WINDSPOT 1.5 KW Y 3.5 KW

OWNER'S MANUAL

General information

Installation

Operation

Maintenance

WELCOME

Thank you for choosing WINDSPOT.

You have selected the leading edge of small wind technology for distributed generation applications. Windspot wind turbines are manufactured to the highest standards in the small wind industry to assure quality, reliability and longer lifetime.

Before going any further, please read carefully the instructions on point 4.1 "Commissioning" and 4.2 "Warranty" to validate Sonkyo Energy's warranty. Sonkyo Energy obeys the law in force on protection of personal data.

If you have any comments or questions, please do not hesitate to contact our customer service department: info@windspot.es

Reference of this manual: 50 030 002_C

TABLE OF CONTENTS

1 INFORMACIÓN GENERAL

1.1 ABOUT THIS MANUAL

This manual contains important information about your Windspot wind turbine system and its technical and operational characteristics. We strongly advise Windspot's owners to read all the contents carefully prior to start with the installation process.

1.2 ABOUT SONKYO ENERGY

SONKYO ENERGY strives to the transition towards a sustainable energetic model based on renewable energies and distributed generation.

We want to help communities and individuals ending their reliance on carbon based fuels, leading to more stable economies besides a large number of related benefits on their surrounding environments.

SONKYO ENERGY is an ISO 9001: 2008 Certified company specialized in designing, manufacturing and distributing Windspot small wind turbines ranging 1.5kw, 3.5kw, 7.5kw and 15kw. Our R&D team has track record of more than 25 years experience in the small wind industry.
We boast with 7000 m2 facilities located in the city of Santander (North of Spain) were design, manufacture and quality control processes take place.

All our products are strictly tested and checked in our factory to later undergo further third-party quality tests.

SONKYOENERGY
Polígono de Raos B-12
39600 Camargo-Spain
http://www.windspot.es/
info@sonkyoenergy.com

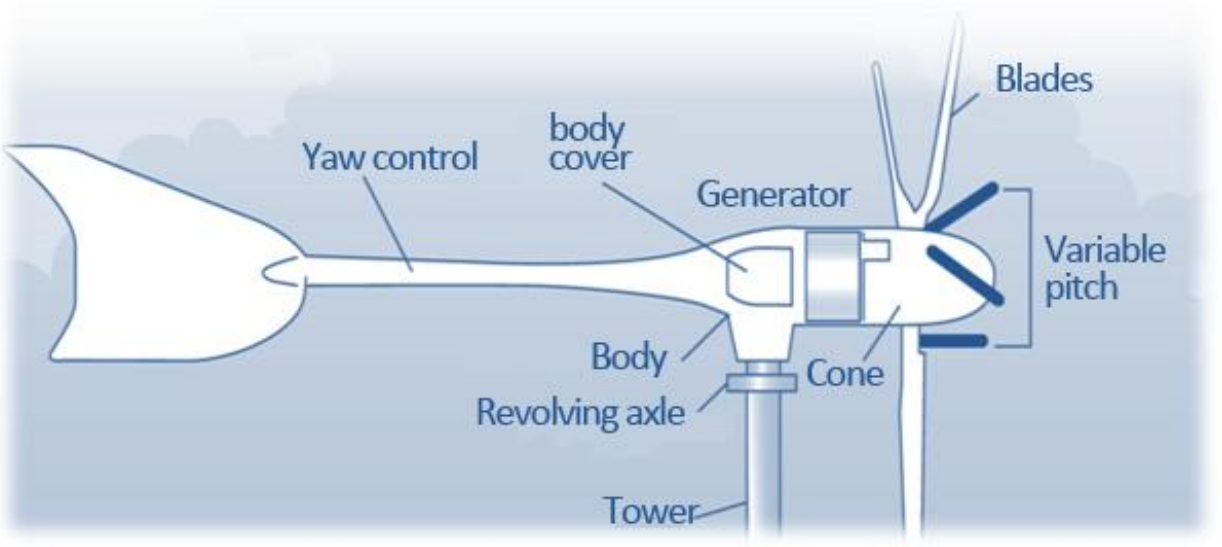
1.3 ABOUT WINDSPOT

General description:

The WINDSPOT is a three-blade, upwind, horizontal-axis wind generator. The wind generator´s rotating blades convert the wind´s kinetic energy into rotational momentum in a shaft. The rotating shaft turns a permanent magnet generator, which makes electricity. This electricity is transmitted through wiring down the tower as three-phase wild alternating current (AC).

The tail directs the rotor into the wind and the yaw bearing will allow the turbine to track the winds as they shift direction. The variable pitch system (governor) limits the rotor rpm as well as generator output to protect the turbine from high winds.

The variable pitch system is protected with a cone.



Variable pitch system:

The greatest innovation to our wind turbines is the incorporation of a new patented variable pitch system which prevents, in the event of heavy winds, any surges that may damage both the generator and the electronics.

By means of a simple robust and reliable dampener mechanism, this passive system uses the centrifugal force created by the spinning of the wind turbine to change the angle of attack of the blades. The straightforward design and the use of high-quality materials, such as stainless steel, anodized aluminum and bronze, have resulted in a smooth working order even in gusty situations.

Blades:
The blades are manufactured using RTM Light (Resin Transfer Molding) technology based on the use of polyester resin with fiber glass. This results in lightweight components with greater mechanical resistance. Using this manufacturing process based on the most advanced technology used in utility scale wind turbines, the weight obtained is less than half of common blades, providing enhanced mechanical resistance.

Tail:
Using the same technology as the blades RTM (Resin Transfer Molding), the tail boom and vane are made in one piece. The tail is attached to the body of the turbine by an aluminum insert, providing greater mechanical strength to the whole structure.

Generator:
Permanent magnet generator with a high number of poles to reduce the rated speed to 250 rpm. This reduced rotation speed considerably reduces materials wear and noise. A low cut-in speed enables it to work with 3m/sec wind speeds.

Body:
Made in anodized aluminum and completely watertight design to prevent corrosion and dirt in the inside parts of the generator, such as magnets, brushes and slip rings, therefore ensuring proper operation with minimum maintenance.

Cone:
Made in ABS plastic and painted with UV resistant coating, it possesses outstanding impact strength and high mechanical strength, which makes it suitable for protecting the variable pitch system from the elements.

Yaw bearing:
Permits the turbine to rotate to face the wind.

1.3.1 LIFETIME

WINDSPOT has been designed to last more than 25 years, even in the most adverse weather conditions, such as marine sites or high wind locations.

UV resistant coatings:

Paints used in WINDSPOT turbines are high quality UV resistant to prevent ageing and discoloration caused by the sun.

High wind resistance:

WINDSPOT turbine will operate normally at punctual high wind gusts up to 60 m/s, 216 km/h or 135 mph (Class I winds according IEC 61400-2 standard). These winds are classified as hurricanes. The well built and rugged design will allow the turbine to withstand mechanical stresses caused by sustained average high winds such as certain locations with 9 m/s (32 km/h or 20 mph).

Corrosion resistance:

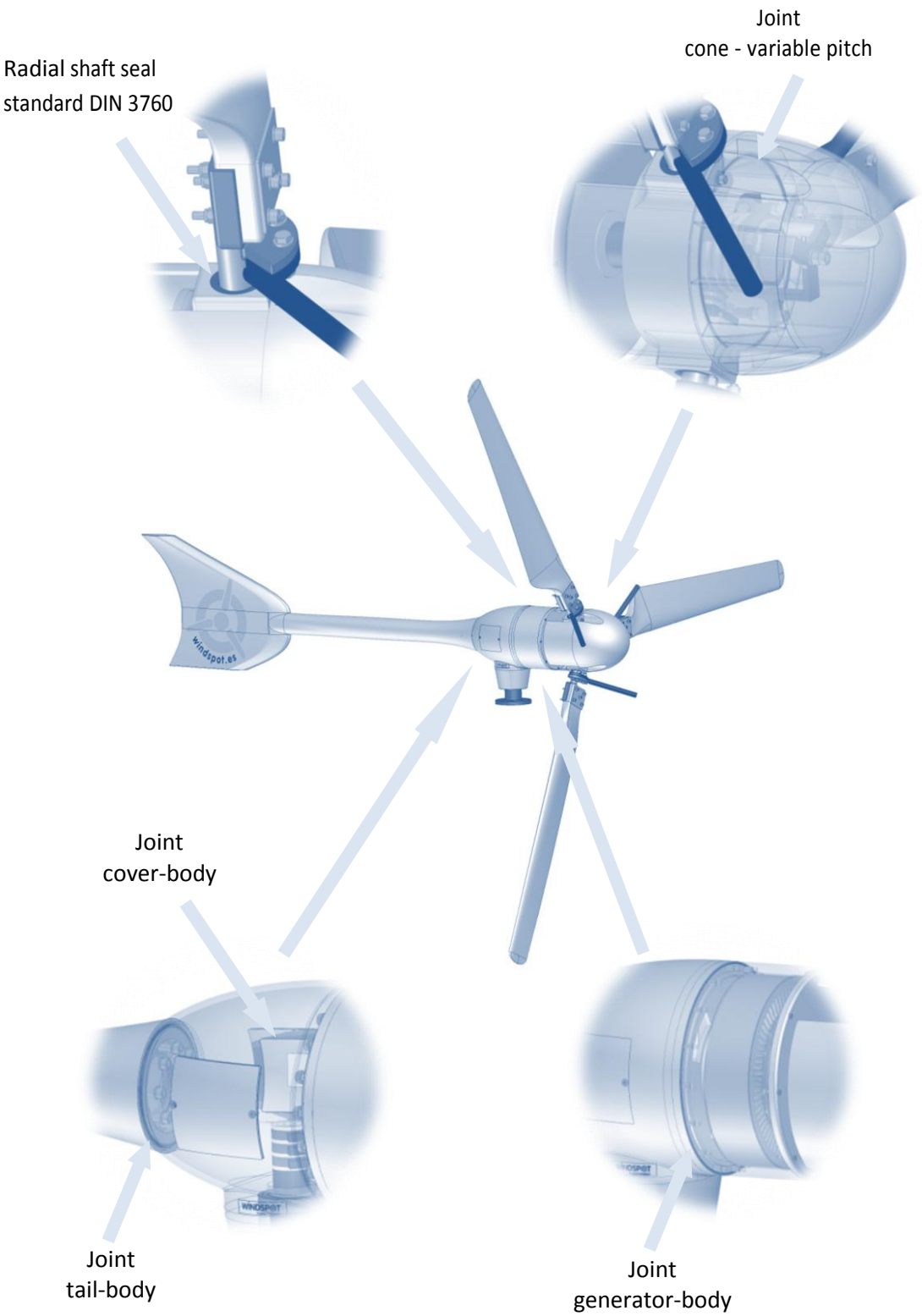
WINDSPOT are designed for coastal and offshore applications. All metal parts have been coated with marine grade powder coat for ensuring superior protection from the environment.

Parts	Anti-corrosion protection
Made of aluminum	Anodized + anti-corrosion paint
Made of steel	Cataphoresis + anti-corrosion paint or Cataphoresis + galvanized + anti-corrosion paint
Standard hardware	Stainless steel AISI 316

Watertight:

WINDSPOT wind turbines come in a waterproof enclosure to guarantee the watertightness. Besides the characteristics like corrosion protection, stainless steel hardware, the turbine features watertight housings seals.

Joint location	Joint characteristics
Joint cone - variable pitch	Toric joint (O-ring), Ø 5 mm
variable pitch	Radial shaft seal standard DIN 3760
Joint body - generator	Toric joint (O-ring), Ø 5 mm
Joint body – tail	Toric joint (O-ring), Ø 5 mm
Joint body - covers	Neoprene joint


Joint
cone - variable pitch
Radial shaft seal
standard DIN 3760
Joint
cover-body
Joint
tail-body
Joint
generator-body



1.3.2 POWER CURVE AND ANNUAL ENERGY PRODUCTION

The maximum voltage seen in the grid-tied version can be up to 500 V (voltage in battery charging model will always be lower)

At those voltages, the variable pitch would control the rpm and thus preventing any overvoltage that may damage the generator or the electronics.

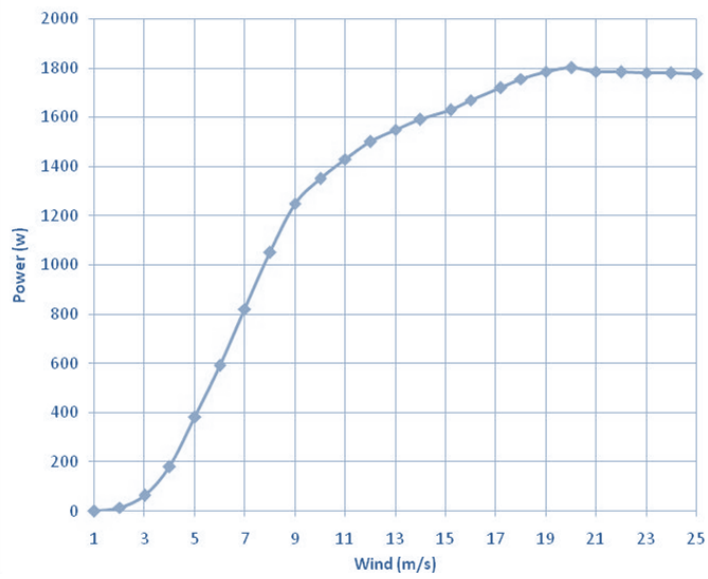
Annual energy production and rated power were calculated using the power curve and Weibull (K) probability density function for wind speed.

WINDSPOT 3.5: Power curve and annual energy production have been measured and certified by **CIEMAT-CENER** (Spanish National Renewable Energy Centre) according to IEC 61400-12-1 standards.

WINDSPOT 1.5: Power curve and annual energy production have been measured and certified by **SEPEN** (Site Experimental Pour le Petit Eolien de Narbonne) according to IEC 61400-12-1 standards.

WINDSPOT 1.5 power curve (According IEC 61400-12-1 standards)

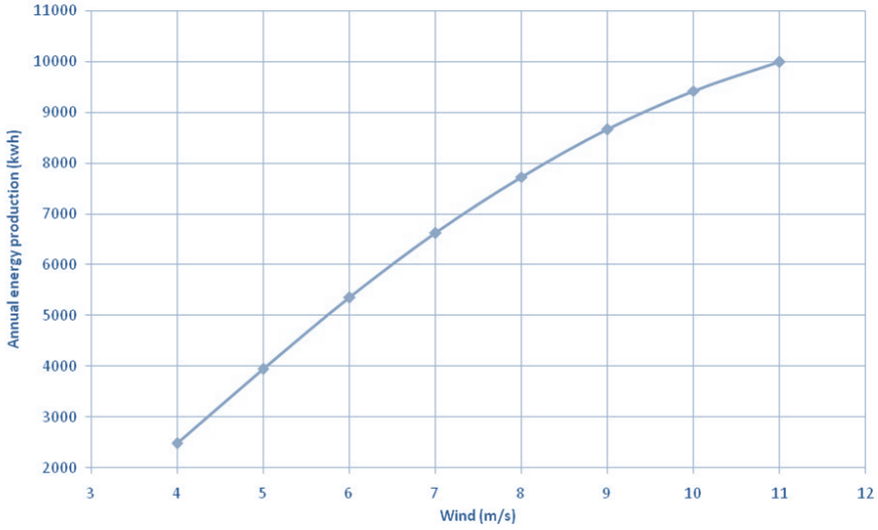
Power output at 11 m/s (24.6mph) at standard sea-level conditions is 1472 watts.



WIND SPEED (m/s)	POWER (W)
0	0
1	0
2	15
3	65
4	180
5	380
6	590
7	820
8	1050
9	1250
10	1350
11	1430
12	1500
13	1550
14	1590
15	1630
16	1670
17	1720
18	1755
19	1785
20	1800
21	1785
22	1783
23	1781
24	1779
25	1777

WINDSPOT 1.5 Annual Energy Production

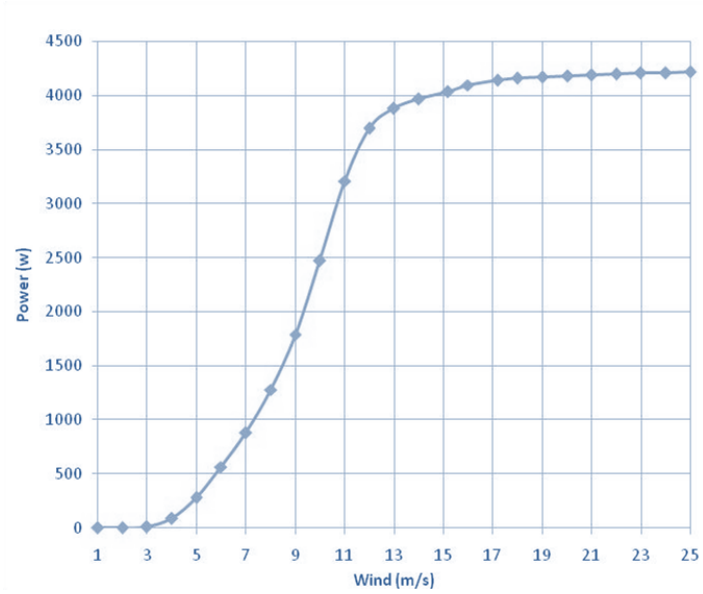
Estimated annual energy production assuming annual an average wind speed of 5m/s (11.2mph) is 3.945 kwh.



Annual Energy Production (Kwh) 4 m/s Average wind speed	Annual Energy Production (Kwh) 5 m/s Average wind speed	Annual Energy Production (Kwh) 6 m/s Average wind speed	Annual Energy Production (Kwh) 7 m/s Average wind speed	Annual Energy Production (Kwh) 8 m/s Average wind speed	Annual Energy Production (Kwh) 9 m/s Average wind speed	Annual Energy Production (Kwh) 10 m/s Average wind speed	Annual Energy Production (Kwh) 11 m/s de Average wind speed
2410	3876	5295	6575	7696	8663	9489	10180

WINDSPOT 3.5 power curve (According IEC 61400-12-1 standards)

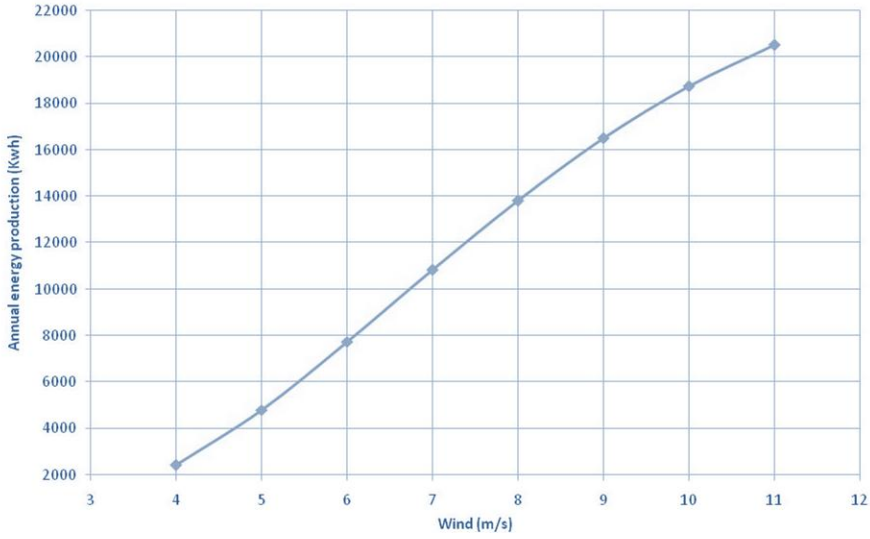
Power output at 11 m/s (24.6mph) at standard sea-level conditions is 3472 w.



WIND SPEED (m/s)	POWER (W)
0	0
1	1
2	1
3	10
4	89
5	285
6	566
7	877
8	1279
9	1790
10	2469
11	3207
12	3697
13	3878
14	3967
15	4032
16	4095
17	4140
18	4160
19	4170
20	4180
21	4188
22	4196
23	4204
24	4210
25	4214

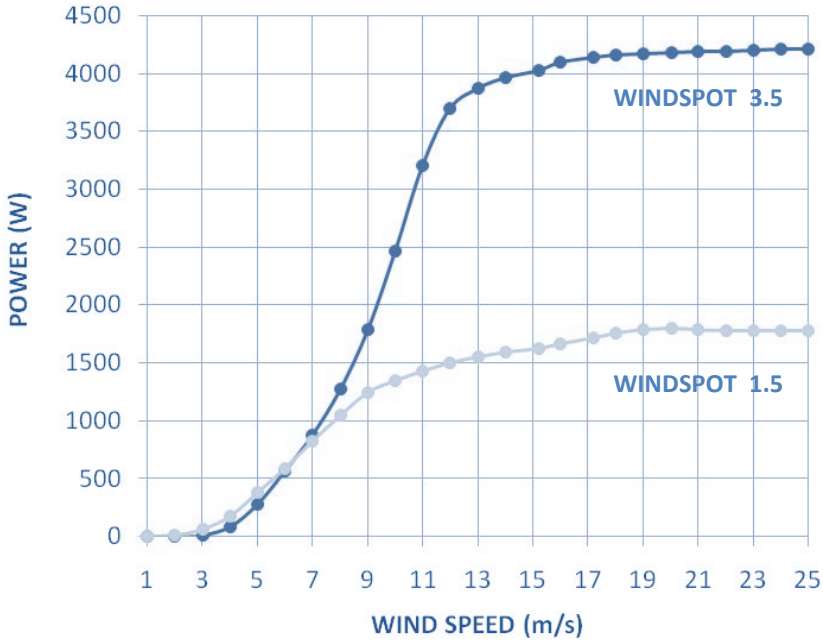
WINDSPOT 1.5 Annual Energy Production

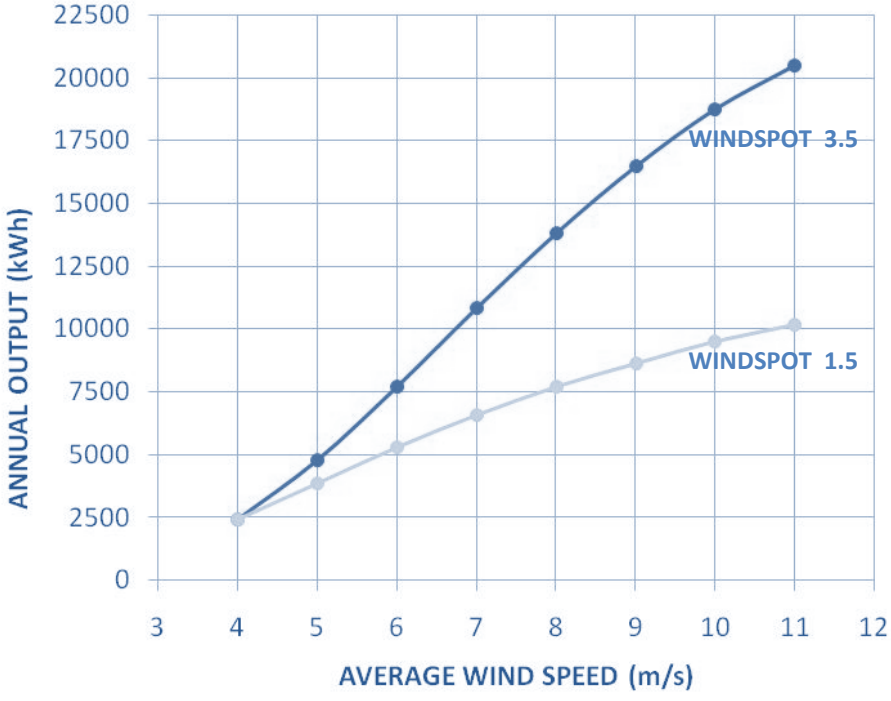
Estimated annual energy production assuming annual an average wind speed of 5m/s (11.2mph) is 4802 kwh.



Annual Energy Production (Kwh) 4 m/s Average wind speed	**Annual Energy Production (Kwh)** 5 m/s Average wind speed	**Annual Energy Production (Kwh)** 6 m/s Average wind speed	**Annual Energy Production (Kwh)** 7 m/s Average wind speed	**Annual Energy Production (Kwh)** 8 m/s Average wind speed	**Annual Energy Production (Kwh)** 9 m/s Average wind speed	**Annual Energy Production (Kwh)** 10 m/s Average wind speed	**Annual Energy Production (Kwh)** 11 m/s de Average wind speed
2417	4802	7736	10839	13818	16488	18740	20515

WINDSPOT 1.5 & WINDSPOT 3.5 power curve comparison:





1.3.3 NOISE

The noise measurements carried out by the certification institution **GRONTMIJ CARL BRO** (Denmark) subject to IEC 61400-11 Standard for the 3.5KW WINDSPOT showed the following results:

At 60m distance and with a constant wind speed of 8 m/s a 37 dB (A) noise level was recorded.

Distance m	LpA 6m/s dB(A)	LpA 8m/s dB(A)	Distance m	LpA 6m/s dB(A)	LpA 8m/s dB(A)	Distance m	LpA 6m/s dB(A)	LpA 8m/s dB(A)
25	40.7	43.4	100	30.0	32.6	175	24.9	27.2
30	39.6	42.3	105	29.6	32.2	180	24.7	27.3
35	38.5	41.3	110	29.2	31.8	185	24.4	27.0
40	37.6	40.6	115	28.8	31.4	190	24.2	26.7
45	36.7	39.4	120	28.4	31.0	195	23.9	26.5
50	35.8	38.6	125	28.0	30.6	200	23.7	26.3
55	35.1	37.8	130	27.7	30.3	210	23.2	25.8
60	34.4	**37.1**	135	27.3	29.9	220	22.8	25.4
65	33.7	36.4	140	27.0	29.6	230	22.4	24.9
70	33.1	35.8	145	26.7	29.3	240	22.0	24.5
75	32.5	35.2	150	26.4	29	250	21.6	24.1
80	31.9	34.6	155	26.1	28.7	260	21.2	23.7
85	31.4	34.1	160	25.8	28.4	270	20.9	23.4
90	30.9	33.6	165	25.5	28.1	280	20.5	23.0
95	30.4	33.1	170	25.2	27.2	290	20.2	22.7

The table below shows a reference of the different noise intensities recorded in common situations:

dB(A) Table	
Silence	0
Footstep	10
Tree leaves	20
Quiet conversation	30
Library	40
Quiet office	50
Conversation	60
Traffic	80
Vacuum cleaner	90
Motorbike	100
Rock concert	120
Pneumatic hammer	130

1.3.4 TECHNICAL DATA SHEETS FOR END USERS

SONKYO ENERGY
WINDSPOT

TECHNICAL DATA SHEET FOR END USERS: WINDSPOT 1.5

MANUFACTURER: SONKYO ENERGY
MODEL: WINDSPOT 1.5
VERSIONS: OFF GRID (48 V), ON GRID (110V AND 220V)

POWER:
Generated power for a 11 m/s wind speed (24.6 mph, 39.6 km/h). Air density at sea level and a Rayleigh wind speed distribution. The generated power will be determined by the installation site specific conditions.

1,43 kW

ANNUAL ENERGY OUTPUT:
Yearly output for a 5 m/s average wind speed (11.2 mph, 18 km/h)l. Air density at sea level and a Rayleigh wind speed distribution. Output will be determined by the installation site specific conditions.

3.876 kWh/año

ACOUSTIC NOISE LEVEL:
Noise level recorded at a 60 m distance from the rotor center with a constant wind speed of 8m/s (17.9 mph, 28.8 km/h), air density at sea level and a Rayleigh wind speed distribution.

37,1 dB(A)

OPERATING LIFE:
Estimated operating life in the harshest conditions, extremely saline environments or locations with high average wind speeds.

25 years

TECHNICAL DATA SHEET FOR END USERS: WINDSPOT 3.5

MANUFACTURER: SONKYO ENERGY
MODEL: WINDSPOT 3.5
VERSIONS: OFF GRID (24V AND 48 V), ON GRID (110V AND 220V)

POWER:

Generated power for a 11 m/s wind speed (24.6 mph, 39.6 km/h). Air density at sea level and a Raleigh wind speed distribution. Generated power will be determined by the installation site specific conditions.

3,47 kW

ANNUAL ENERGY OUTPUT:

Yearly output for a 5 m/s average wind speed (11.2 mph, 18 km/h). Air density at sea level and a Rayleigh wind speed distribution. Output will be determined by the installation site specific conditions.

4.800 kWh/año

ACOUSTIC NOISE LEVEL:

Noise level recorded at a 60 m distance from the rotor center with a constant wind speed of 8m/s (17.9 mph, 28.8 km/h), air density at sea level and a Rayleigh wind speed distribution.

37,1 dB(A)

OPERATING LIFE:

Estimated operating life in the harshest conditions, extremely saline environments or locations with high average wind speeds.

25 años

1.4 CERTIFICATIONS, TESTS AND STANDARDS

WINDSPOT has been designed according to the technical standards in force for the design of small wind turbines. Tests for data collection have been undertaken by outstanding international institutions.

Power curve and annual power output for WINDSPOT 3.5: obtained at the CIEMAT (Spanish Research Center for Energy, Environment and Technology) according to **IEC 61400-12-1** standard.

Power curve and annual power output for WINDSPOT 1.5: obtained at the **SEPEN** (Site Experimental Pour le Petit Eolien in Narbonne, France) according to **IEC 61400-12-1** standard.

WINDSPOT 3.5 acoustic noise level: Measurements done by the **Certification Institution GRONTMIJ CARL BRO** (Denmark) according to **IEC 61400-11** standard**.**

WINDSPOT 1.5 AND 3.5: **CE** Declaration of Conformity.

WINSPOT 1.5 AND 3.5 DESIGN: according to **IEC 61400-2 standard** (Class I), **IEC 61400-1** and **UNE-EN ISO 12100-1**.

SONKYO ENERGY: Quality Management System **ISO 9001**.

CE
2006/42/CE
2006/95/CE
200 /108/CE

LLOYD'S REGISTER QUALITY ASSURANCE · ISO9001 · UKAS MANAGEMENT SYSTEMS 001

1.4.1 DECLARACIÓN CE DE CONFORMIDAD

DECLARATION OF CONFORMITY WINDSPOT

CE

SONKYOENERGY

SONKYOENERGY S.L.
Pol. de Raos. P12 Nave B3.
39600 Maliaño. CANTABRIA

Hereby declares that the following models:

WINDSPOT wind turbines

1.5 KW	7.5 KW
3.5 KW	15 KW

Meet the essential European Union requirements of design and construction. The products comply with the following European Directives:

-Machinery Directive 2006/42/EC
-Low Voltage Directive 2006/95/EC
-EMC Directive 2004/108/CE

The following harmonized standards were applied:

- UNE-EN 61400-2:2006 : Wind turbines. Design requirements for small wind turbines.
- UNE-EN ISO 61400-1:2006 : Wind turbines. Design requirements.
-UNE-EN ISO 12100-1:2004 : Safety of machinery. Basic concepts, general principles for design. Part 1: Basic terminology, methodology.

Dated, 6th of July 2010

Name: Iñigo González
Manager

1.4.2 CERTIFICACIÓN ISO 9001: SONKYO ENERGY

CERTIFICATE OF APPROVAL

This is to certify that the Quality Management System of:

SONKYO ENERGY, S.L.
Maliaño, Cantabria
Spain

has been approved by Lloyd's Register Quality Assurance to the following Quality Management System Standards:

ISO 9001:2008

The Quality Management System is applicable to:

Design and manufacturing of small wind turbine generators. Commercialization of towers for small wind turbine generators.

Approval
Certificate No: SGI 6010073

Original Approval: 18 October 2010
Current Certificate: 18 October 2013
Certificate Expiry: 17 October 2013

Issued by: LRE, S.A.
On behalf of Lloyd's Register Quality Assurance Limited

UKAS MANAGEMENT SYSTEMS
001

This document is subject to the provision on the reverse
71 Fenchurch Street, London EC3M 4BS United Kingdom. Registration number 1879370
This approval is carried out in accordance with the LRQA assessment and certification procedures and monitored by LRQA
The use of the UKAS Accreditation Mark indicates Accreditation in respect of those activities covered by the Accreditation Certificate Number 001

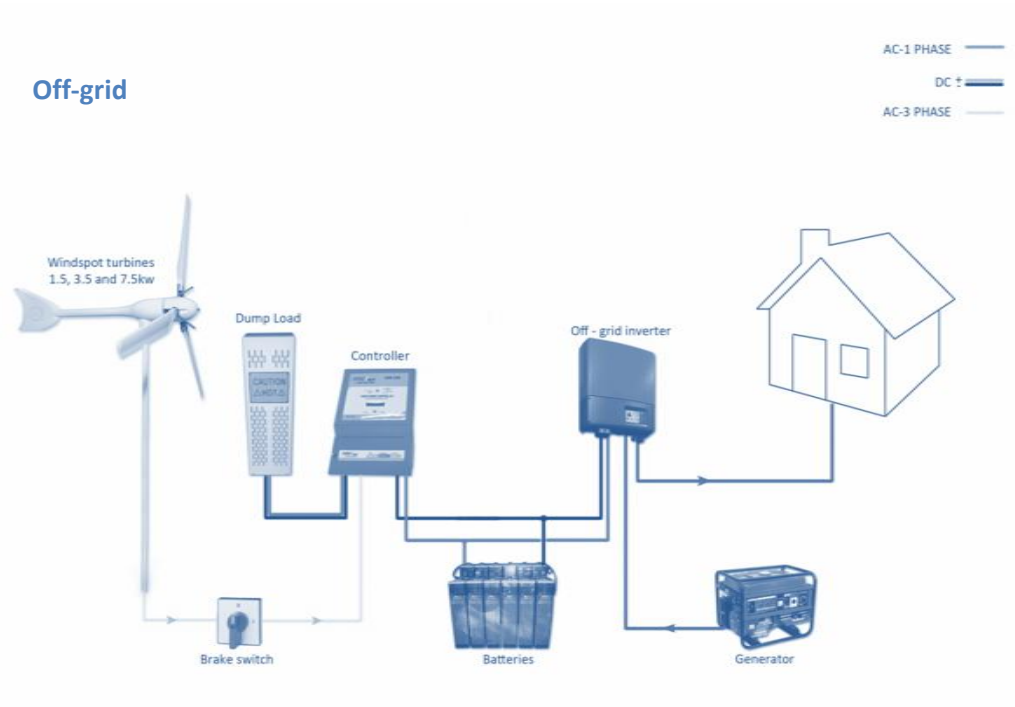
1.5 WINDSPOT APPLICATIONS: TYPICAL INSTALLATIONS

WINDSPOT is a small wind turbine both for domestic and industrial use, it can be installed on grid or off grid using batteries. Some of the Windspot most common applications are telecom towers, water pump systems and hybrid systems that combine wind and solar energy.

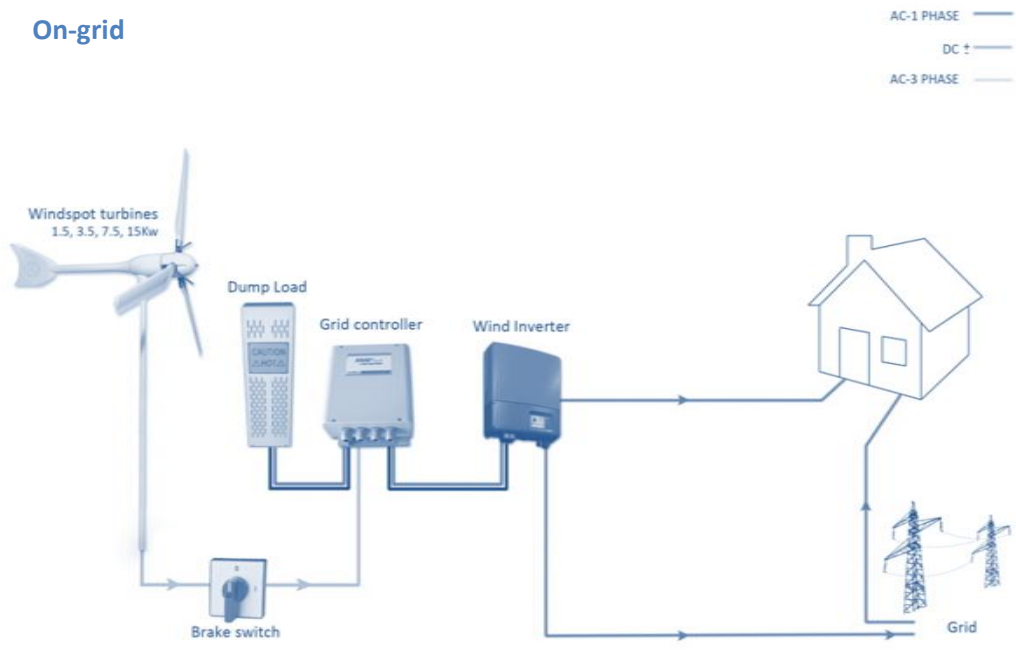
Business	Residential
 Madeira (Portugal)	 Michigan (USA)
Grid connection	**Farms and industries**
 Alicante (España)	 Taiwan
Water pump	**Isolated installations**
 Turkana (Kenia)	 Parque nacional de Monfragüe
Hybrid systems	**Telecom towers**
 Alicante (España)	 Alicante (España)

1.6 WINDSPOT APPLICATIONS: CONNECTION DIAGRAMS

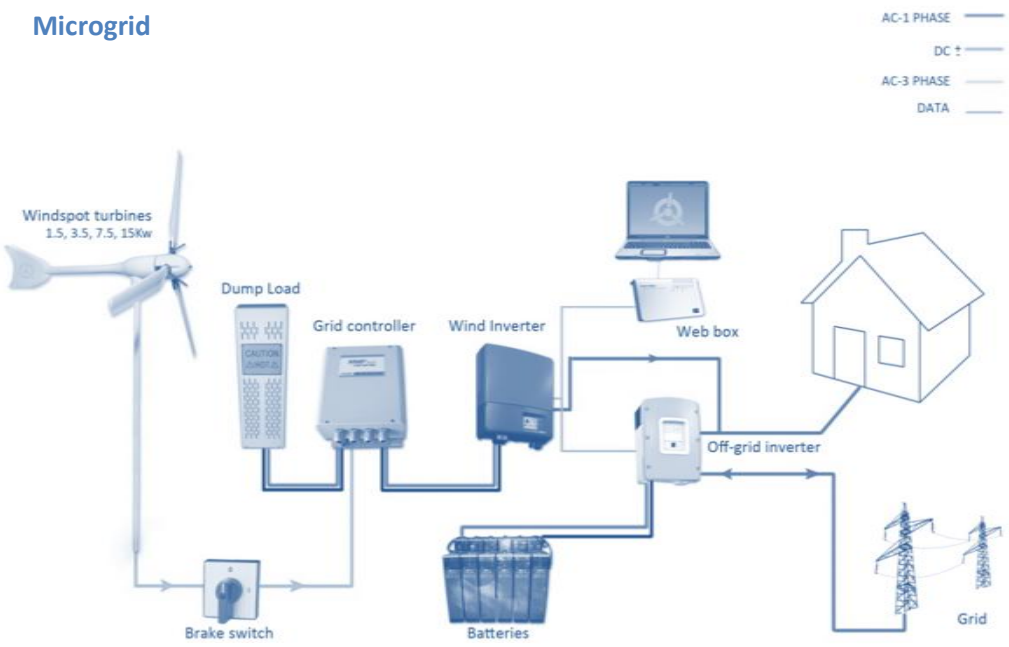
Off-grid



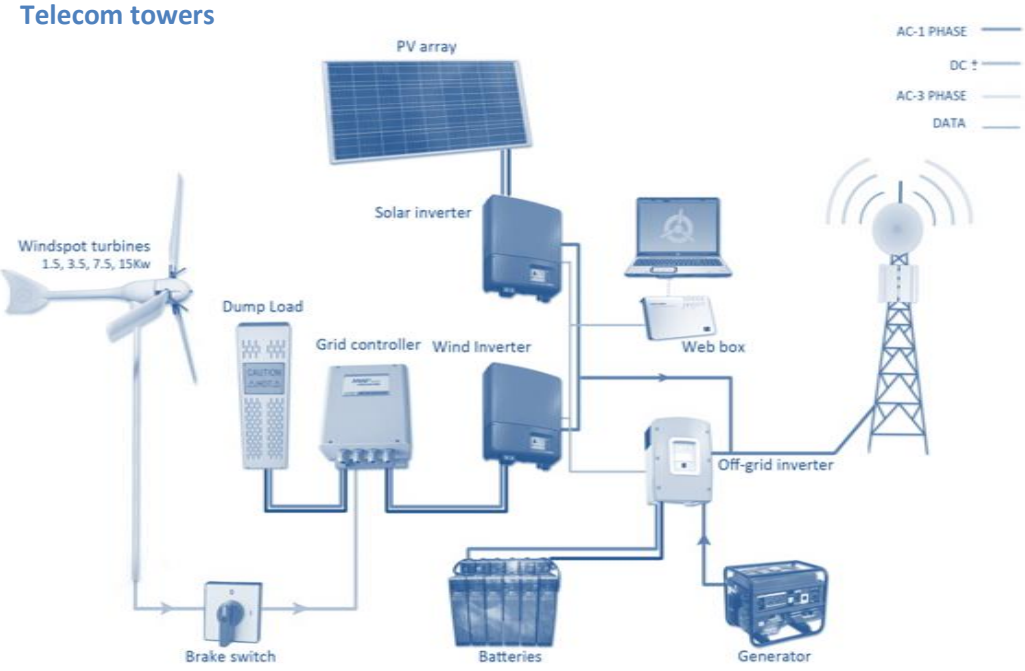
On-grid



Microgrid



Telecom towers



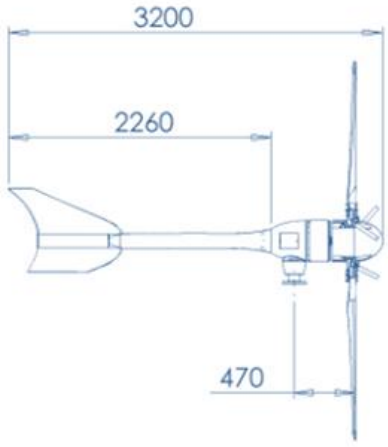
2 BEFORE THE INSTALLATION

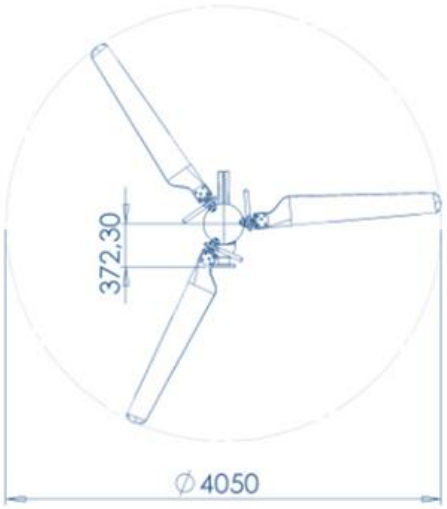
2.1 TECHNICAL FEATURES

POWER	1.5KW @ 250rpm	3.5KW @ 250rpm
ROTOR DIAMETER	4.05 m	4.05 m
ROTOR SWEPT AREA	12.88 m^2	12.88 m^2
CUT IN SPEED	3 m/s	3 m/s
RATED SPEED	12 m/s	11,5 m/s
WEIGHT	165 kg	185 kg
TOTAL LENGTH	3.17 m	3.2 m
ESTIMATED ANNUAL ENERGY OUTPUT	3.945 – 6.622 kWh (5-7 m/s)	4.802 – 10.839kWh (5-7 m/s)
CO2 SAVED	2.621 – 4.966 kg (5-7 m/s)	3.610 – 7.350 kg (5-7 m/s)
GENERATOR	Synchronous, permanent magnets; 3 phases, 24-48-110-220 V, 50/60 Hz	Synchronous, permanent magnets, 3 phases, 48-110-220 V, 50/60 Hz
TYPE	Up-wind horizontal rotor	
YAW CONTROL	Passive system: yaw tail	
POWER CONTROL	Passive variable pitch system, centrifugal and absorbed (patented design)	
TRANSMISSION	Direct	
BRAKE	Electric	
CONTROLLER	On-grid or off-grid connection option	
BLADES	Polyurethane core + polyester resin +fiber glass	
INVERTER	Efificiency ≈ 95% ; Algorithm MPPT	
NOISE	37 dB (A) from 60 m (65 yd) with a wind speed of 8 m/s	
ANTI-CORROSION PROTECTION	Sealed design + e-coat + galvanizing + anodizing + UV resistant paint	
TOWER	12, 14 and 18 m (39, 46 and 59 ft); hydraulic or mechanical lay down system	
DESIGN	According to IEC61400-2	
SURVIVAL WIND SPEED	60 m/s (class 1 according to IEC 61400-2)	
TEMPERATURE RANGE	-20 C / 50 C (extreme conditions according to IEC 61400-2)	

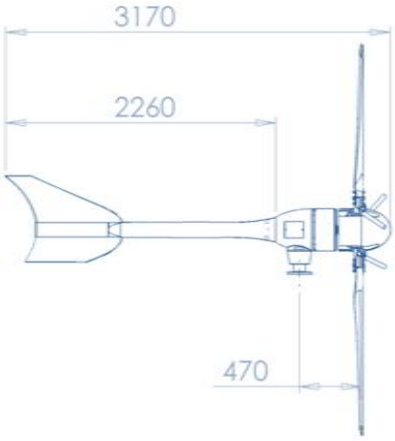
2.2 MEDIDAS GENERALES

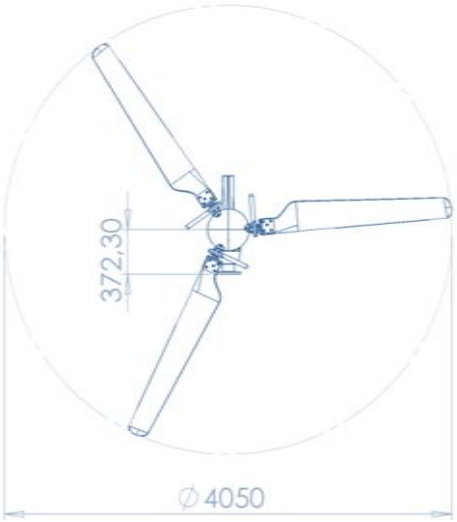
WINDSPOT 3.5





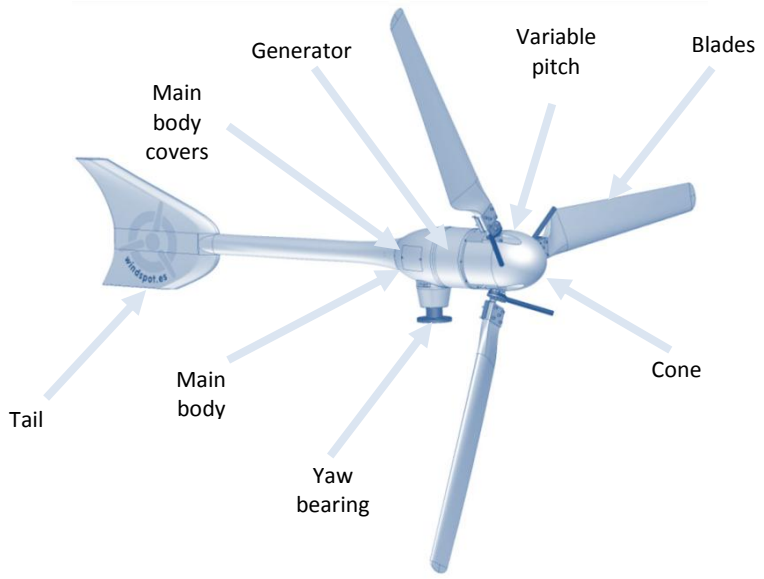
WINDSPOT 1.5

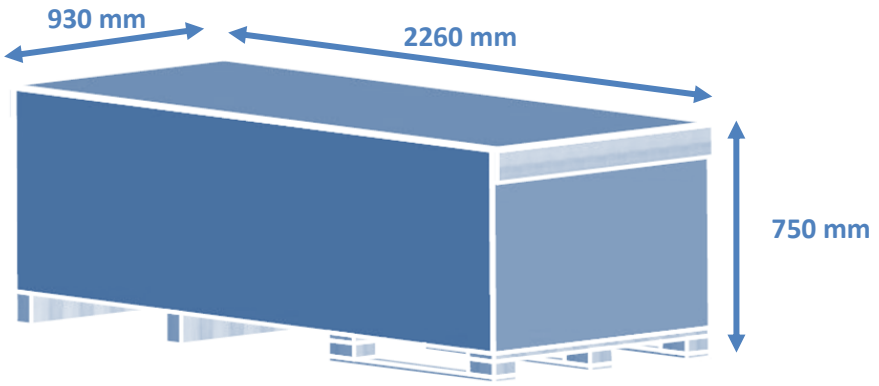


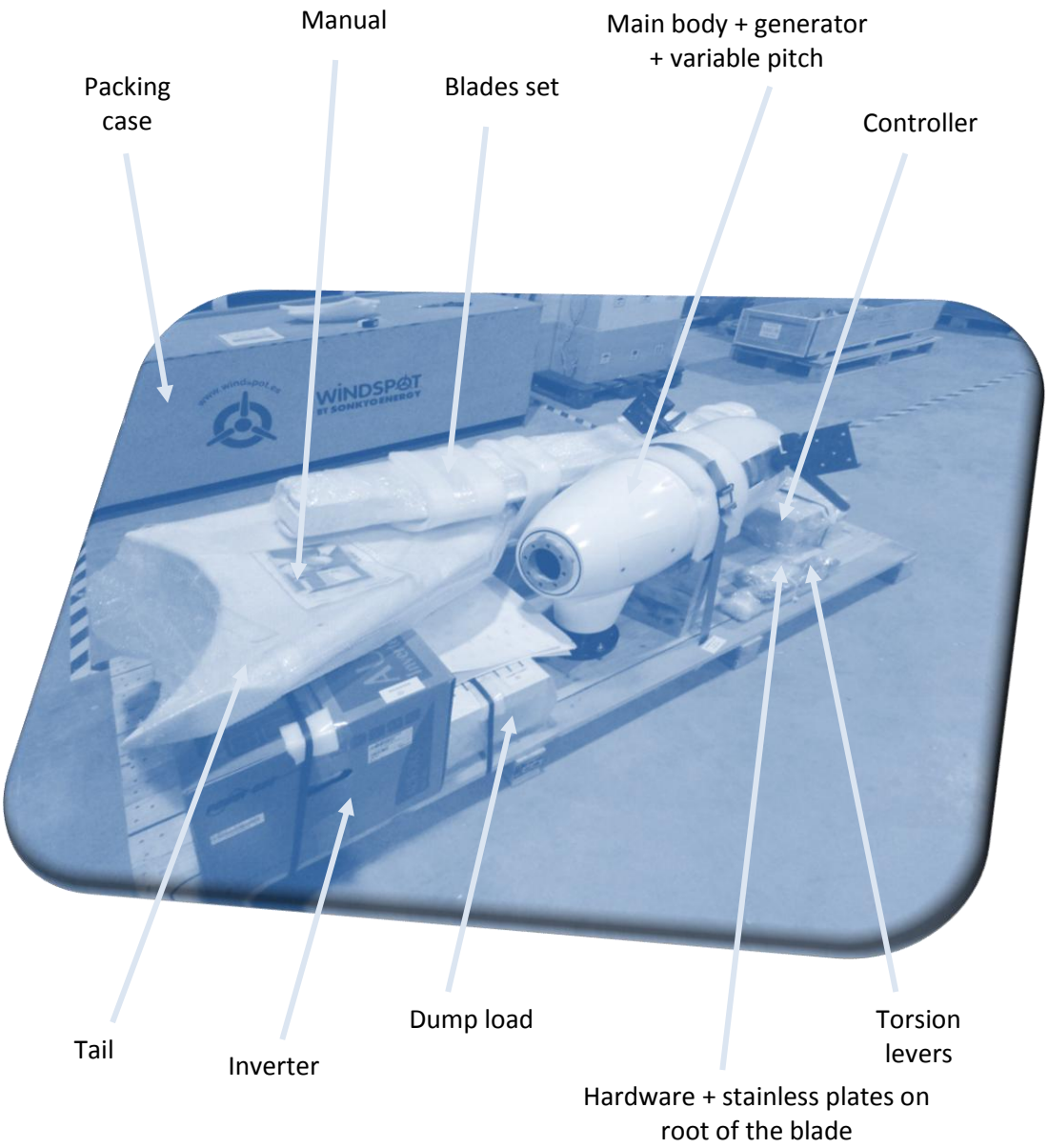


2.3 EMBALAJE

WINDSPOT will be supplied in a 2260 x 930 x 750 mm box that includes:
- Main body + generator + variable pitch
- Hardware (please see all details below)
- 1 Tail
- 1 Blades set (3 blades)
- 1 Controller (off-grid or on-grid)
- 1 Inverter (optional)
- 1 Dump Load





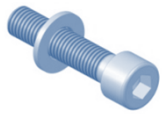


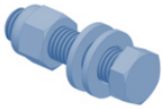
Note: Two torsion levers are supplied in a package. The other one is already assembled in the variable pitch.

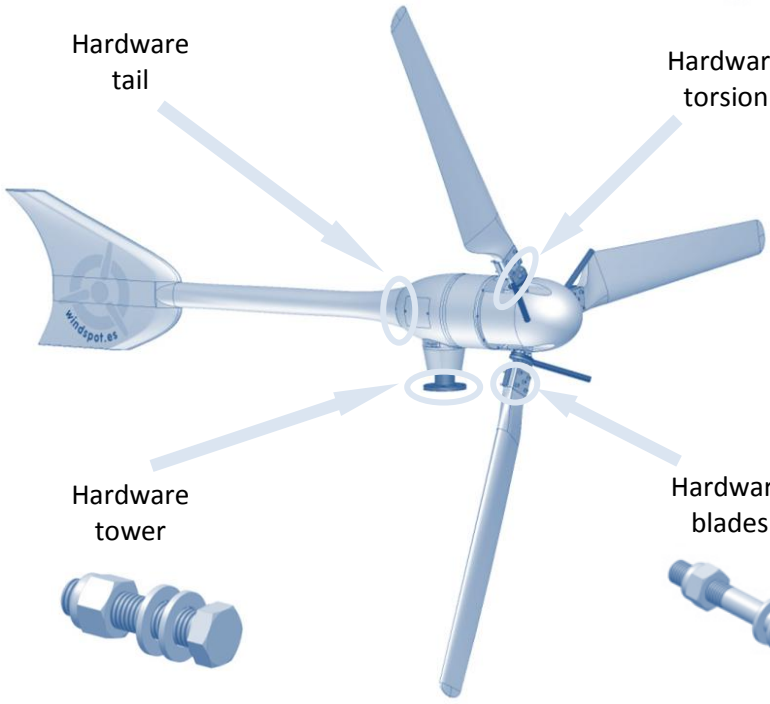
Hardware: specifications and quantities

Allen bolt A4 DIN912 M10x45	8
Flat washer A4 DIN126 M10	8

Hex head bolt A4 DIN 933 M12x50	4
Hex nut A4 DIN934 M12	4
Flat washer A4 DIN126 M12	8







Hex head bolt A4 DIN 933 M14x60	8
Hex nut A4 DIN934 M14	8
Flat washer A4 DIN126 M14	16

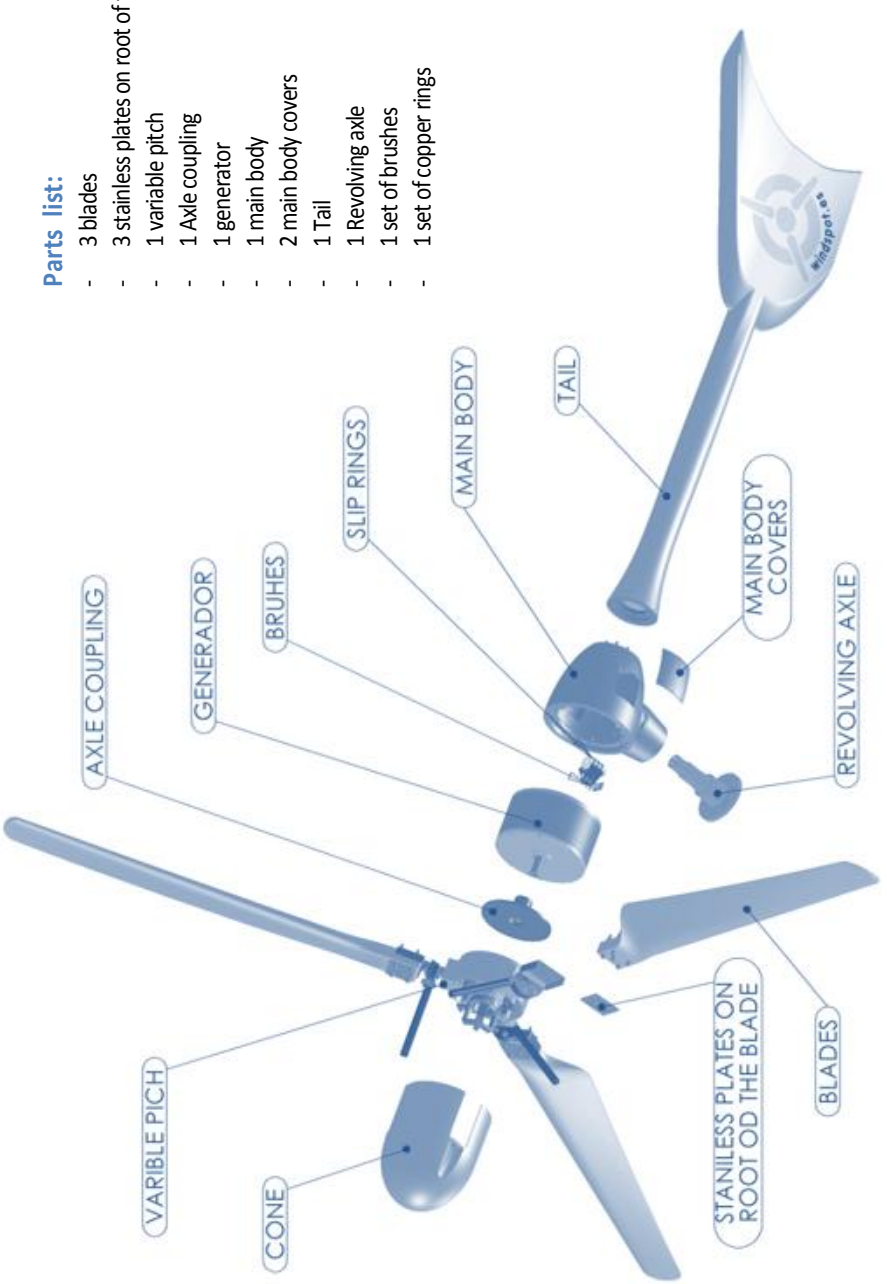
Allen bolt A4 DIN912 M10x90	15
Hex nut A4 DIN934 M10	15
Flat washer A4 DIN126 M10	30

Note: Hardware in stainless steel AISI 316 (A4).

2.4 PARTS LIST

Parts list:

- 3 blades
- 3 stainless plates on root of the blade
- 1 variable pitch
- 1 Axle coupling
- 1 generator
- 1 main body
- 2 main body covers
- 1 Tail
- 1 Revolving axle
- 1 set of brushes
- 1 set of copper rings



3 INSTALLATION

3.1 LOCATION

The correct location of the WINDSPOT wind turbine is as important as the wind speed resources available. Some of the following considerations should be taken into account:

The ideal location for WINDSPOT usually is the : Height of the closest obstacles, distance from these obstacles, height of the tower installed or the space available for the installation.

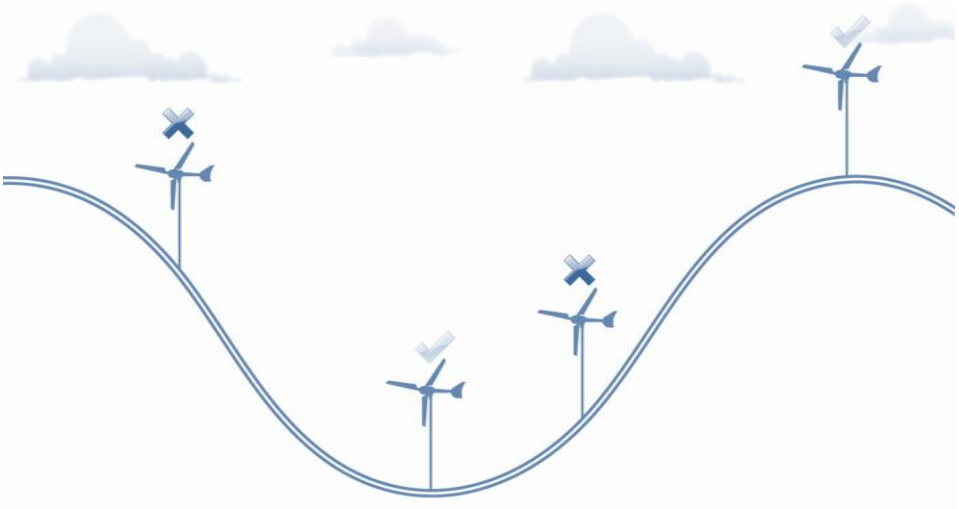
CAUTION: Your installer may give you technical assistance to find the best location for your WINDSPOT.

Height of the tower:

In general you will get more power from your wind turbine as higher is the height of your tower, as the wind speed increase with height, but a taller tower is also a bigger investment.

Terrain shape:

Usually the highest location has the best wind conditions, however, the areas around rivers, valleys, hills, mountains or forests may affect the wind speed available.

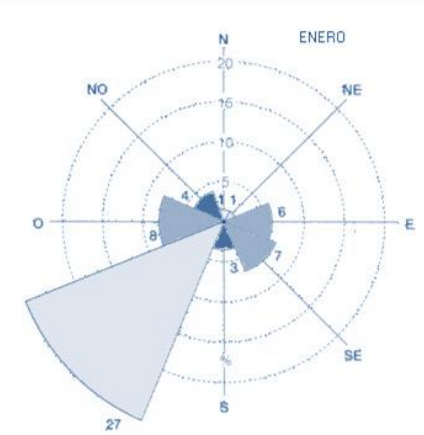


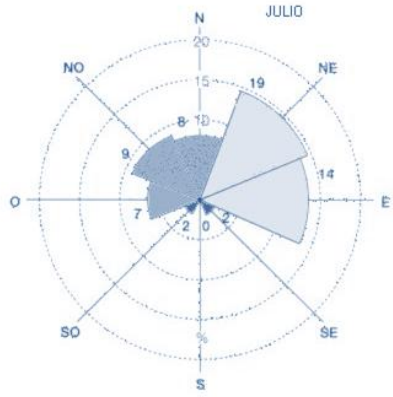
Prevailing winds:

It is important to know where the most frequent winds and the strongest winds come from in the area where WINDSPOT will be installed. As far as possible this area should be clear of obstacles.

A wind study with an anemometer of wind speed and wind direction during a certain period of time, sometimes is required to know the above mention information. With this data we will get what it is called a compass rose.

See below an example of the mentions compass roses. These two compass roses are from the same location but in different seasons, one in summer and the other in winter. As you can see, both compass roses are completely different. So, a detail study of the wind characteristics and electricity demand during these two seasons will be useful.





Building roofs:

WINDSPOT can be installed in the roof of big buildings.

As a general rule the first thing to consider is the direction of the prevailing wind. We may try to avoid any obstacle from this direction.

Then, you shall consider the effects of the roof edge. This area creates turbulent air flow movements; the rotor of WINDSPOT must be place high enough to avoid this turbulent area.

We advise a minimum tower height of 10m over the roof; this height should be increased for bigger buildings.

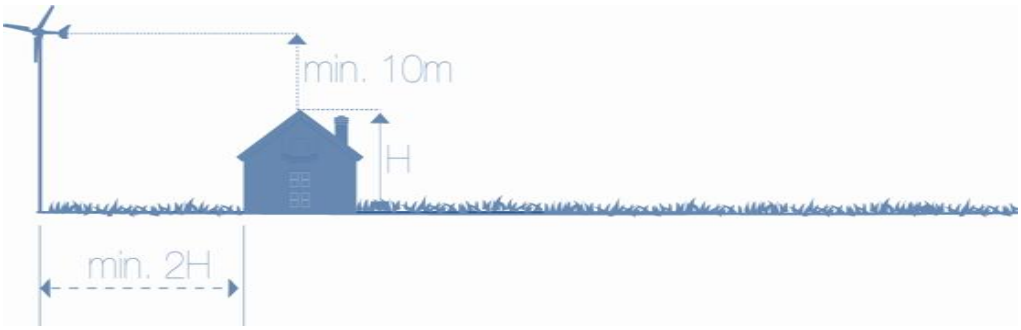
Obstructions:

An obstruction is considered to any obstacle interfering from the wind direction that affects the direction and the speed of the wind. The most common obstructions are houses or trees.

It is impossible to fully avoid all the obstacles but we can reduce the turbulence factor as maximum following some easy rules during the location of WINDSPOT.

Areas without a clear prevailing wind direction:

As a general rule WINDSPOT rotor should be place 10m over any obstacle and a minimum distance of twice the height of the obstacle far from the base of the wind turbine.



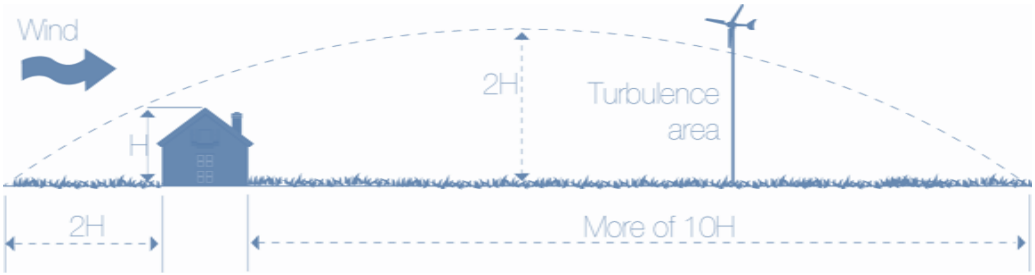
Areas with a clear prevailing wind direction:

Around an obstacle there is turbulent air:

- The dimensions of the turbulent area depend on the height of the obstacle.
- Turbulent area direction is defined b the prevailing wind direction.

The dimension of the turbulent area at leeward (more than 10H) depends on the obstacle´s width (A):

- Si A>3H → The dimension of the turbulence at leeward area is 20H.
- Si A≤3H → The dimension of the turbulence at leeward area is 10H. (This is the most common situation)

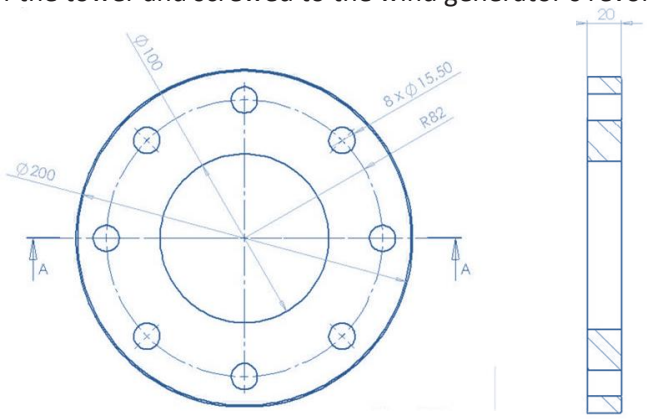


By the way, the best situation for the better production of WINDSPOT is when the rotor is completely out of any turbulence.

3.2 TOWER: GENERAL COMPONENTS

Flange between the revolving axing and the tower:

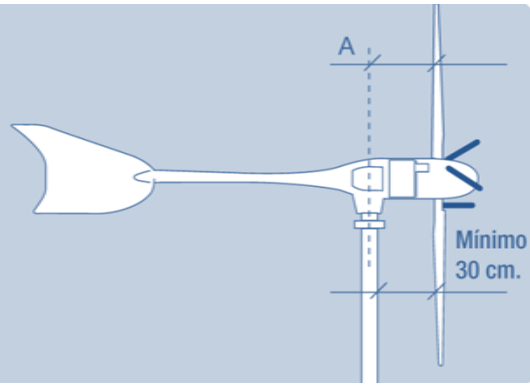
For customers who have their own tower we have included a drawing of the flange that connects the revolving axle and the tower. That connection should be welded to the top part of the tower and screwed to the wind generator's revolving axle.



Minimum distance between WINDSPOT'S blade and the tower:

Remarks to take into account during the installation:

No matter what kind of tower is installed, the minimum distance between the blade and the tower must be at least 30cm.



Data for the towers design:

WINDSPOT	WEIGHT	THRUST	OVERTURNING MOMENT
1.5 KW	165 kg	4500 N / 650 N (fatigue)	1700 Nm / 500 Nm (fatigue)
3.5 KW	185 kg	4500 N / 650 N (fatigue)	1700 Nm / 500 Nm (fatigue)

CAUTION: The data supplied have been obtained using IEC 61400-2 standard and does not include security factor.

3.3 INSTALLATION: SAFETY RECOMMENDATIONS

Safety requirements should be taken into account during the installation and maintenance of WINDSPOT:

• WINSPOT fulfills all the international rules about safety. So, the installation should be dangerous.

• WINDSPOT has being designed for a safe installation but there are some risks coming from all the electro mechanic equipments operation.

• WINDSPOT should be installed following the instructions of this manual as well as fulfill all the local and nationals rules.

• WINDSPOT installation must be carry out by qualified staff.

• During the installation you must assure the wind turbine is braked (The 3 phases of the generator short circuit) and disconnected from the grid.

• Make the installation and maintenance works during wind calm conditions. Wind should be less than 6m/s.

• Don´t stay at the tower bottom during the installation and maintenance operations.

• Two persons are necessary for the safe installation and maintenance of WINDSPOT.

• During the installation you must always use the correct safety equipment: Hamlet, safety footwear, globes, safety glasses, etc.

CAUTION: SONKYO ENERGY does not take the responsibility of the inappropriate use of the generator. WINDSPOT shouldn´t be manipulated without the permission of the installer or the manufacturer. Do not make the proper use of the wind turbine may end on electrocutions and burns. A non authorized manipulation will void automatically the warranty of the small wind turbine.



3.4 ASSEMBLY

At the moment the foundation is finished and the tower installed WINDSPOT will be ready for the installation in the tower.

WINDSPOT is designed for an easy, fast and safe installation.

Torque:

CAUTION: In order to apply the correct torque, use a torque wrench.

Metric	Torque recommended	
	Nm	Lbf.ft
M4	3	2
M6	7	5
M8	17	13
M10	33	24
M12	57	42
M14	91	67
M16	140	104
M20	273	203

If the torque applied is more than recommended there is a risk of damage in the pieces join by the screws.

If the torque applied is less than recommended there is a risk of vibrations.

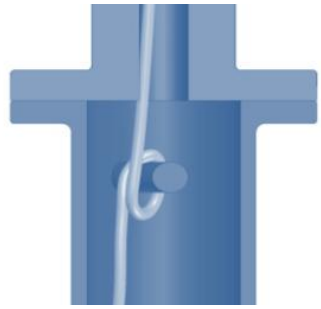
WINDSPOT assembly:

In order to proceed with the assembly of WINDSPOT there are 5 steps. You must follow the steps in the correct order.

STEP 1: Electrical connections:

Using **three electrical connectors** joint the cables coming from the slip rings with the cables going down the tower.

In order to avoid overvoltage in the joint between these two cables due to the weight of the cables, you should fix the cables in the hook inside the top of the tower.



STEP 2: Bolting WINDSPOT to the tower:

Hardware:

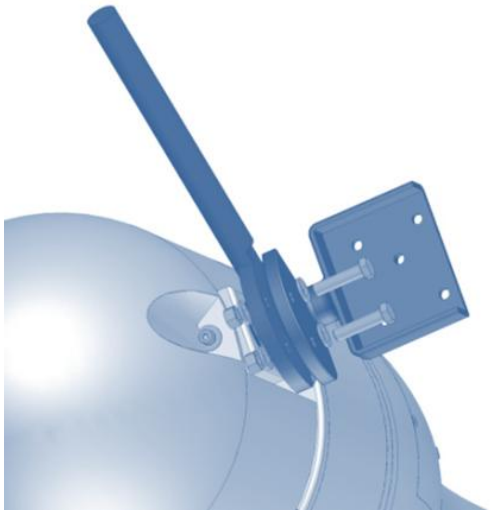
Hex head bolt A4 DIN 933 M14x60	8
Hex nut A4 DIN934 M14	8
Flat washer A4 DIN126 M14	16

Tools:

22 wrench, 22 hex socket and a torque wrench.

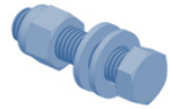
Torque: 91 Nm ó 67 Lbf.ft

STEP 3: Torsion levers



Hardware:

Hex head bolt A4 DIN 933 M12x50	4
Hex nut A4 DIN934 M12	4
Flat washer A4 DIN126 M12	8



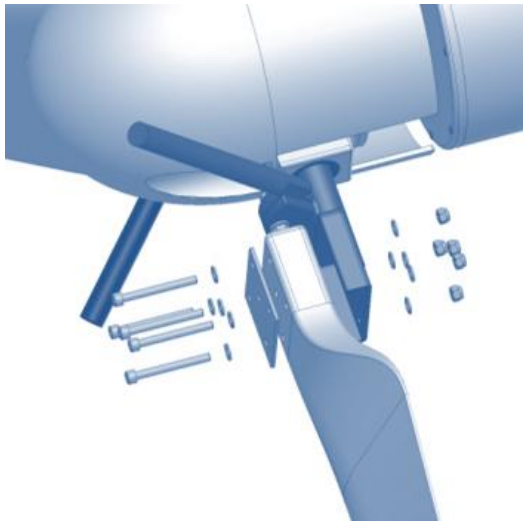
Tools:

19 wrench, 19 hex socket and a torque wrench

Torque: 57 Nm ó 42 Lbf.ft

CAUTION: There are three torsion levers. One of them is place during the manufacturing but the second and the third must be place during the assembly. The three torsion levers are identify with the numbers 1, 2 and 3. The three levers are not interchangeable.

STEP 4: Blades



Hardware:

Allen bolt A4 DIN912 M10x90	15
Hex nutA4 DIN934 M10	15
Flat washer A4 DIN126 M10	30

Tools:

22 wrench, 22 hex socket and a torque wrench.

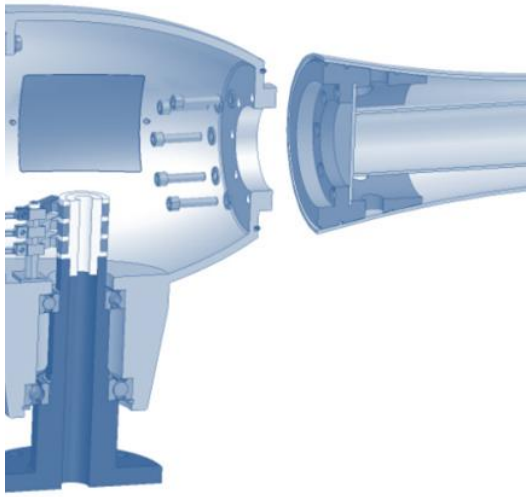
Torque: 33 Nm ó 24 Lbf.ft

The blades should be assembly with the stainless plates in the root of the blade. You will find the plates in the hardware kit.

CAUTION: The holes of the blade and the screws are tight so it is recommended to use an electrical drill with a 10 bit to rethread the blade holes.

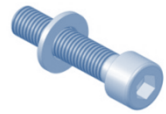
In order to warranty the correct assembly of the blades, the holes in the root of the blade are place to allow just one position of the blade in the blade holder.

STEP 5: Tail



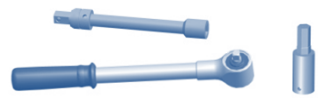
Hardware:

Allen bolt A4 DIN912 M10x45	8
Flat washer A4 DIN126 M10	8



Tools:

8 hex socked, wrench extension and torque wrench.



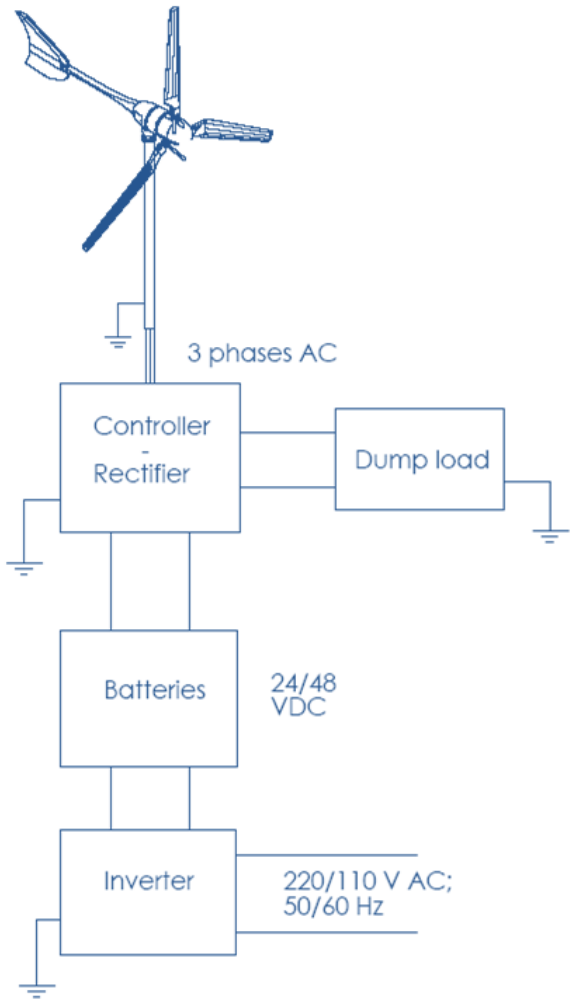
Torque: 33 Nm ó 24 Lbf.ft

3.5 ELECTRICAL SCHEME

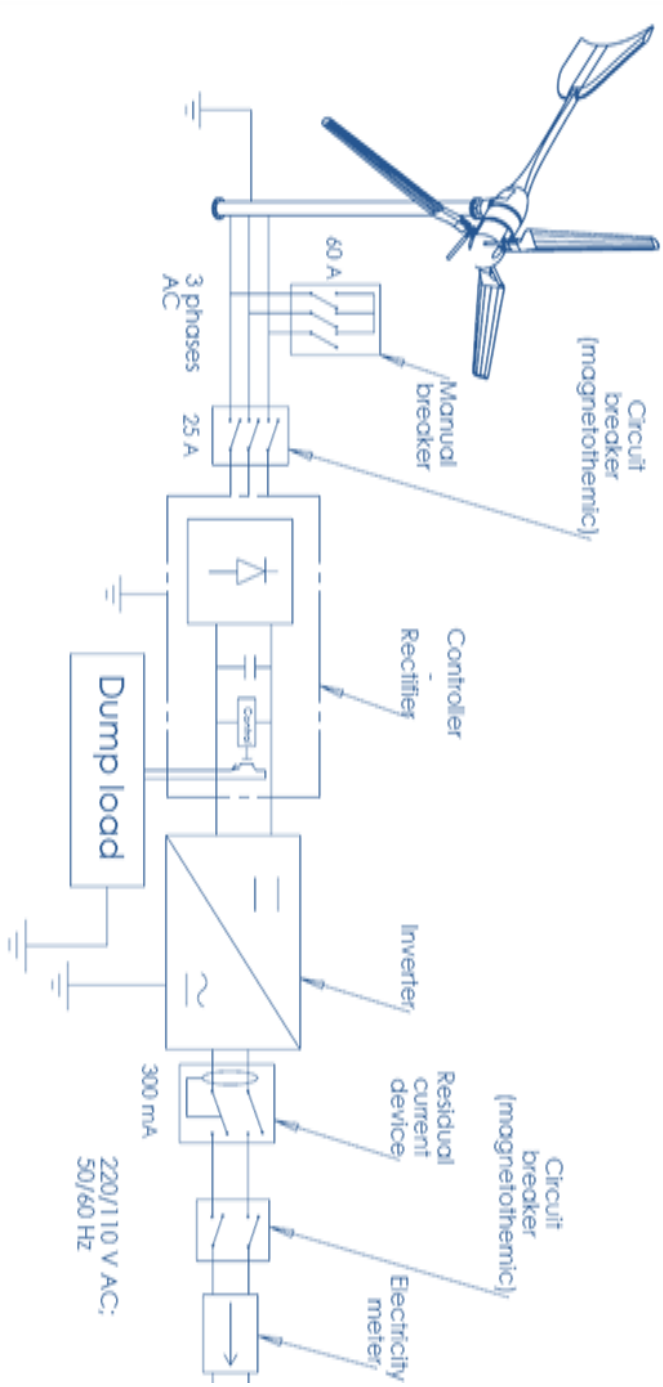
CAUTION:

- **The installation needs grounding.**
- **The information in the scheme is just for guidance.**
- **Each installer should calculate the wires dimensions and the equipment protection following the electromagnetic installations law.**
- **SONKYO ENERGY does not take any responsibility of the installation.**

Battery charging connection:



On-grid connection:



4 OPERATION AND MAINTENANCE

4.1 SITE COMMISSIONING

Site commissioning certificate:
You will find it in our website: www.windpot.es, then you shall fill in correctly and send it to info@sonkyoenergy.com . You have **10 days** to from the installation date to send us the site commissioning form.

Serial number:
You will find it at the characteristics plate inside the body, at the interior side of the right lid looking at the wind turbine from the back. You will find also the serial number in the documentation attached with the wind turbine.
Before installing your WINDSPOT you shall check the serial number in the plate and the serial number I the documentation is the same.

4.2 WARRANTY

Warranty has a validity of **2 years from the purchase date (Warranty period extension is negotiable)** and you will find it in our web site: www.windspot.es

Terms for warranty validity:

- Payment should be done.
- Site commissioning form should be sent *(See part 4.1"Site commissioning ", page 41).*
- Correct maintenance with the correct frequency corresponding to the location of the wind turbine should be done *(See part 4.3 "Maintenance", page 42).*

4.3 MAINTENANCE

WINDSPOT está diseñado para funcionar de manera óptima con un mantenimiento mínimo.

CAUTION:Before any maintenance operation, please check *apart 3.3 "Installation: Safety Recommendations" (Page 34)*

WINDSPOT components just can be handled by capable technical people. Under any circumstances no capable people will take part in the maintenance operations, unless a qualified technician manages the procedures.

All the screws hardware handled during maintenance should be adjusted with a torque wrench with the correct torque as it is specified on *apart 3.4 "Assembly" (Page 35).*

Maintenance frequency depends on the wind class in your location.

Wind class:

Wind class	Average wind speed in the installation lotation		
	m/s	Km/h	Mph
1	<5.6	<1.5	<0.9
2	5.6 – 6.4	1.5 – 1.7	0.9 – 1
3	6.4 - 7	1.7 – 1.9	1 – 1.2
4	7 – 7.5	1.9 – 2.1	1.2 – 1.3
5	7.5 - 8	2.1 – 2.2	1.3 – 1.4
6	8 – 8.8	2.2 – 2.4	14 – 1.5
7	>8.8	>2.4	>1.5

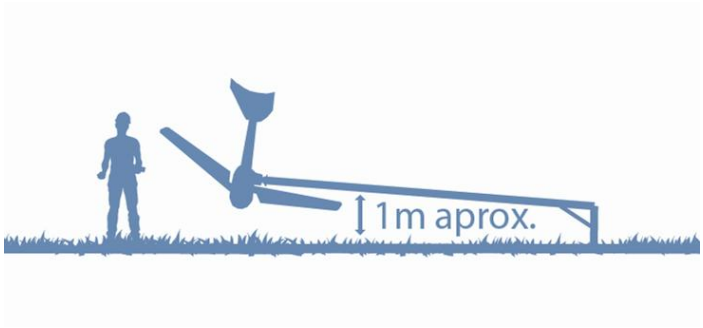
Maintenance planning:

Wind class	1	2	3	4	5	6	7
Visual inspection (Both the WINDSPOT and the tower), Check uncommon noise and vibrations.	One month after the installation and each time a big storm come through or wind speeds of more than 25m/s(90km/h, 56Mp)						
1-Check the screws of the blades, torsion levers and the revolving axle.	Each 18 months			Each 12 months			
2-Check other screws.							
3-Variable pitch bearings grease.							
4-Whole variable pitch grease.							
5-Visual inspection of the blades, particularly focusing on the leading edge.							
6-Check the correct movement of the variable pitch system.							
7-Check the paint looking for flaws or rusty spots.							
8-Check brushes, slip rings and electrical connections.							
9-Replace brushes.	Each 9 years (aprox)			Each 7 years (aprox)			

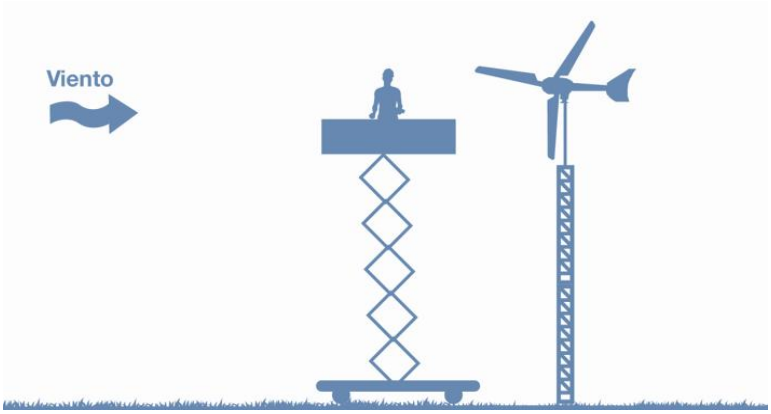
How to position the turbine to carry out the maintenance service?

The position of the turbine depends on the type of tower it is installed.

- Tower with mechanical or hydraulic lifting: In case of a hydraulic tower you will need a diesel generator and a hydraulic pump.



- Lattice/Guy wired tower: You will need to use an elevator platform to elevate the personnel. The position of the platform depends on the wind direction, always placed windward from the turbine.

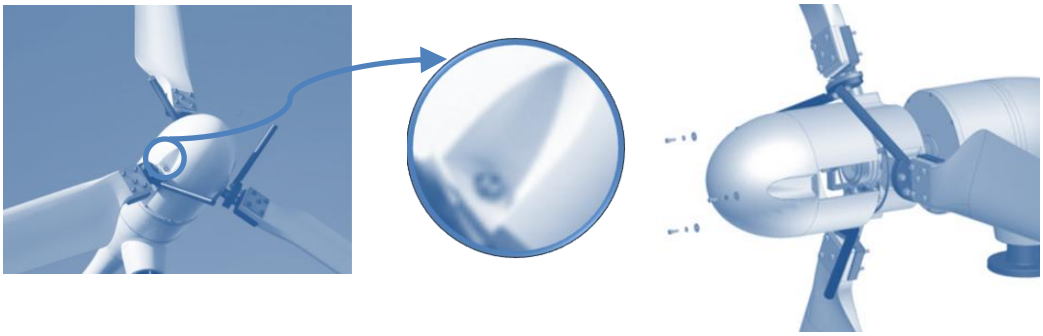


CAUTION: Fix one WINDSPOT blade to the elevator platform to prevent turbine rotation during the maintenance.

Access to the interior of the machine:

To carry out the maintenance, it will be necessary to remove the cone and at least of the covers on the side of the turbine's body:

Cone



Hardware:

Allen bolt A4 DIN912 M8x30	3
Flat washer, broad side A4 DIN9021 M8	3
Spring washer A4 DIN127A M8	3

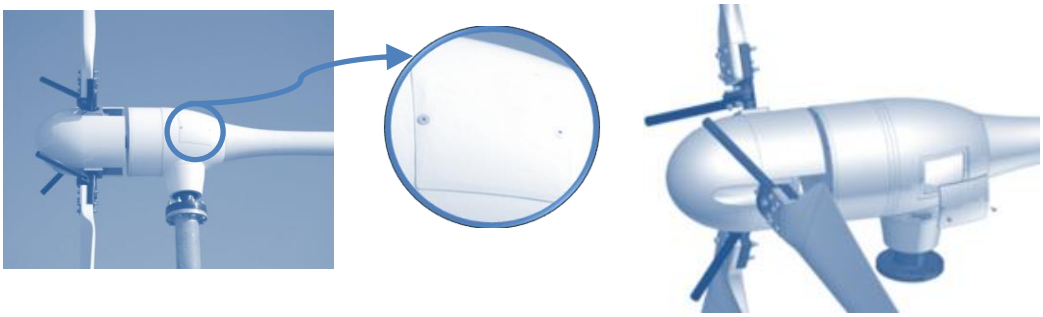
Tools:

Hex socket 6, wrench extension and torque wrench

Torque:

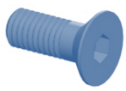
17 Nm ó
13 Lbf.ft

Tapas laterales



Hardware:

Flat Allen bolt A4 DIN7991 M6x16	4



Tools:

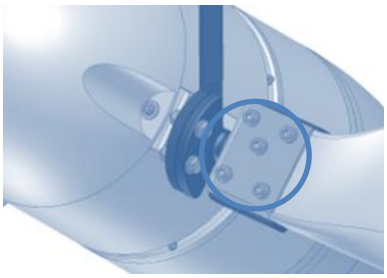
Hex socket 6, wrench extension and torque wrench

Torque:

7 Nm ó
5 Lbf.ft

1-Tighten the bolts: Make sure that the following screws have the torque specified below.

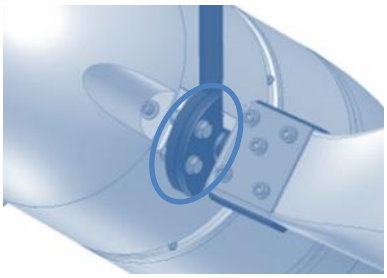
Blades



Tools:
17 wrench, 17 hexagon Socket and torque wrench

Torque: 33 Nm ó 24 Lbf.ft

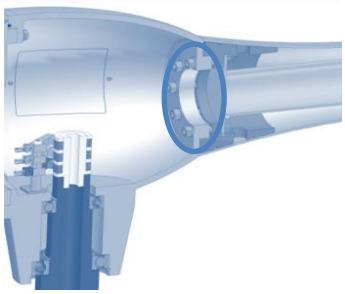
Torsion levers



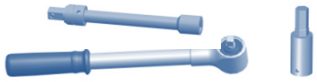
Tools:
19 wrench,19 hexagon socket and torque wrench

Torque: 57 Nm ó 42 Lbf.ft

Tail



Tools:
8 hex socket, wrench extension and torque wrench



Torque: 33 Nm ó 24 Lbf.ft

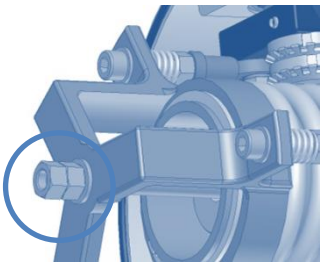
Tower

Tools:
22 wrench, 22 hexagonal socket and torque wrench

Torque: 91 Nm ó 67 Lbf.ft

2- Check the bolts: Simply check that none of these bolts get loose. You should never exceed the recommended torque, according to the bolt metrics.

Slide

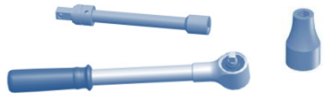


Tools:
19 wrench, 19 hexagon socket and torque wrench

Torque: 57 Nm ó 42 Lbf.ft

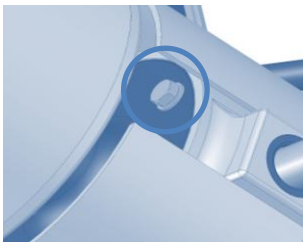
Sliding cylinder

Tools:
17 hexagon socket, wrench extension and torque wrench

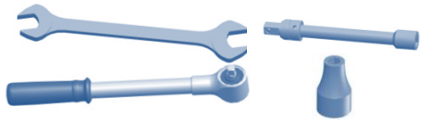


Torque: 57 Nm ó 42 Lbf.ft

Axle coupling

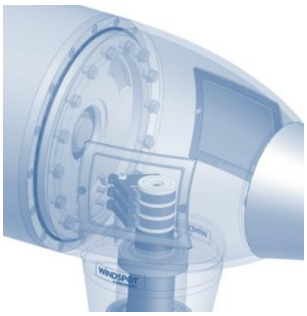


Tools:
Llave fija de 24, vaso hexagonal de 24, alargador y llave dinamométrica

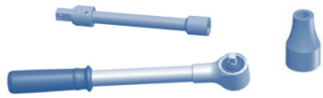


Par de apriete: 57 Nm ó 42 Lbf.ft

Generator

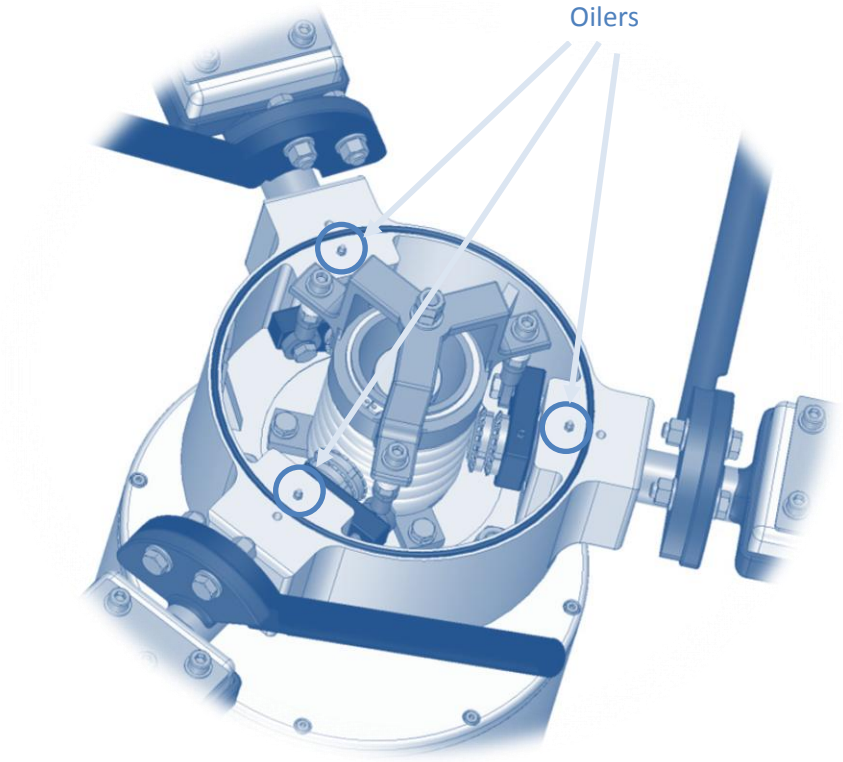


Tools:
17 hexagon socket, wrench extension and torque wrench

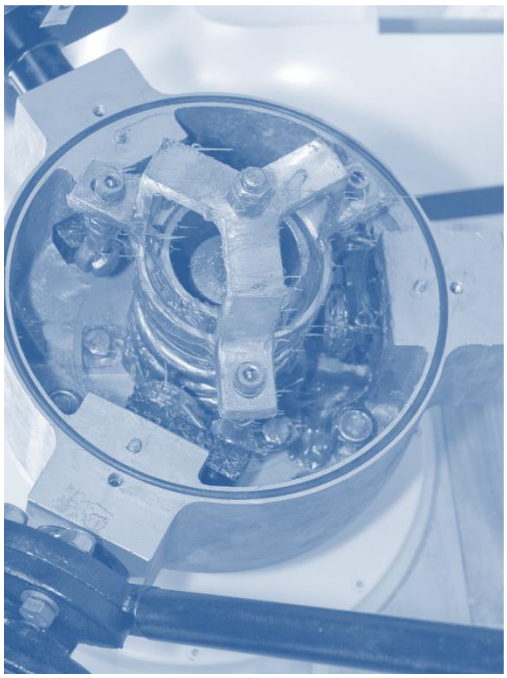


Torque: 57 Nm ó 42 Lbf.ft

3 – Grease the bearings of the pitch system: Inject the grease through the 3 greasing holes indicated. You should fill them up until the grease overflows at the side of the inner bearings.



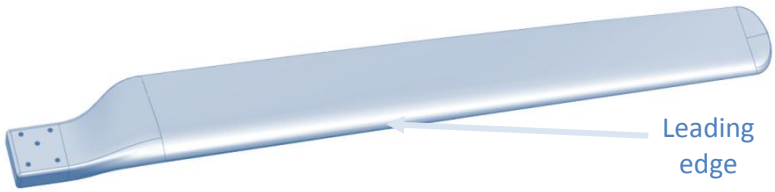
4 – Grease the pitch system: Grease the whole pitch system as shown in the photos.



Grease type: Lubricating grease for extreme pressure and high temperatures.

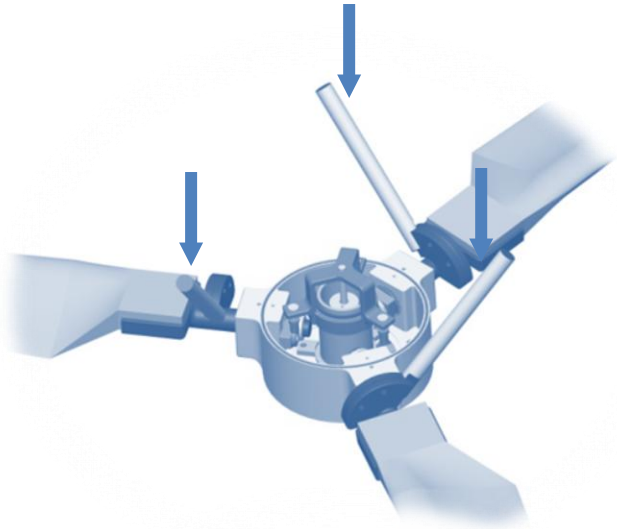
CARACTERÍSTICAS FÍSICAS DE LA GRASA	
Appearance/physical state	Grease
Colour	Bluish green or brown
Classification NL6Z	Grade 2
Work Penetration (60 cycles)	280 1/10 mm
Dropping point	230^0C
Soap type	Aluminum Complex Grease

5 – Check the status of the blades: Check the surface of the blades, paying special attention to the leading edges. A light wear on them is normal. If you see large surface defects, replace all the 3 blades.

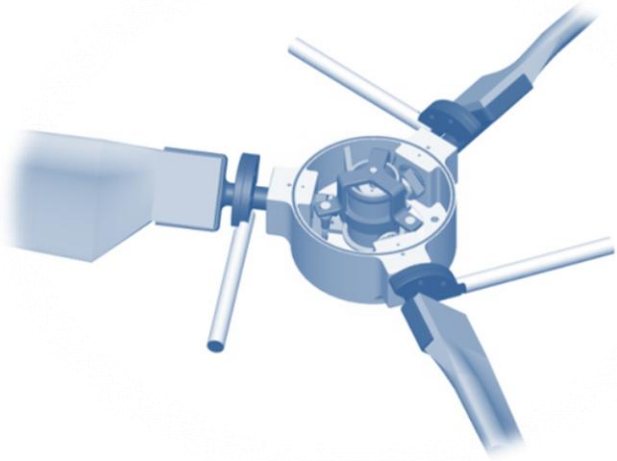


6 – Check the proper operation of the pitch system:

1. - Press (between 2 persons) the 3 counterweights at the same time. You will notice the resisting force of the spring.
2. - The counterweights should be pressed down until their limit position.
3. - Release gently the counterweights to get back to the initial position.



Pressing the 3 torsion levers at the same time

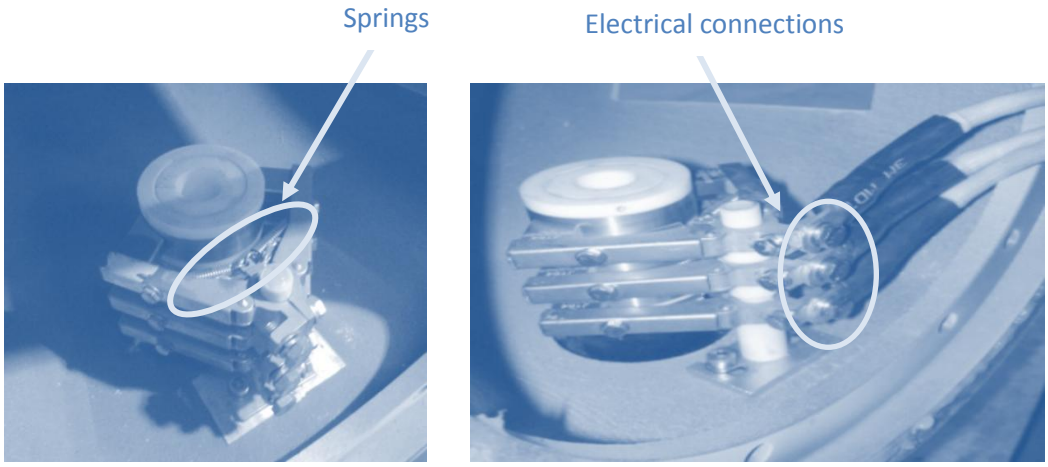


Limit position of the torsions levers

7 –Check for the painting, small defects and rust: Look through the entire exterior surface of WINDSPOT, repaint if necessary.

CHARACTERISTICS OF THE PAINT		
White paint	Poliurethane paint, RAL 9003	High resistance to corrosion and ultraviolet radiation
Black paint	Poliurethane paint, RAL 9004	

8 – Check the brushes, slip rings and connecting cables:



Check the spring tension, the correct connection of the brushes with the rings and the wire connections. Clean the set if necessary. In case the set is not in good condition replace the brushes. (*See point 9 of this section, "Replacing the brushes")*.

9 – Replacing the brushes: The brushes and slip rings are exposed to a continuous wear. You will need to replace the brushes if the wear reaches the marks or the whole set is in an unsatisfactory condition.

4.4 FAQ

1. What is the right turbine size for my installation?

The following table is a guide on what wind turbine to choose depending on the wind and energy consumptions. As a reference, a normal house uses about 4000 kWh annually, while a large consumer might consume around 6000 or 8000 kWh.

Purpose	Required power
Energy saving	1.5 or 3.5 kW
Self-sufficient normal household	3.5 or 7.5 kW
Self-sufficient household with high consumption	7.5 or 15 kW
Energy saving for a small industry or farmer	1.5, 3.5, 7.5 or 15 kW

2. Is my site suitable for a wind turbine?

Ideally a turbine works the better, the less obstructions can be found in the direction from where the wind is coming. Although at a sufficient distance buildings, trees and other obstructions have almost no effect on the performance of the turbine.
As a general rule WINDSPOT rotor must be 10 m above any obstacle and to a minimum distance of twice the height of the object.

3. Are wind turbines noisy?

WINDSPOT wind turbines have been especially designed to avoid noise with a rated speed between 200 and 250rpm depending on the model. The height at which they are placed makes them almost impossible to be heard by someone staying beside them.
Moreover, the relatively slow rotation, compared to other wind turbines on the market, increases the performance and durability while also reduces the mechanical stress on the components.

4. Will WINDSPOT affect birds?

It is unlikely that a bird hits the blade of a small wind turbine like WINDSPOT, since it works at low revolutions (between 200 y 250 rpm depending on the model) and it is not placed to the height where migratory birds make their long journeys.

5. Can I use WINDSPOT for heating?

Yes, you can use the turbine for heating water. Simply connect the controller output to an electric heater. However, the energy required for heating is normally much higher than that of electricity, so you might need a larger turbine to heat a building.

6. Can I connect WINDSPOT to the grid?

Yes, WINDSPOT wind turbines can be connected to the local electricity network. You need to use an inverter compatible to the grid and the installation has to be approved by the local utility company to meet the standards and to be assigned to a point of connection to the network.

7. When do WINDSPOT wind turbines produce electricity?

It depends on the wind turbine location, the wind speed and the quality of that wind (the more turbulence the less efficient the system will be).

On a proper place, a wind turbine generates electricity around 75% of the time, although not always at the rated power. Usually, over a year, a small wind turbine can generate about 20% or 30% of the amount it would generate working at constant rated power. It is called capacity factor.

8. How long do WINDSPOT wind turbines last?

WINDSPOT wind turbines are designed to last more than 25 years. This is possible because of their robust design, high quality materials, anti-corrosion treatments and also due to the fully sealed body that prevents the entrance of water, dust and other particles into the wind turbine. That's why our design resists even in harsh environments like next to the sea.

9. Can I have my own WINDSPOT?

Small wind turbines are a good deal for householders, communities and small energy consumers to use for on-site energy generation. Your site characteristics (average wind speed, location and local landscape) will determine the size and type of the wind turbine in each case.

10. How I know I have wind enough?

The wind flow can be highly variable and very turbulent, so in any doubt take expert advice and contact professionals dedicated to the installation of small wind turbines. Generally, with an average of 5 m/s it is worthwhile to install a small wind turbine.

11. How does a wind turbine make electricity?

Broadly speaking a wind turbine works in the following way:
The blades take advantage of the wind energy and generate a torque force on the generator. The generator, depending on the rotation speed and the force exerted by the blades on its shaft, generates electricity that reaches the controller and the inverter. These electronic components transform electricity to direct current (DC) to charge/store in batteries; and to alternate current (AC) to inject it to the main grid.

12. At what height must small wind turbines be installed?

Tower height varies according to wind turbine model and the wind speed at site, normally ranging from 10 to 25 meters. Generally the higher the tower, the higher the average wind speed and the smoother the wind.
Furthermore, to determine the total height of the system you must take into account the diameter of the turbines, which typically ranges between 1.5 and 10 m.

13. Do I need a planning permission?

Small wind energy installations may require planning permission and you should always consult the planning officials. It depends mainly on the height and the legislation of each country. The best option is to ask for professional advice if you have any doubts.

14. What are wind turbines made of?

The structural parts of our turbines are made of stainless steel and aluminum while the blades and other components of polyester resin, glass fiber, plastic and copper. All of them are properly protected against corrosion either by hot dip galvanized or via other surface treatments to ensure adequate protection even in saline environments.
Besides, the whole system is sealed in order to avoid the entrance of water, dust or any other particle. This way the electrical components are safe and well protected.

15. What is the maximum wind speed that WINDSPOT can support?

In heavy winds WINDSPOT patented variable pitch system prevents overcurrents that could damage both the generator and the electronic components.
WINDSPOT wind turbines are designed according to the IEC 61400-2 standards for maximum wind speeds of 60 m/s (216 km/h or 134 mph).

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