Airdolphin Mark- Zero Z-1000-24 VDC

Instruction Manual

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Zephyr Corporation

Contents

1. Getting Started

Thank you for purchasing the Airdolphin (Z-1000).
The Airdolphin's creation is the culmination of Zephyr Corporation's years of experience and technical expertise with small wind turbines.
This turbine is powered by wind, which it harnesses to generate electricity. Since wind is a natural energy source, its output varies in accordance with time, date, and the seasons. Wind conditions may not always be optimal, and can range from no breeze to raging gusts. Although people cannot influence wind force directly, it is possible to adapt to changes in the wind itself. Zephyr Corporation Airdolphin engineering focused on building a system that can adjust to subtle wind conditions in real time, generating the maximum amount of electricity.
We at Zephyr Corporation hope that our products are both fun and useful, contributing to the development of an ecological minded culture by reducing carbon dioxide emissions through the use of natural energy, thus leaving a better Earth for future generations.

This manual provides specific information on the Airdolphin, including its features, instructions for use, safety precautions, maintenance procedures, and peripheral equipment.
It is intended to be read by those who own or work on this product. Read this manual thoroughly and familiarize yourself with this product before attempting to use it.
In the unlikely event that this product does not function properly, prohibit all persons except for trained technicians from handling its internal systems and contact either the dealer from whom you purchased it or Zephyr Corporation customer service department.

- The specifications of this product may change due to improvements without prior notice.
- For purposes of explanation, the illustrations and photographs throughout this manual may differ from the actual product.
- "AIRDOLPHIN" and "Airdolphin" are trademarks of Zephyr Corporation.
- The serial number of the wind turbine is written at the last page of this manual. You will need this information in the event a warranty claim.

Read the following!

- ◆ Certain Airdolphin installation procedures are dangerous. Always have a trained professional perform installation work.
- ◆ Be aware that Zephyr Corporation assumes no responsibility for accidents or damages sustained as a result of not following the procedures and warnings specified in this manual.
- ◆ Be aware that Zephyr Corporation assumes no responsibility for accidents or damage caused by improper installation, use, or attempts to modify this product.
- ◆ This product may suffer salt erosion or other forms of corrosion if installed in a location that places it in direct contact with salt water.

* Failure to operate this product in accordance with the content of sections labeled “Danger”, “Warning”, and “Caution” may result in accidental death, injury, fire, or damage to the product itself.

2. For Your Safety (Read before using.)

SAFETY WARNINGS AND SYMBOLS

To ensure proper use of this product, read this section (“Safety warnings and symbols”) before attempting to install, operate, or inspect the Airdolphin (Z-1000). Throughout this manual, safety information is divided into three categories: “Danger”, “Warning”, and “Caution”.

DANGER: This symbol indicates information that could result in death or severe injury if ignored. It is used to indicate information of a particularly dangerous and/or urgent nature.

WARNING: This symbol indicates information that could result in death or severe injury if ignored.

CAUTION: This symbol is used to indicate information that could result in death, severe injury, or damage limited to property if ignored.

Be aware that failure to use the product in the manner indicated by ⚠**Caution** may, depending on circumstances, also have severe consequences. All of the symbols described above indicate important safety information. Obey all safety information when using this product.

This manual contains caution information related to the rotors.
“Rotor” is the term used to describe the three blades when they are attached to the hub. Caution information that describes the rotor gives warnings about the rotating blades.
(See to page 13.)

SAFETY INFORMATION IS INDICATED AS SHOWN BELOW

The ⚠ symbol is intended to draw readers’ attention to Danger/Warning/Caution information. Specific details on the nature of the threat to safety are indicated inside or beside the symbol.

The ⃠ symbol indicates prohibited actions. Specific details on the prohibited action are indicated inside or beside the symbol.

The ❗ symbol indicates instructions that must be followed. Specific details on the mandatory instructions are indicated inside or beside the symbol.

⚠ DANGER

Do not install the Airdolphin (Z-1000) before inspecting the durability/quality of the pole to which it will be attached and the area in which it will be installed for safety.
If the pole and the location are not suitable for the installation of this product, the pole may break or fall over, resulting in injury or death.

Install this product so that the tips of the rotor are at least 3.5m away from locations that may be approached by people. After installation is complete, clear away all scaffoldings, making sure that nobody goes near the rotor.

Never touch a moving rotor with your hand or any other part of the body. The rotor is as dangerous as a sword and accidental contact can result in death or severe injury.

The body of the Airdolphin (Z-1000) will also move in accordance with wind direction once it begins to make contact with the wind. Exercise caution if it is necessary to approach the Airdolphin (Z-1000) to perform installation or maintenance work.

⚠ WARNING

Do not install the Airdolphin (Z-1000) in close proximity to electric or telephone lines. A fallen pole or contact between the rotor and electric/telephone lines could result in electrocution, disconnection, or damage to/ malfunction of the Airdolphin (Z-1000).

Do not install the Airdolphin (Z-1000) in close proximity to structures such as smokestacks that attain extremely high temperatures. The heat could melt the insulation on electrical cables, resulting in electrocution, fire, or other damage.

Do not install the Airdolphin (Z-1000) if the pole to which it will be attached is not standing straight up. The Airdolphin (Z-1000) could fall, causing an accident or mechanical damage/malfunction.

Do not use the Airdolphin (Z-1000) for any purpose other than generating electricity from natural wind. Do not attempt to generate electricity by mounting the Airdolphin (Z-1000) on a moving vehicle. Do not use the Airdolphin (Z-1000) in close proximity to an exhaust duct or in any other extremely high-temperature environment. Doing so could result in fire, injury, or damage to the Airdolphin (Z-1000).

Contact either the dealer where you purchased the Airdolphin (Z-1000) or Zephyr Corporation for repairs if the lines or cables are damaged (i.e. exposed wires, cut cables, plug damage). Continued use could result in electrocution, fire, or short circuits.

Do not pull on, excessively bend, or attempt to modify the wires/cables of the Airdolphin (Z-1000).
Doing so could result in cord damage, electrocution, or fire.

Never attempt to disassemble or modify the Airdolphin (Z-1000). Doing so could result in electrocution, fire, or Airdolphin (Z-1000) malfunction.

Due to conditions of use, this system may not continuously supply stable electrical power. Do not attempt to use the electricity generated by the Airdolphin (Z-1000) to power medical devices or other equipment related to human life systems support . Do not attempt to use the electricity generated by the Airdolphin (Z-1000) to power personal computers not equipped with batteries or other auxiliary power sources.

⚠ CAUTION

Observe all safety precautions when working on the Airdolphin (Z-1000) in high locations. Take care to ensure that hardware and other parts do not fall from the Airdolphin (Z-1000). Falling parts can cause injuries or other accidents.

Before assembling the Airdolphin (Z-1000), secure adequate space to ensure that work can be completed safely. Inadequate space can result in injuries or other accidents.

3. Airdolphin Features

3-1 10 State-of-the-Art Technologies

◆ Extremely Low Mass

The total weight of the Airdolphin is only 17.5kg. This means it weighs just 17.5g.per generated watt (when the continuous rated output is 1kW). Thus, the Airdolphin tracks wind better in turbulent flows, resulting in more efficient power generation. The light weight also allows the unit to be installed in a wide variety of places.

◆ Newly-Designed Rudder

The rudder of the Airdolphin uses the newly-developed Swing Rudder System. This system ensures the turbine's superior response to sudden changes in the direction of wind, improving the efficiency of power generation.

◆ Newly-Designed Rotor

The Airdolphin comes with a new rotor system consisting of:
(1) Three ultra low-mass blades, reinforced by a carbon-fiber skin for superior rigidity. (2) A hub mechanism that uses the newly-developed Multi-Stagger System (incorporating multiple airfoils and lift angles). This technology allows the turbine to capture the wind effectively and respond flexibly to changing conditions, from slight to stormy winds, eliminating the need for pitch controls.

◆ An Innovation for Low Noise Newly-Designed Rotor

The Airdolphin comes with the "Noise Disrupter Coating". This new blades have a number of thin ridges applied on its surface, which significantly reduces air flow noise. Our designers were inspired by the wings of owls that enables it to fly almost silently and unnoticed while approaching its prey.

◆ Robust Body Structure

Bolt-less self-fitting body inspired by Japanese traditional block puzzle craftsmanship. This technique ensures an exact fit and provides superb resistance to adverse weather conditions, greatly minimizing maintenance requirements.

◆ Power-Assist Function

For 10 seconds every minute when there is no wind, the Airdolphin uses previously- generated power to spin the rotor. This allows the rotor to reach the cut-in point more quickly--even when there is near zero wind, allowing the unit to capture the wind effectively. The Power Assist Function also prevents freezing of the rotor due to low temperatures.

◆ New Power Management System

The newly-developed Power Management System is aimed at optimizing the safety and efficiency of power generation.

Non-Stop Operation with Continuous Output

At its upper potential, the Airdolphin can deliver a 2.3kW output (at 20m/s). During strong winds (at 20m/s or more), the Airdolphin automatically moderates its spinning speed and continues working at a reduced output.

Safety Control

Several technologies are applied to keep the turbine from disintegrating and allow it to control its output, even during overheating of the power generator, excessive spinning speed, and other unfavorable situations.

High-Efficiency Operation

To maintain optimum efficiency at a variety of wind speeds, the turbine is controlled by a special computer program coordinated with the Multi-Stagger System of the rotor. An ultra-lightweight rotor, a special propeller design optimized for varying wind speeds, and a power generator with superior efficiency was also developed.

Battery Charge Management

Management of the rechargeable battery, optimized for using the wind turbine as an independent power supply, is controlled by a system based on a 3-step battery recharge. Charge can be managed under a variety of conditions, from arctic to tropical weather. Management includes compensations for wire cable length and even current (more than 100 amps of continuous power).

◆ New Generator

For the Airdolphin, a newly-developed heavy-duty generator is used with a max. 4.5kW power output. The magnet used for the turbine is a neodymium iron boron magnet which boasts of an extremely high magnetic flux.

◆ Data Communication System

The Zephyr Communication System was recently developed, which will soon allow you to connect the Airdolphin to the internet. This way, you can check the wind strength, amount of generated power, and other information on your PC remote from the turbine's location. You can also install a GPS receiver to the turbine for confirming the location of each unit.

◆ Fresh Design - Winner of the Good Design Award 2005

The attractive body was designed, using nature's animals as our inspiration. The sleek lines, high power, cleverness and playful responsiveness of this design inspired the name Airdolphin. Our turbine looks alive, eager and ready to catch the wind.

3-2 Specification

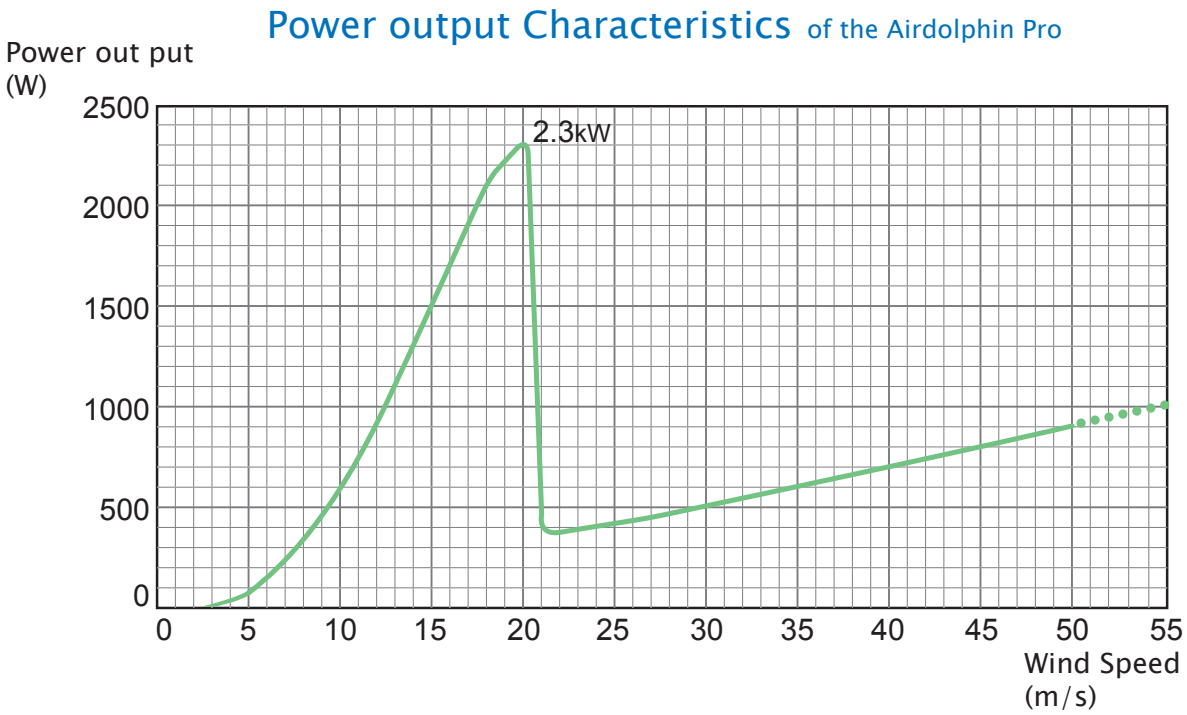
Wind Turbine Type	Horizontal axis, up-wind
Rotor Diameter	1800mm
Mass	17.5kg
Mount Diameter	48.6mm
Number of Blades	3
Blade Material	Carbon-fiber laminate over foam core
Blade Mass (per piece)	380g
Blade Retention	Interlock hub mounting
Body Material	Aluminum diecast
Body Construction	Screw-free joints (based on traditional Japanese handicrafts)
Product Finish	Teflon-based paint
Generator	Synchronous-type, three-phase power generator with neodymium iron boron magnets
Protection Circuit	Built-in
Data Logger	Built-in
Yaw control	Free yaw (360 degrees)
Direction Control	Original Swing-Rudder System
Output Control	Non-stop output control
Start-up Wind Speed	0m/s (Power-Assist Function)
Cut-in Wind Speed	2.5m/s
Cut-out Wind Speed	-
Survival Wind Speed	65m/s
Rated Power	1kW (12.5m/s)
Rated Rotor Speed	1000rpm
Maximum Power	2.3kW (20m/s)
Maximum Rotor Speed	1000rpm (20m/s)
Mass per Watt	17.5g/W (at rated power)
Power per Square Meter	393W/m^2 (at rated power)

Control System	Built-in Zephyr-Original Power Management System* (ZPMS) with:
	1. Power-Assist Function 2. Stall Mode 3. Safety Control 4. Battery Charge Management 5. Data Communication System

Power Generation Features			
Wind Speed (m/s)	(mph)	Power (W)	Rotor Speed (rpm)
3.5	7.8	27	350
6.5	14.5	170	650
10.0	22.4	620	1000
12.5	27.9	1000	1000
15.0	33.5	1500	1000
17.5	39.1	2000	1000
20.0	44.7	2300	1000
30.0	67.1	500	600
40.0	89.4	700	600
50.0	111.8	900	600

Output Voltage	DC25V
Braking System	Regenerative electro-magnetic braking system
Communication System (Signal Output)	RS-485
Recommended System	Off-grid : Deep cycle lead acid battery,500Ah or more For on-grid use,please contact your dealer or Zephyr Corporation.

3-3 Power Output Characteristics



* Cut-in; wind speed at which the turbine begins to produce power.
* Cut-out; wind speed at which the turbine stops the rotation and shuts down.

The intelligent power management system has succeeded in truly seamless power generating performance for a broad spectrum of wind energy ranging from 2.5 m/s (5.6 mph) upwards, never cutting out. The system instantly responds to sudden changes in the wind speed and adapts by creating the most suitable power point production. At its upper potential, by incorporating sophisticated software algorithms, the Airdolphin Pro can deliver 2.3 kW output when capturing 20 m/s (44.7 mph) gusts and winds. It then shifts to a more gradual power curve slowly increasing output as the wind strength increases.

4. Installation Environment

1. Safety

Although the Airdolphin (Z-1000) has been engineered to withstand wind speeds of 65m/s, the rotating blades may be damaged by tree branches or other flying objects during strong winds. In addition, unforeseen circumstance may cause the pole supporting the wind turbine to topple or the wind turbine itself to fall. Keep these possibilities in mind when selecting a location for the installation of the Airdolphin (Z-1000).

Although the blades of the Airdolphin (Z-1000) are constructed from laminated carbon fiber and are extremely durable, they can cause severe injury in the unlikely event that they make contact with a human being. For this reason, we recommend that you install the wind turbine in a location away from people. Install the wind turbine in a high location that people cannot reach up and touch it.

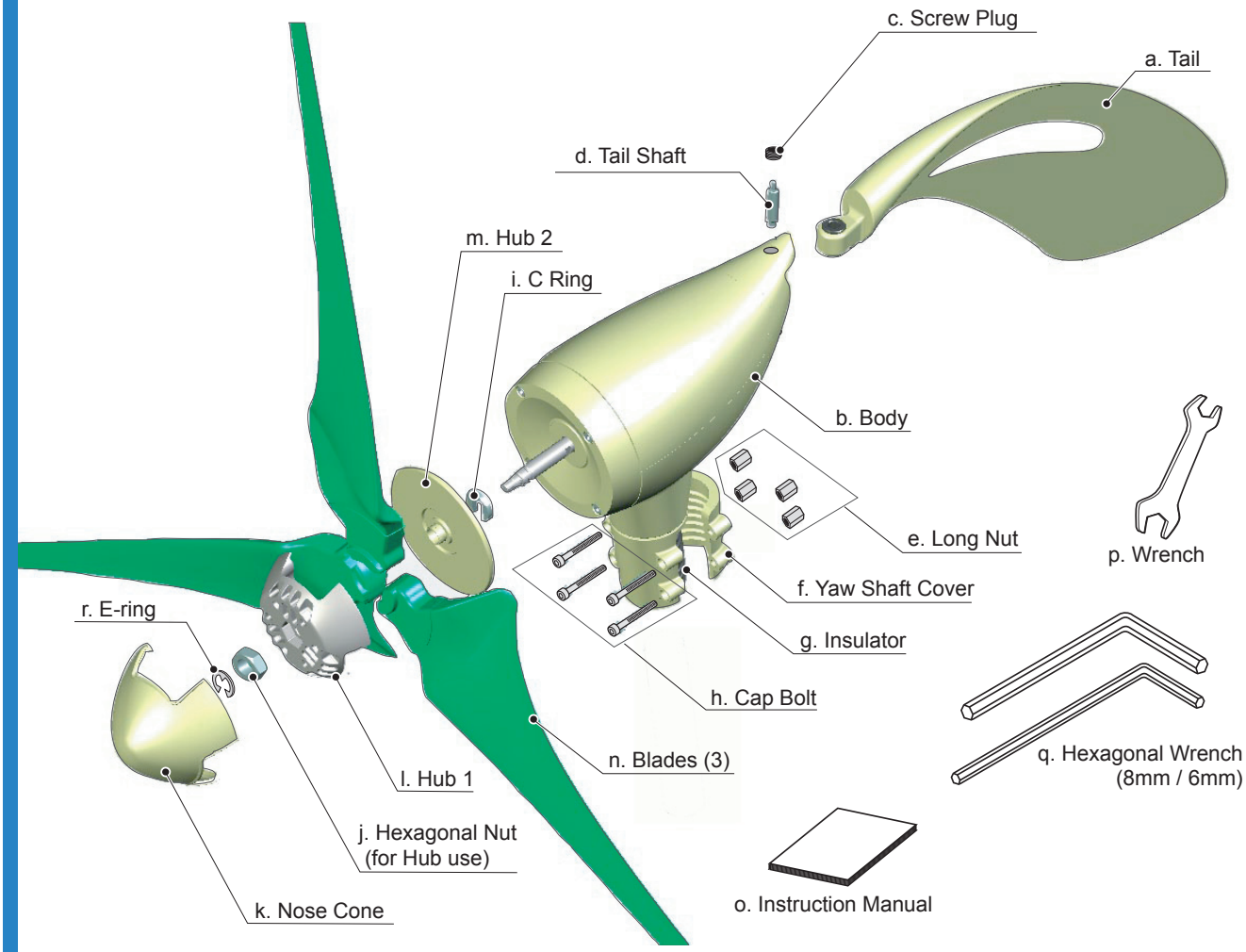
2-1.Environmental deterioration (public nuisance)

The wind turbine is a mechanical equipment that rotates at a high rate of speed during periods of strong wind. It is intended for installation outdoors in locations high above the ground. During periods of strong wind, the rotor rotates at a high rate of speed. Although the blades on the rotor are engineered to minimize the noise they produce, certain individuals may still be disturbed by the noise. The shadows of wind turbines mounted in high locations may also fall on neighboring houses. Be aware of the flickering shadows that the rotating blades may cast when considering the location in which the wind turbine will be mounted.

3. Generation environment

Since the wind turbine's output is proportional to the cube of the wind speed, it is advantageous to optimise the location where wind speed is highest within the possible choices. The wind turbine must be installed in a location that is high above ground level and free from obstructions has unobstructive wind passage.

5. Part Name



	Name	Quantity		Name	Quantity
a	Tail	1	j	Hexagonal Nut (for Hub use)	1
b	Body	1	k	Nose Cone	1
c	Screw Plug	1	l	Hub 1	1
d	Tail Shaft	1	m	Hub 2	1
e	Long Nut (for Yaw Shaft use)	4	n	Blades	3
f	Yaw Shaft Cover	1	o	Instruction Manual (this document)	1
g	Insulator	1	p	Wrench (13mm / 17mm)	1
h	Cap Bolt (for Yaw Shaft use)	4	q	Hexagonal Wrench (8mm / 6mm)	1
i	C Ring	1	r	E-ring (1pc. for spare)	2

6. Assembling the Airdolphin (Z-1000)

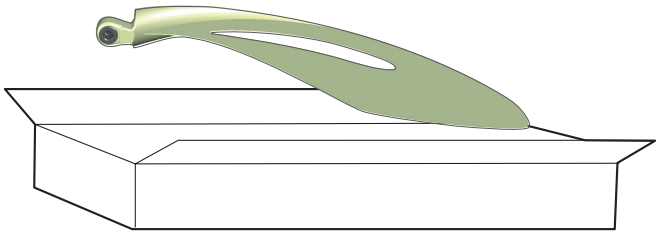
6-1 Verify the following upon purchase

■ The Airdolphin consists of the items listed below. Upon opening the package, check the parts against the list shown above in “5. Part Names” to ensure that nothing is missing.

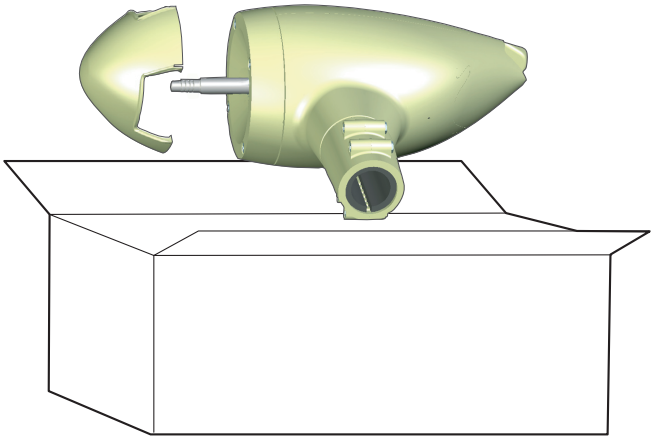
* Although Zephyr Corporation verifies the quality of all our products before shipping them, damage may occur during shipping. Check the surfaces of the blades, the tail, and all other components to ensure that they are free from any damage or warping that may affect performance.

■ If any parts are missing or damaged, please contact the dealer at which you purchased the Airdolphin for assistance.

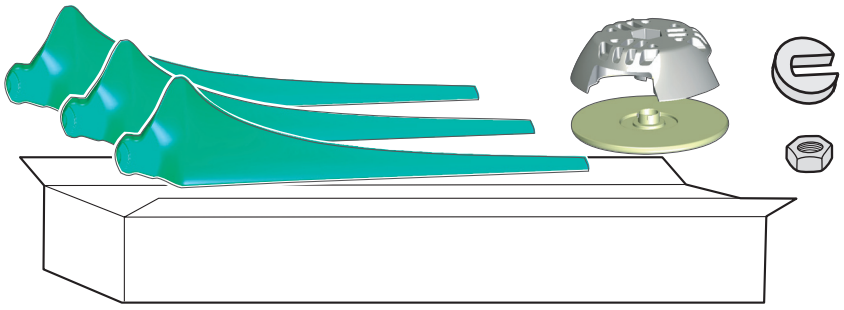
Tail Unit
The Body Unit and the tail is in one box.



Body Unit

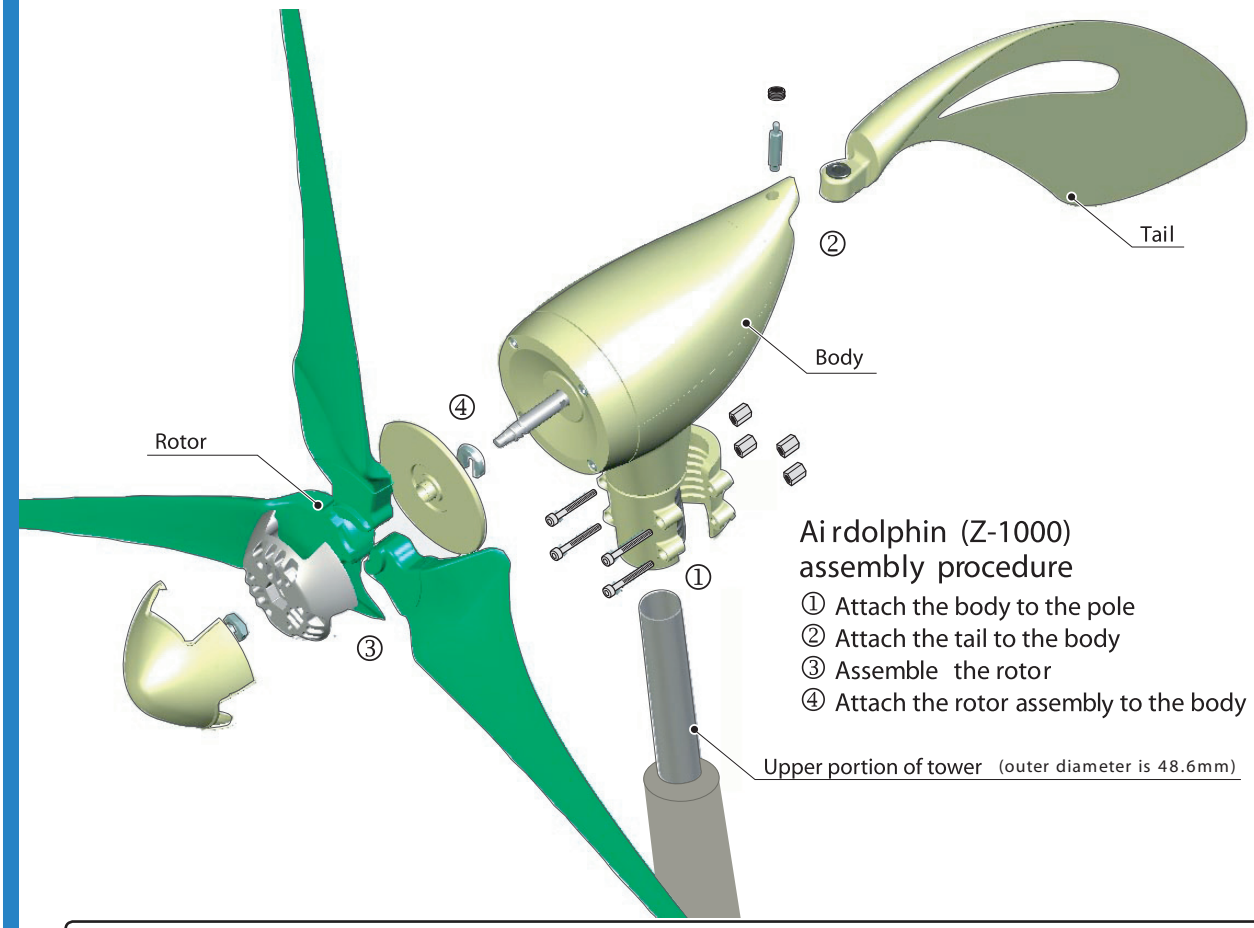


Blades, Hub, and Nuts



6-2 Assembly procedure

Follow steps ①–④ below to assemble the Airdolphin (Z-1000). The assembly procedure for each part is shown on the following and subsequent pages.



Airdolphin (Z-1000) assembly procedure

① Attach the body to the pole
② Attach the tail to the body
③ Assemble the rotor
④ Attach the rotor assembly to the body

Warning

OBSERVE THE FOLLOWING SAFETY INSTRUCTIONS DURING ASSEMBLY AND INSTALLATION

- Failure to observe these safety instructions may result in a severe accident or damage to the Airdolphin (Z-1000) or other parts of the system.
- **Do not place the Airdolphin body upside down or inclined during installation or maintenance. Water (rain, snow) can leak inside a body joint gap and cause damage to the turbine. When the body is upside down or inclined and has the possibility of getting wet, put a cover over the body well.**

- Always assemble/install the Airdolphin in accordance with the procedure outlined in this manual.
- Use a tower in which the upper portion has an outer diameter of at least 48.6mm and at least 100mm in length.
- Do not install the Airdolphin if the pole is not standing straight.
  If the Airdolphin is not mounted in an upright position, it could topple or fall, causing injury or damage to the system.
- Moving roter blades are as dangerous as a sharp object. During installation and maintenance attaching the rotor to the tower body is extremely dangerous because the wind could blow while the work is being performed, rotating the rotor and causing a serious accident such as death or injury. After attaching the rotor to the body, fix the rotor in place to prevent it from rotating until the wind turbine has been completely installed
- If the wind turbine has not been completely assembled, a strong gust of wind or similar phenomenon may cause it to fall, causing an injury or other misharps.

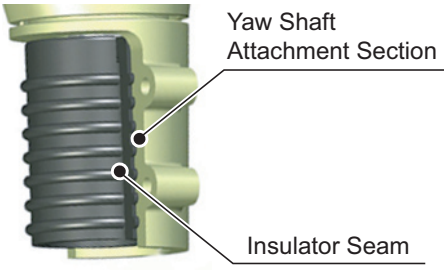
6. Assembling the Airdolphin (Z-1000)

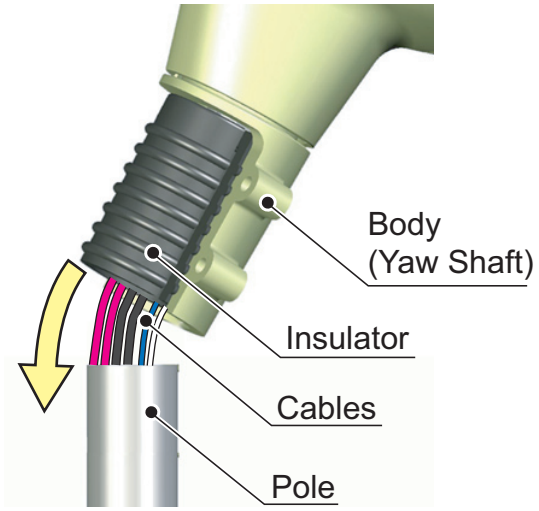
CAUTION: DO NOT CONNECT TO BATTERIES WHEN INSTALLING.
Airdolphin is in brake mode when disconnected from the batteries.

① Fastening the pole to the body (yaw shaft)

1. The wind turbine has six cables. Connect these cables to the extension cable that passes through the pole. (See page 20.)
2. Connect the pole to the body (yaw shaft).
   Lower the yaw shaft until the end of the pole fastens inside the yaw shaft.

- Match the seam of the insulator up with the connection section of the yaw shaft. Affix the insulator in place.

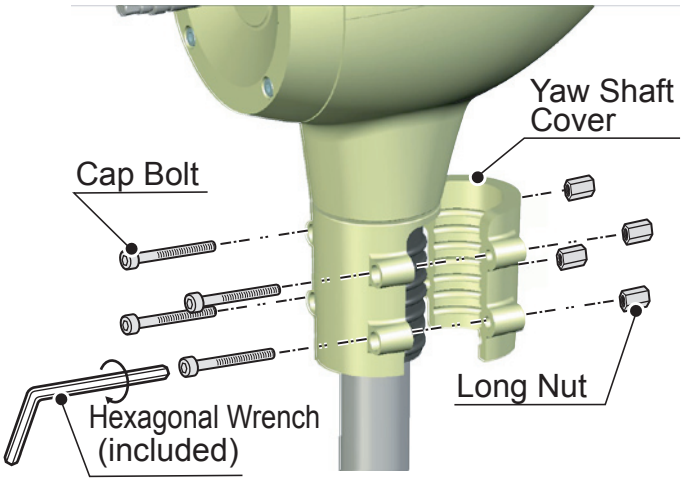




3. With the body pressed down firmly on the pole attach the yaw shaft cover as shown in the figure on the right. (Tightening torque 22Nm)

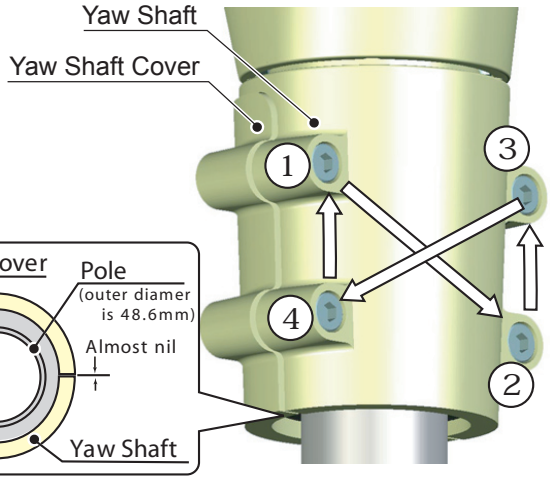
- All electrical power cables should run inside the tower for protection.

Important
- Cap bolts shoud be tightened with the included hexagonal wrench with a force of 14 -16Nm

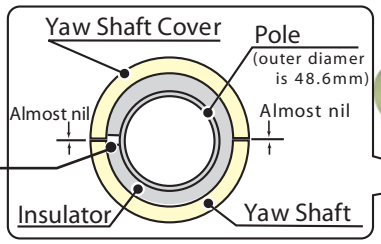


CAUTION: OBSERVE THE FOLLOWING WHEN ATTACHING THE YAW SHAFT

Tighten the cap bolts (①–④) in order incrementally so that all four bolts hold the yaw shaft cover in place with an uniform degree of tightness.
Tighten the cap bolts leaving no space between the yaw shaft and the yaw shaft cover



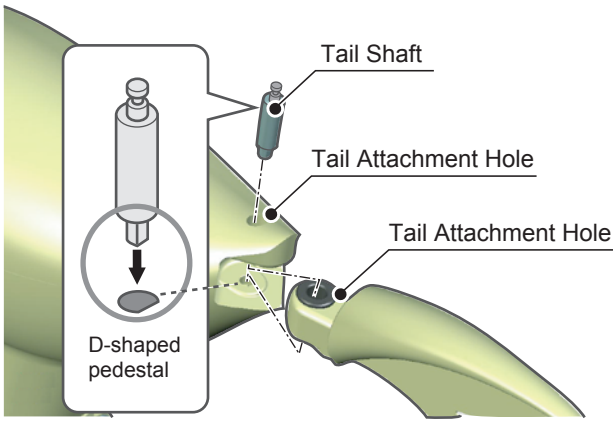
- The yaw shaft and the yaw shaft cover are designed to be fastened together tightly around the insulator.



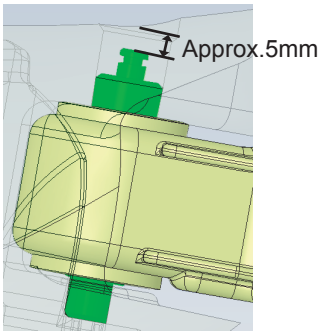
Match the edge line of the insulator with the connection section of the yaw shaft. Affix the insulator in place.

② Attaching the tail to the body

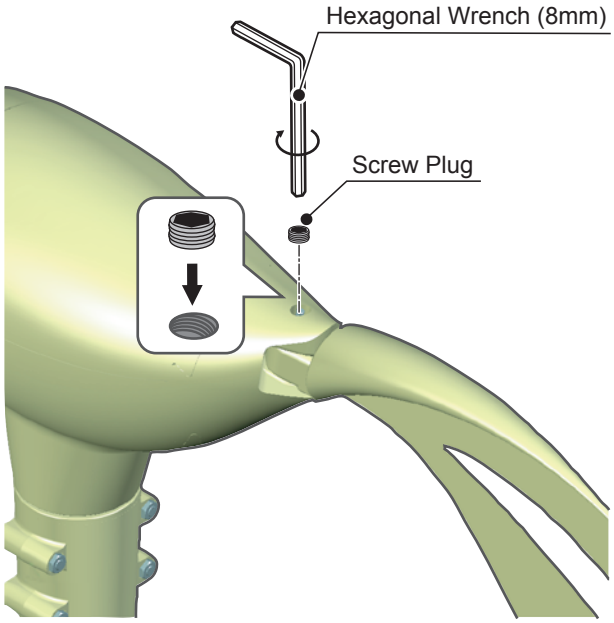
1. Line up the attachment holes on the body and the tail.
2. Make sure you have the tail shaft right side up and then insert it into the attachment hole on the body until it makes contact with the bottom as shown in the figure below.

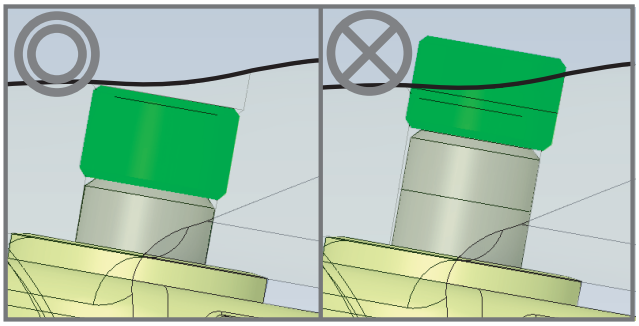


* When the tail shaft is inserted correctly, the top of the tail shaft should be approximately 5mm below the uppermost body surface.



3. Install the screw plug on top of the tail shaft and then tight it snugly into place.

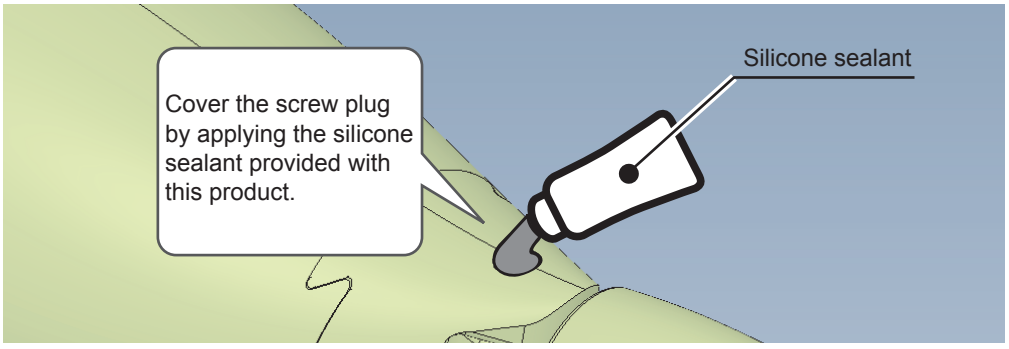




Correct Incorrect

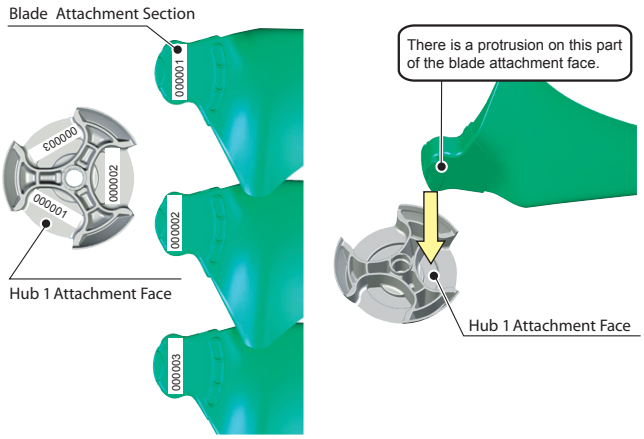
* Tighten the screw plug so that it is completely below the body surface.

4. In order to prevent crrosion, apply silicone sealant to the screw plug from above and ensure that the screw plug is completely covered.
   * Be careful not to apply the silicone sealant to other parts of the body.



③ Assembling the rotor

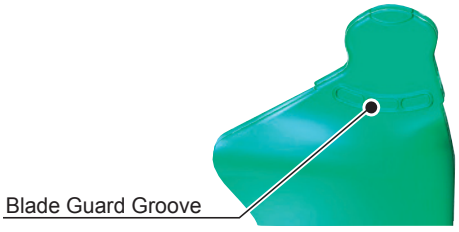
1. Attach the three blades to the blade attachment sections on hub 1. There are numbers on hub 1 and the attachment sections of the blades. Make sure that these numbers match when attaching the blades.



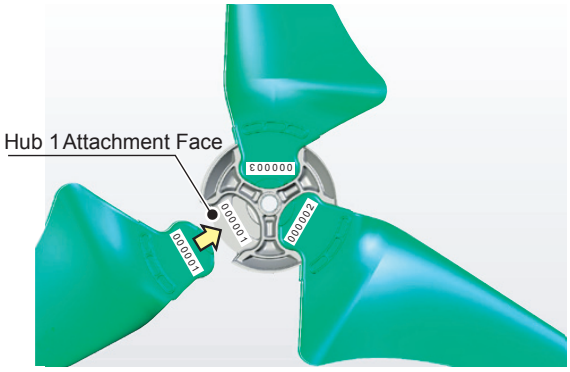
Important

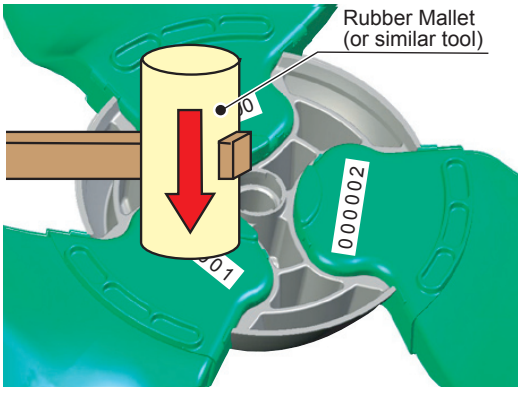
* Attach the blades to hub 1 so that the corresponding numbers match. Using the wind turbine with the blades attached in the wrong locations will result in degraded performance and may cause damage to the turbine itself.
If the numbers on the supplied hub 1 and the three blades do not match, contact the dealer where you purchased the Airdolphin (Z-1000) and have it exchanged so that the numbers properly.

* The rotor is tuned so that it is dynamically balanced. The groove on the blade guard contains a clay-like tungsten substance used for balancing weights. Do not remove the tungsten material under any circumstances.

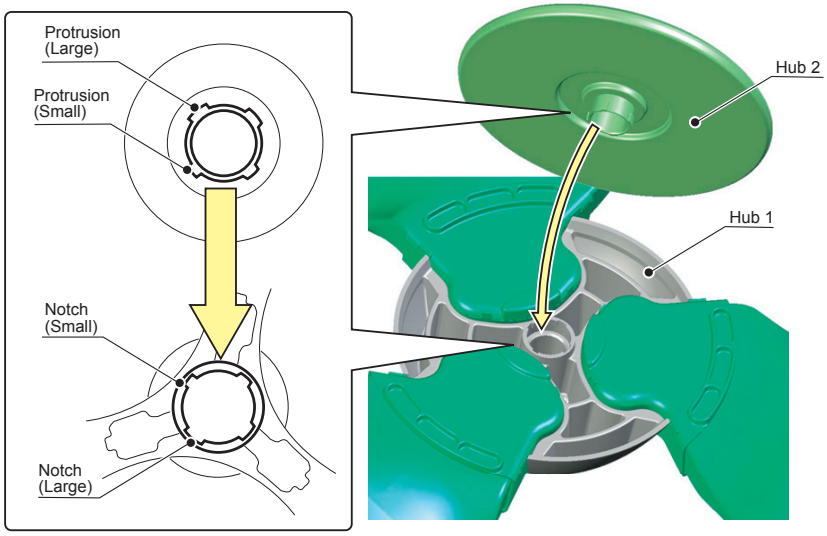


2. After attaching the blades, tap them with a rubber mallet or other tool that will not damage them until they are fixed securely in place. The wind turbine could break if the blades are not securely attached to hub 1



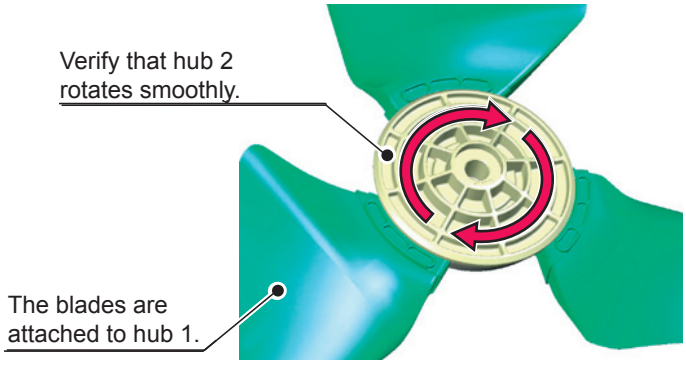


3. There are four notches, ranging from large to small, in the assembly holes on hub 1. On hub 2, there are four protrusions, ranging from large to small. These protrusions fit into the corresponding notches, fixing parts securely into place.



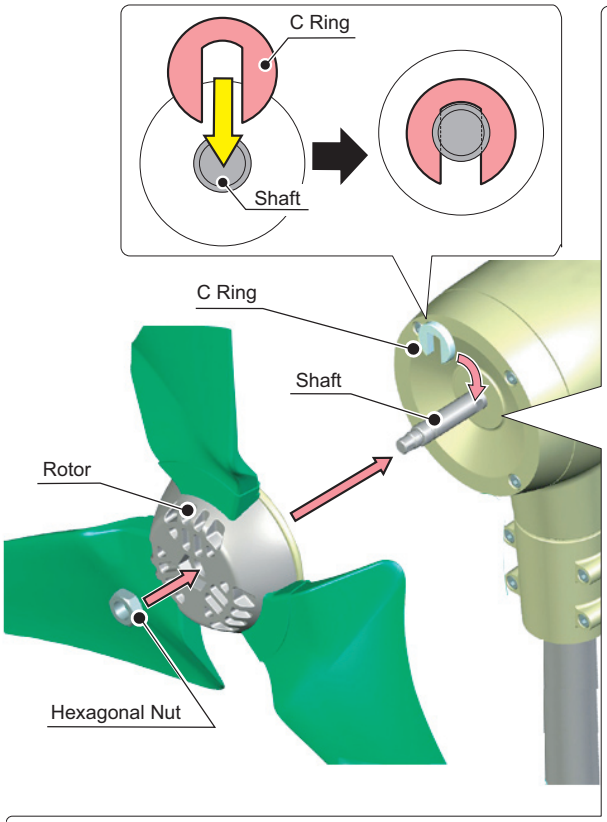
4. Rotate hub 2 while holding hub 1 (to which the blades have been attached). Hub 2 will come free. If it rotates, rotor assembly is complete.

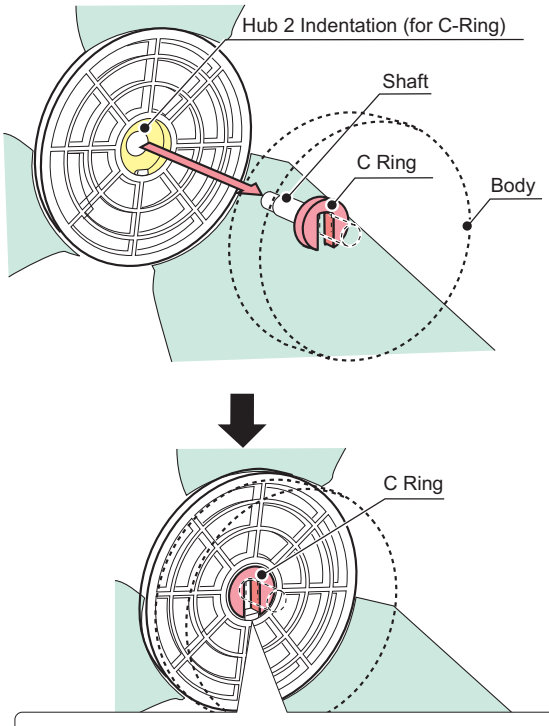
Important In the event that Hub 2 does not rotate smoothly, return to step 2 above, make certain that the blades are securely fastened, and repeat the assembly procedures.

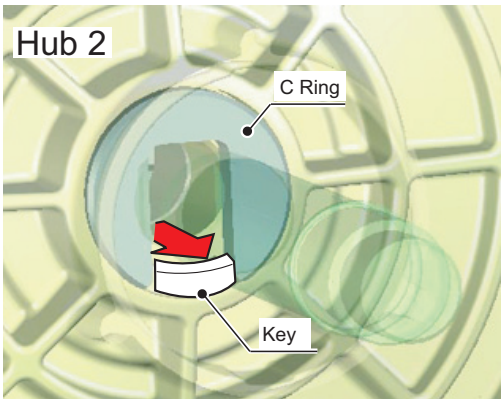


④ Attaching the rotor to the body

1. Fit the C ring onto the shaft of the body facing downwards as shown as in the illustration below.
2. Referring to the figure shown below, attach the rotor to the shaft.



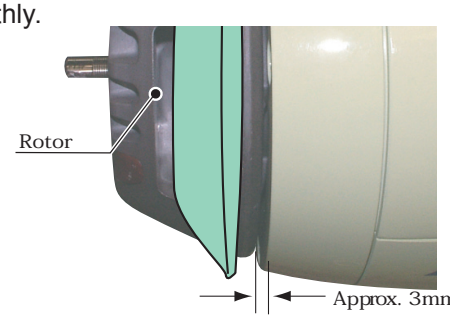




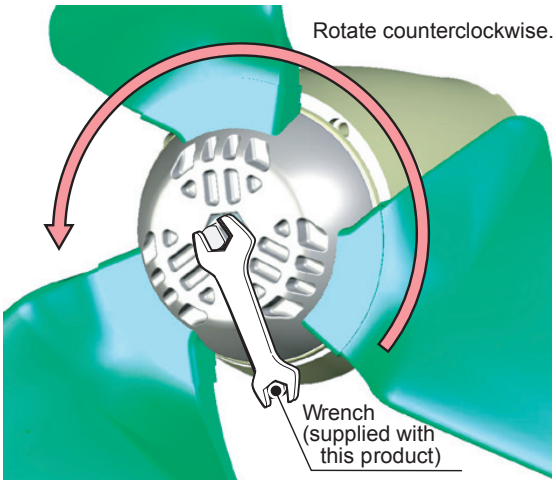
* When attaching the rotor to the shaft, make sure that the C-ring, which is installed first, securely fits into the appropriate indentation. Slide hub 2 onto the shaft so that hub 2's key fits snugly onto the C ring slot.

6. Assembling the Airdolphin (Z-1000)

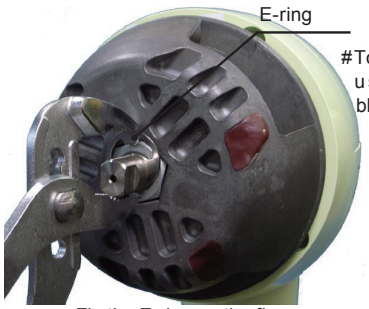
3. Once the rotor is in place, use the hexagonal nut to fasten it to the shaft.
4. The rotor will be fixed into place once the gap between the body and the rotor reaches 3mm.Verify that the rotor can rotate smoothly.



5. Holding the rotor in place, use the wrench included with this product to grip the nub on the end of the shaft and turn it counter clockwise. Continue to tighten until the three plates are quite snug. (Tightening torque 30Nm)

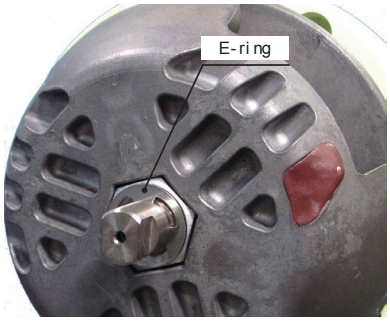


6. Fix the E-ring to the shaft. Use the pliers etc to fix the E-ring as the below figure.

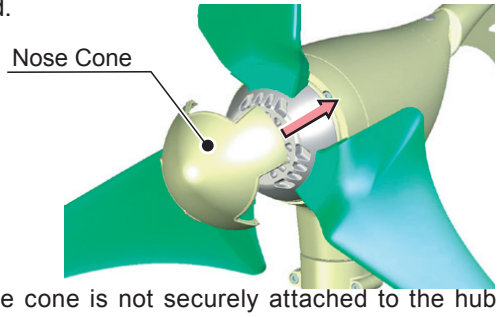


Fix the E-ring as the figure.

7. Check the Rotor that will rotate smothly after attaching the E-ring to the shaft.



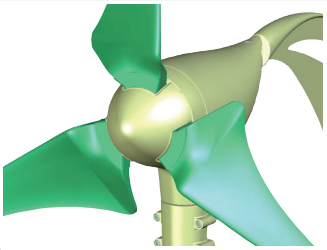
8. Slide the nose cone onto the end of the rotor. Lining the protrusions on the nose cone up with the blades, press the nose cone onto the rotor until in locks into place with a snapping sound.



9. If the nose cone is not securely attached to the hub 2, then the cone will become detached, resulting in severe rotor damage while turning at high speeds! Ensure that the three protrusions on the nose cone are evenly fastened to the hub 2 as shown in the image below.

Important

Completely Assembled Unit



7. Connecting the System

7-1 Before connecting

There are two Airdolphin system configurations—one in which generated electricity is stored and fed to the commercial electricity grid(On-grid system) before being used, and another in which the wind turbine is used as a standalone system(Off-grid system). A 24V battery is required for both systems. The following explains how to connect the Airdolphin power cable (approx. 500mm long) and provides a typical example of a wind turbine system connection.
For On-grid system ,contact dealer or Zephyr Corporation for details.

Important

* Pay attention to the + and – terminals when connecting the power cable to the battery. Reverse connection will cause serious damage.

(Be aware that any damage to this product caused by improper connection is NOT covered by the warranty. Connect the cables to the correct terminals.)

7-2 Length of the extension cable that leads from the Airdolphin to the battery

If length of the power cable that connects the Airdolphin (Z-1000) to the battery is within 15 meters, connect the Airdolphin directly to the main battery. If the cable is longer than 15 meters, please refer to page 25 for more details.

Important

The Airdolphin (Z-1000) has an output voltage of 25V.
Connect either a single 24V battery or two 12V batteries in a serial connection.

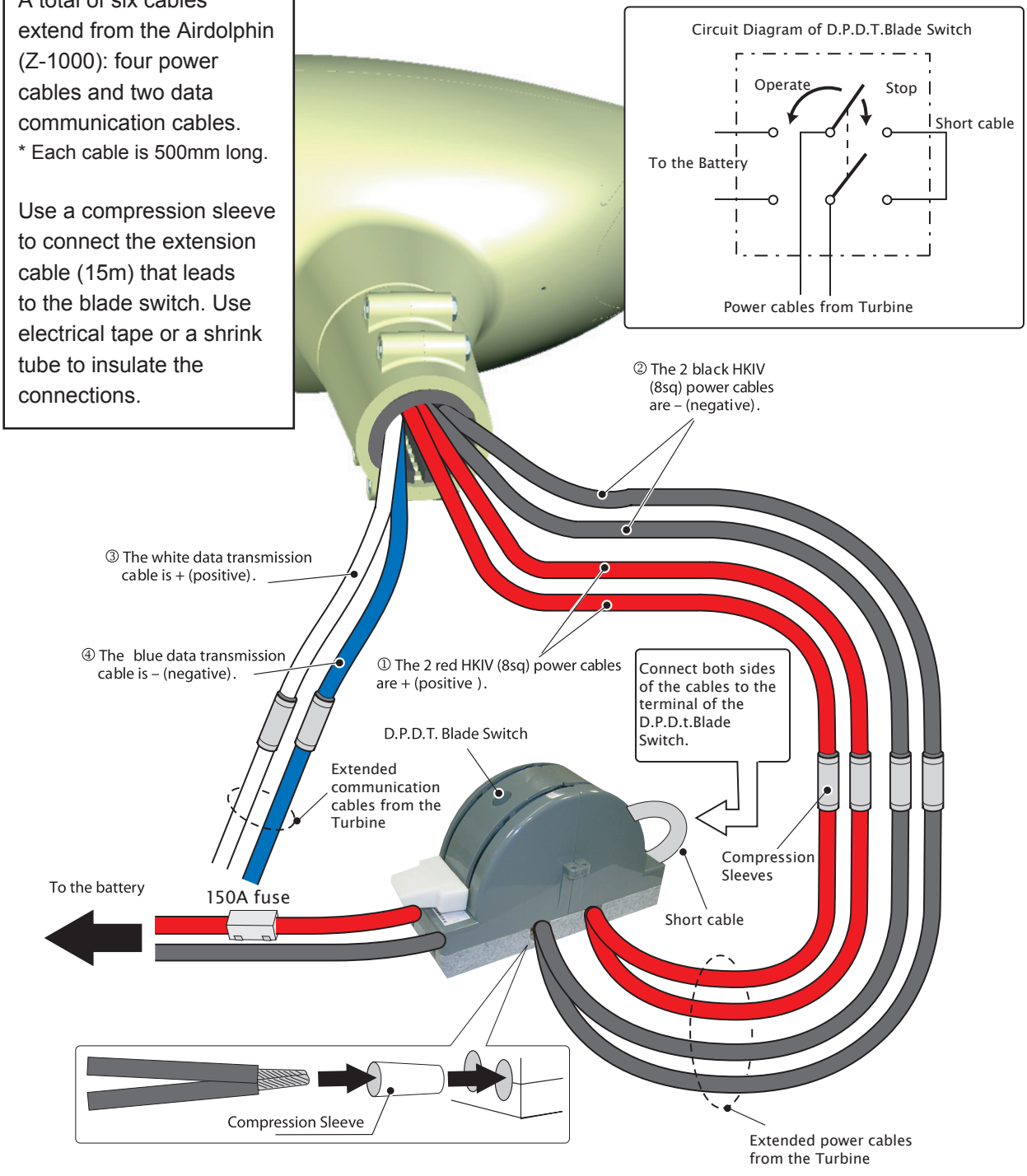
7-3 D.P.D.T.(Double pole double throw) blade switch

To ensure safety, the Airdolphin (Z-1000) is equipped with an emergency stop feature (See page 24.). In the event of an emergency stop, the Airdolphin (Z-1000)'s power supply must be shut off for approximately 10 seconds before being restarted. In order to facilitate turning the power on/off, Zephyr Corporation recommends the installation of a D.P.D.T. BLADE SWITCH between the Airdolphin (Z-1000) and the battery. (See next page.)

7-4 Connecting the Airdolphin output cable extension

A total of six cables extend from the Airdolphin (Z-1000): four power cables and two data communication cables.
* Each cable is 500mm long.

Use a compression sleeve to connect the extension cable (15m) that leads to the blade switch. Use electrical tape or a shrink tube to insulate the connections.



Important Pay attention and abide by all safety and electrical codes before installation.

- Pay attention to the + and – terminals when connecting the power cable to the battery. Reverse connection will cause serious damage.
- Pay attention to the + and – terminals when connecting the data transmission cable to the Remote Monitor "RM-1000". Reverse connection will cause serious damage.

7-5 Connection example

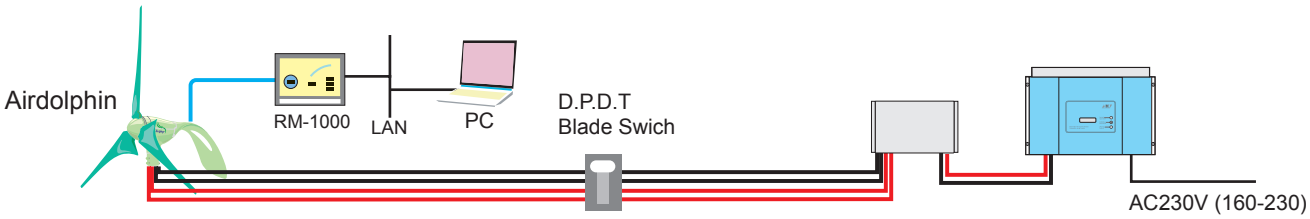
The Airdolphin can be used in a multitude of configurations. This section shows a typical connection example recommended by Zephyr Corporation.

Caution

This manual is intended for individuals who have the knowledge and technical skill needed to work with batteries and electrical wiring. If the Airdolphin is used in an inappropriate configuration or wired incorrectly, its use could cause a severe accident and damage the system, including this product.
If you have any questions regarding Airdolphin system configuration, contact either the dealer where you purchased this product or Zephyr Corporation for more information.

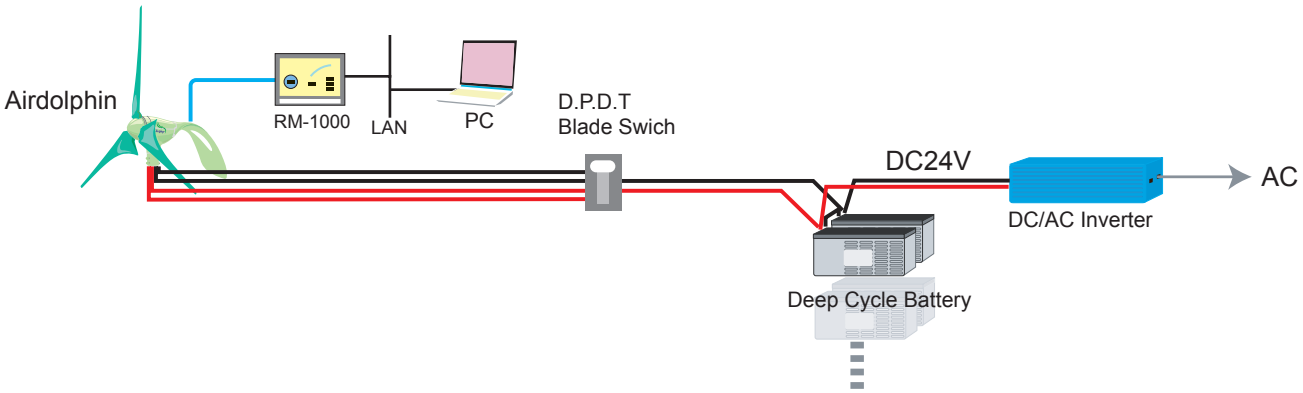
7. Connecting the System

Grid Connection System (On Grid)



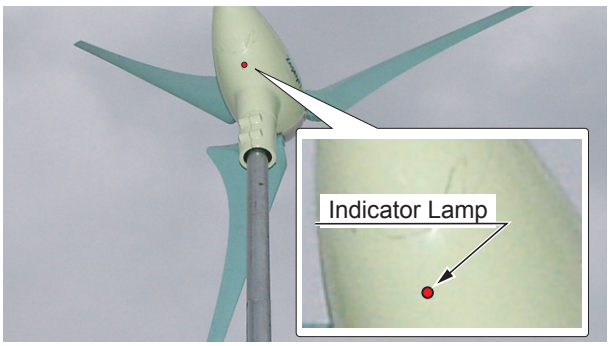
* Grid connection is not authorized in some countries,
For more details, contact your dealers or Zephyr Corporation.

Standalone System (Off Grid)



8. Explanation of Airdolphin Operations

During operation, the indicator LED on the body of the Airdolphin can be used to check the operating status of the system.
The indicator LED can light up red, green, orange, or blink.



Operating Status List

Mode	Indicator Status	Status	Cause	Operation
Power Assist Mode	Orange LED lights up	Power Assist rotates the Airdolphin at 200rpm in 10-second intervals each minute	No wind for 1 minute	Operating Normally
Normal Mode 1 (250rpm–1000rpm)	Green LED lights up	Generating electricity Wind speed - 10m/s	Rotor rotating at 250–1000rpm	Operating Normally
Normal Mode 2 (1000rpm)	Green LED blinks	Generating electricity Wind speed 10 - 20m/s	Rotor rotating at 1000 rpm	Operating Normally
Normal Mode 3 (600rpm)	Red LED lights up	Generating electricity Wind speed 20m/s -	a. Battery fully charged (voltage exceeds 28.6V) b. At around 20m/s or more of wind speed	Operating Normally
Stop Mode	Red and green LED blinks alternatively	Rotor not rotating Power assist stop	a. Overcharged (battery voltage exceeded 36V) b. Generator ambient temperature exceeded 90°C	a. System returns to stall mode if the battery voltage drops below 25.6V. b. System returns to stall mode if generator motor ambient temperature drops below 60°C
Restart (Same as start mode)	Green LED lights up 10 seconds, orange LED blinks 5 seconds, red LED lights up 90 seconds		Power On/Off	System started install mode

9. Considerations When Choosing Peripheral Materials/Devices

Choosing peripheral materials/devices

Batteries

Zephyr Corporation recommends the use of a deep cycle battery (AGM) for all off-grid applications to handle the deep charge/discharge cycles in the wind turbine system. (A car battery cannot be used for repeated deep charge/discharge.)
Connect two 12VDC batteries in a series circuit to attain 24VDC performance.

Recommended battery specifications:
Off-grid : Deep cycle lead acid battery, 500Ah or more

Mounting Tower

The mounting Tower that supports the Airdolphin is an extremely important part with respect to safety. We recommend that all locations to which equipment will be attached as well as the foundation mast are strong enough to provide adequate safety.

- Location and height of the mounting tower : Select free and safe location where the ample amount of wind flow is obtained. The height of the pole must be 3.5m or more to ensure safety from hazard to people.
- The tower must have an upper portion of at least 100mm in length and an outer diameter of 48.6mm. The total tower height must be of sufficient height to prevent accidental with body or structures.
- The tower must withstand horizontal wind pressure of 105kgf /231lbf(at a wind speed of 65m/s,145.3mph)
- You should consult with your local dealer or Zephyr Corporation for details.

Cables

A considerable amount of current flows through the cables and devices (batteries, use inverter etc) connected to the Airdolphin (Z-1000). Use cables specified by Zephyr Corporation or manufactured them to recommended specifications.

- Battery Cables : Use the cable included with the Airdolphin (Z-1000) that is equipped with a reverse connection prevention 150A fuse.
- Wire Diameter Sizes

To select the appropriate size wires, measure the distance between the turbine and the batteries. Make sure you include the height of the tower and refer to the following wire size chart.

Distance between Airdolphin and Batteries	Cable diameter
7m (22.96 ft)	5.5 mm2
15m (49.21 ft)	8.0 mm2

* Cable quality and electricity transfer rate vary in accordance with turbine quantity.
* A multitude of cables with different specifications is also available. For details, contact the dealer where you purchased the Airdolphin (Z-1000) or Zephyr Corporation.

9. Considerations When Choosing Peripheral Materials/Devices

Inverters

Since batteries are a direct current power source, a DC-AC inverter is needed to convert direct current (DC) to alternating current (AC) when an alternating current device is used to manage the electrical load. Verify the capacity and type of your inverter to ensure that it is appropriate for the load you are using.

* Always use 24VDC inverters.
* Always use inverters equipped with an overvoltage protection circuit.

Fuse

Use a 150A fuse for protection against reverse connection to connect the turbine and the battery.

10. Maintaining the Airdolphin System

Perform the maintenance tasks listed below to ensure the safe operation of this system.

10-1 Daily Inspection

Although the Airdolphin is basically a maintenance-free system, Zephyr Corporation recommends visual inspections.(See page 24 for details on the indicator lamp.)

a) Is the power assist rotating the turbine at the standard speed (80rpm) for 10 seconds each minute?
   * The power assist will rotate the turbine at a speed slower than the aforementioned standard approximately 10% of the time. This is not a malfunction.
b) Is the system exhibiting operations listed on the “Explanation of Airdolphin Operations” chart above? (Example: Indicator lamp is green when the rotor is rotating at a high rate of speed (250-1000rpm), etc.)
c) Are the blades free from damage?
d) Is there an approximate 3mm gap between the hub and the main unit face?
e) Is any debris such as ice, snow, or tree branches jamming the turbine?
f) Is the joint on the tail moving smoothly?
g) Is the tail free from any minor damage?

⚠ WARNING **⚠ CAUTION**

If replacement is necessary, only use parts specified by Zephyr International. Use of other parts could cause accidents or malfunction.

- When strong winds blow, tree branches and other objects may make contact with and damage the wind turbine, its support pole, or its wiring. Continued use of the wind turbine when it is damaged may cause electric shock, fire, a serious accident, or cause the turbine to cease functioning. Inspect all parts of the Airdolphin (Z-1000) after periods of strong wind.
- Do not place the Airdolphin body upside down or inclined during installation or maintenance. Water (rain, snow) can leak inside from the joint gap of the body and may cause damage to the turbine. When the body is upside down or inclined and have a possibility of getting wet, put a cover over the body to avoid water.

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