |
| 11 | 25.2 - 29 | 91 - 104 | Violent storm |
| 12 | More than 29 | More than 104 | Hurricane |

*On receiving strong storm warnings, Bornay recommends manually braking equipment in order to protect the wind turbine.

Annex 2.- Landscape and objects that influence on wind turbines

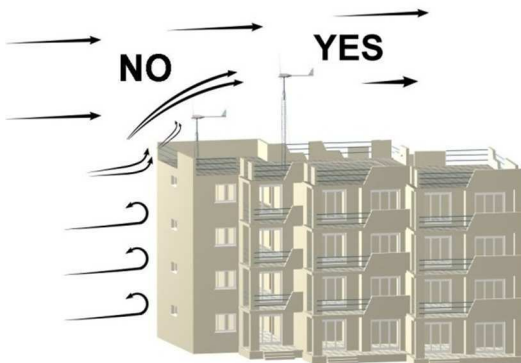


When the wind is eclipsed by the objects it finds in its way, it reduces its speed and turbulence results. The performance of a windmill installed on the wrong location will be adversely affected by turbulence and light winds.



To maximize the performance of your wind turbine, it should be installed as far as possible from the obstruction and atop a tower higher point from this obstacle.

If the windmill is going to be installed in a valley, it should be at the lowest point where the wind is channeled and freely flowing, or at the highest peak of the valley, where it can capture wind moving in any direction.



Declaration of

Declaration of conformity



Mr. Juan Bornay Rico, on behalf of and representing Bornay aerogeneradores, slú,

STATES

That Bornay wind turbine models 600, 1500, 3000, 6000 and their corresponding regulators, have been produced in compliance with regulations applicable under the E.U. directives:

89/392/CEE

91/368/CEE

And in accordance with the safety regulations for small wind power turbines:

UNE-EN-61400-2

Castalla, January 1, 2010

Signed. Juan Bornay Rico.

A handwritten signature in blue ink, appearing to be "Juan Bornay Rico", written over the printed name.

Warranty

LIMITED WARRANTY

Your new Bornay wind turbine is guaranteed against any material defect. This warranty does not include other equipment or accessories that could be involved in repairing the windmill. The warranty does not cover defects or damages produced by improper use or installation of the product.

WARRANTY PERIOD – BORNAY WIND TURBINES

The warranty period for the Bornay wind turbines and their components is 36 months from date of original installation or 40 months from fabrication date.

BORNAY WIND TURBINES ACCESORIES

The warranty period for the Bornay accessories is 36 months from date of original installation or 40 months from fabrication date.

WARRANTY CONDITIONS

The Warranty covers parts and labour in our workshops only. The wind turbine must be returned suitably packaged and at the buyer's expense.

The Warranty does not cover breakage due to incorrect usage or equipment with signs of manipulation. Shipping is not covered by the Warranty.

Bornay reserves the right to substitute or modify any part should the case call for such.

Any wind turbine not meeting these conditions will be repaired and shipped at cost to buyer, with prior authorization from the customer.