Wind Energy Education Kit
Assembly Guide

Model No.: FCJJ-39

⚠ Warning

To avoid the risk of property damage, serious injury or death:

This kit should only be used by persons 14 years old and up, and only under the supervision of adults who have familiarized themselves with the safety measures described in the kit. Keep small children and animals away, as it contains small parts that could be swallowed. Read the instructions before use and have them ready for reference.

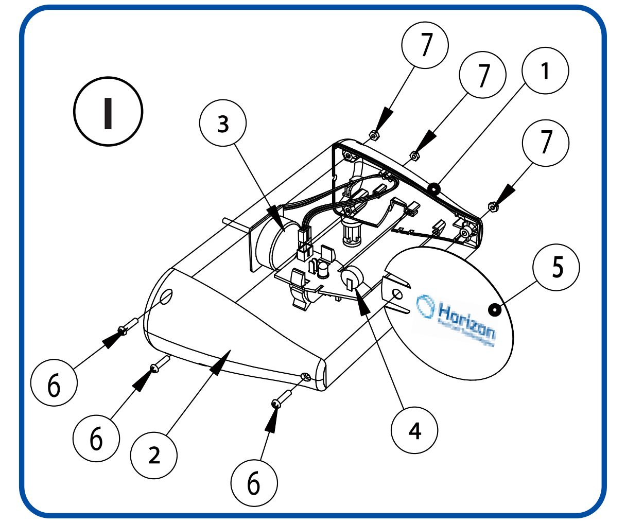
Wind Energy Education Kit **ASSEMBLY GUIDE**

Refer to the following assembly drawing and the Part List reference numbers for assembly.

I. Main Body Assembly

Part List

1. Left Housing
2. Right Housing
3. Generator
4. Printed Circuit Board Assembly
5. Polypropylene Vane
6. Screw, M2.5 x 8 mm
7. Hex Nut, M2.5
8. Rotor Base
9. Molded Profile Blade
10. Profile Blade Holder
11. Blade Assembly Lock
12. Polypropylene Sheet Blade
13. Aluminium Post
14. Screw, M3 x 2 mm
15. Output Wire
16. Support Base Assembly
17. Output Socket
18. Post Secure Pin

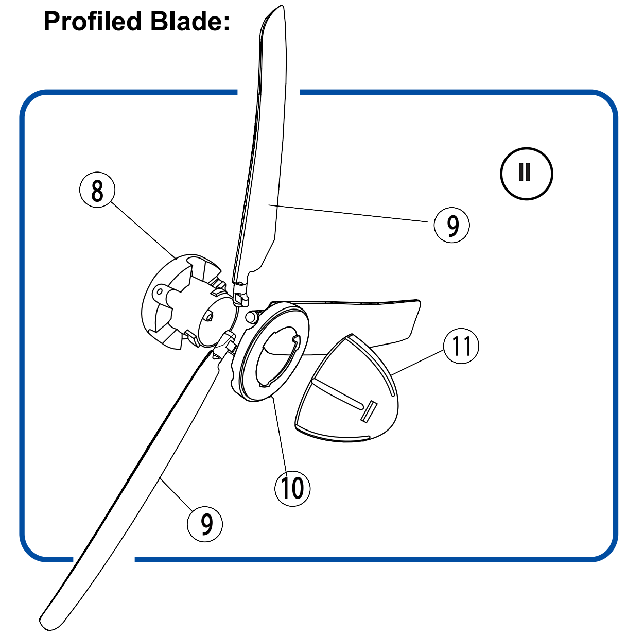


300001271

www.horizonfuelcell.com

II. Blade Unit Assembly

Profiled Blade:



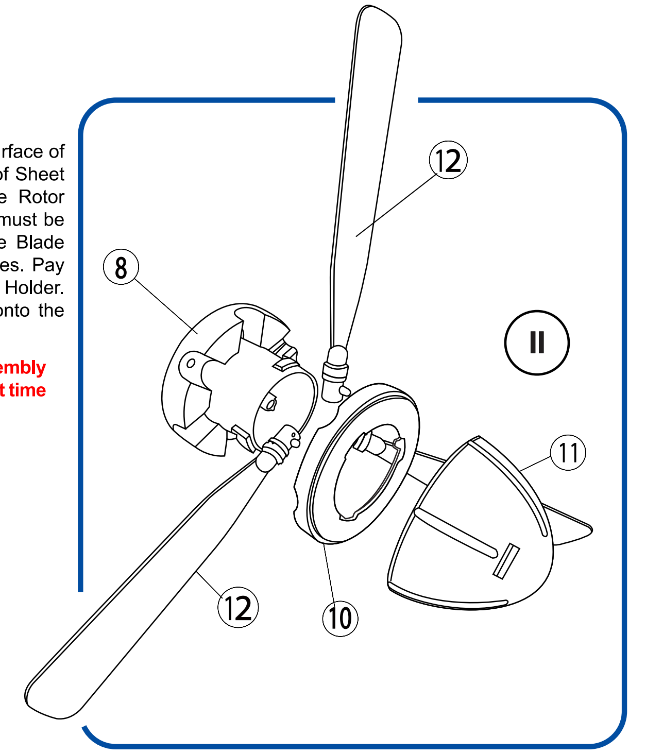
Place the Rotor Base (8) onto the flat surface of a table. Install 3 pcs of the same type of profiled blades (marked B or C) evenly on the Rotor Base. Pay attention that the snap joint must be pushed into the Rotor Base. Place the Blade Holder (10) on top of the installed blades. Pay attention to the direction of the Blade Holder. Screw the Blade Assembly Lock (11) onto the top of the Blade Assembly.

***Do not over tighten the Blade Assembly Lock otherwise you may have a difficult time in unlocking the Blade Unit Assembly.**

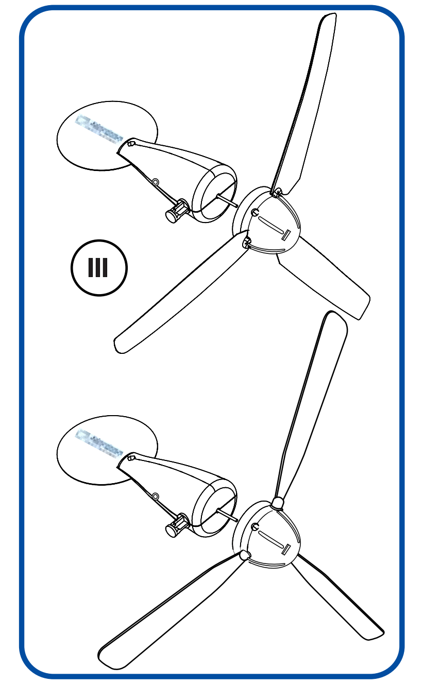
Sheet Blade:

Place the Rotor Base (8) onto the flat surface of a table. Install 3 pcs of the same type of Sheet blades (12) (marked A) evenly on the Rotor Base. Pay attention that the snap joint must be pushed into the Rotor Base. Place the Blade Holder (10) on top of the installed blades. Pay attention to the direction of the Blade Holder. Screw the Blade Assembly Lock (11) onto the top of the Blade Assembly.

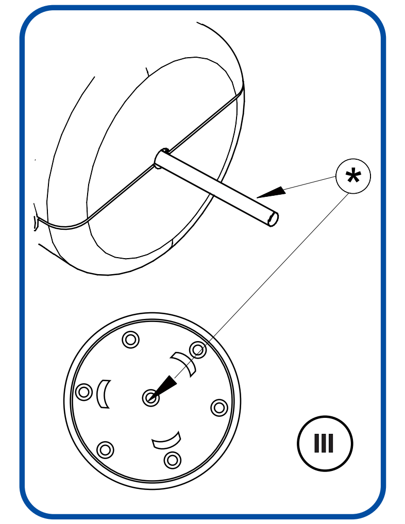
***Do not over tighten the Blade Assembly Lock otherwise you may have a difficult time in unlocking the Blade Unit Assembly.**



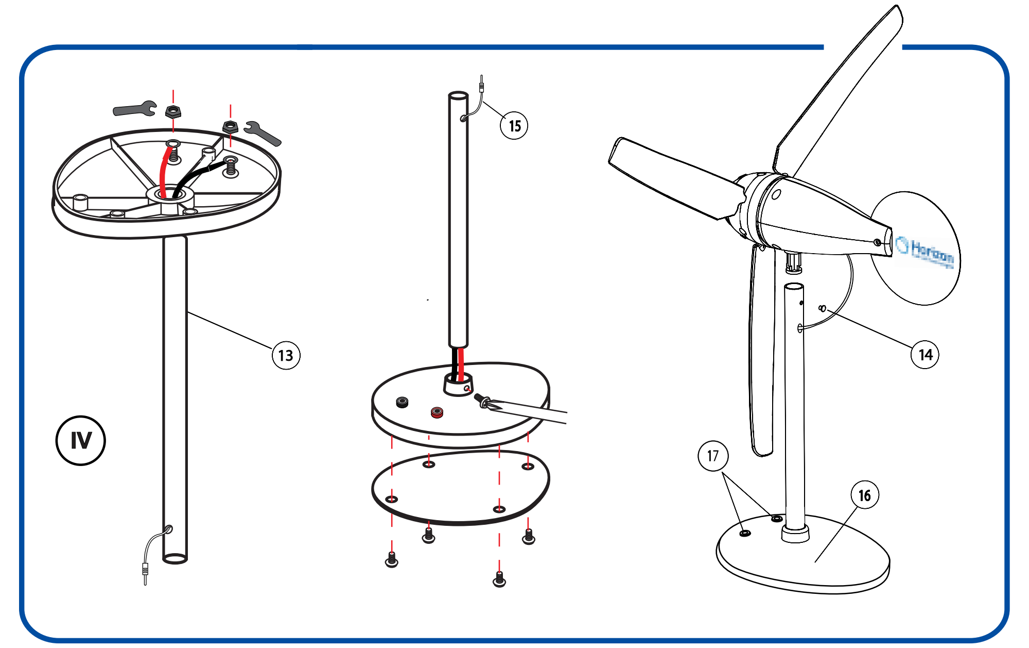
III. Blade Unit Installation



Push the rotor shaft to the rotor base to ensure the main body and rotor head are properly connected. Make sure you press the Blade Unit all the way onto the shaft. Check that the Blade Unit is securely connected onto the shaft of the turbine. If not properly installed, the rotor may not effectively turn the rotor shaft and will not generate electricity.



IV. Post and Support Base Assembly



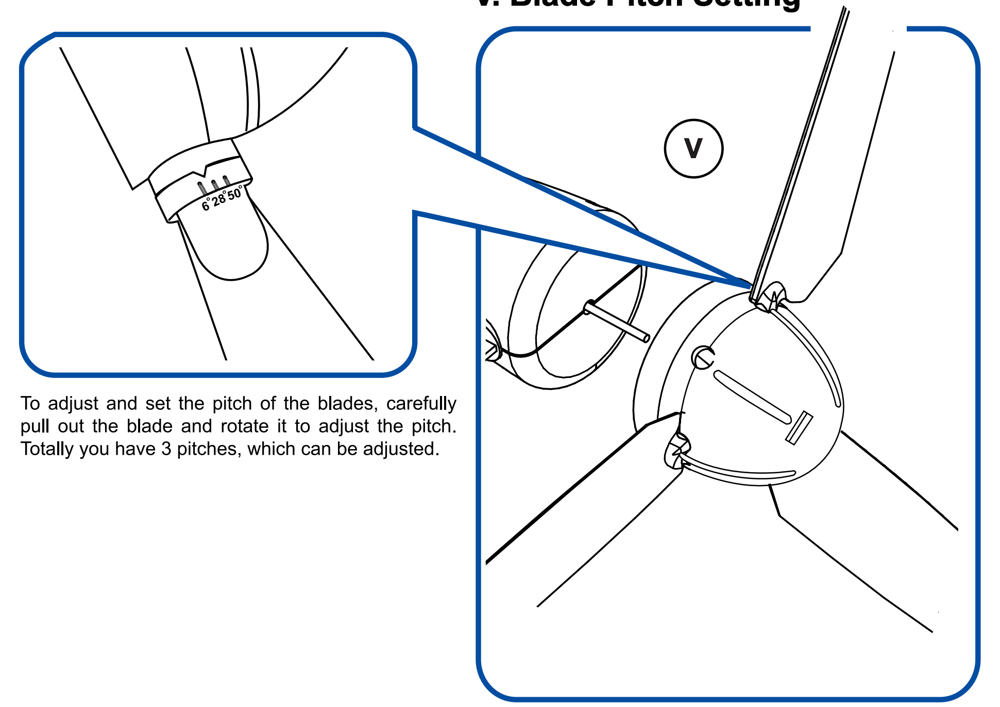
Enable Yawing:

Yaw- To turn about on vertical axis. To move unsteadily or weave.
The wire connector hole should be located on the **same** side of the tube (13) with two vertically aligned holes. Insert the Aluminium Tube into the Support Base. Install the Body Assembly onto the top of the Aluminium Tube and secure it with the screw (14). The screw should be secured from the **back** side of the wind turbine body into the groove of the plastic stud to **enable** yawing and movement of the turbine body.

Disable Yawing (Not shown in the Assembly Drawing):

The wire connector hole should be located on the **opposite** side of the tube (13) with two vertically aligned holes. Insert the Aluminium Tube into the Support Base. Install the Body Assembly onto the top of the Aluminium Tube and secure it with the screw (14). The screw should be secured from the **front** side of the wind turbine body through the hole on aluminum tube into the solid plastic stud to **disable** yawing and movement of the turbine body.

V. Blade Pitch Setting



To adjust and set the pitch of the blades, carefully pull out the blade and rotate it to adjust the pitch. Totally you have 3 pitches, which can be adjusted.

The Pitch Angle

The blades themselves have different set angles at different sections to enhance the performance. This setting is to compensate the rotating speed of the blade at different radius (sections) so that the blades will not stall at a particular section. You may have to learn more about a parameter called Tip Speed Ratio to understand more thoroughly. This Ratio defines how fast the turbine is rotating under a wind speed environment. By changing the blade pitch, this ratio will be changed. Thus the output power of the turbine is changed. Each adjustment represents a change of 22 degrees. Therefore, the pitch is allowed to be adjusted from 6 to 50 degrees.

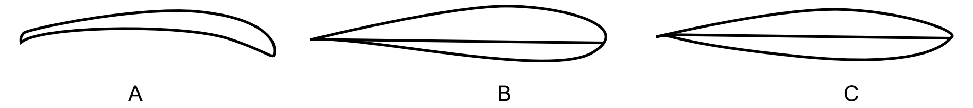
At smaller pitch value settings, the start up wind speed has to be very high. Maximum output power occurs at a pitch of around 28 degrees. The start up wind speed is higher at a lower pitch setting. If the wind speed is low you should increase the pitch so that you can achieve a higher power output.

Wind Kit Technical Specifications:

Blade Type	No. of Blade	Wind Speed (mph)	Load (Ohm)	Output Voltage (V)	Output Current (mA)	Output Power (W)	Rotor Speed (RPM)
Blade A	3	10	50	1.15	28	0.03	400
Blade B	3	10	50	1.35	30	0.04	490
Blade C	3	10	50	2.50	50	0.125	705

Different Blade Types

There are three types of profiled blades included in the Wind Energy kit. After you obtain the maximum output power with a particular blade type, you may replace with another type of profiled blade and evaluate it's performance in comparison.

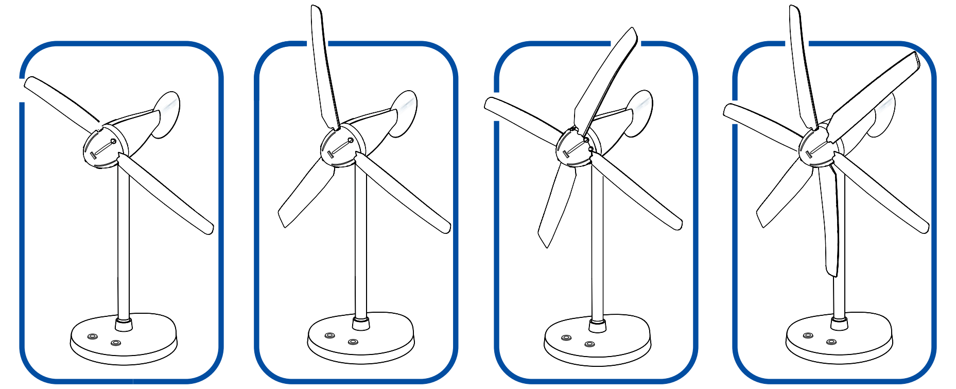


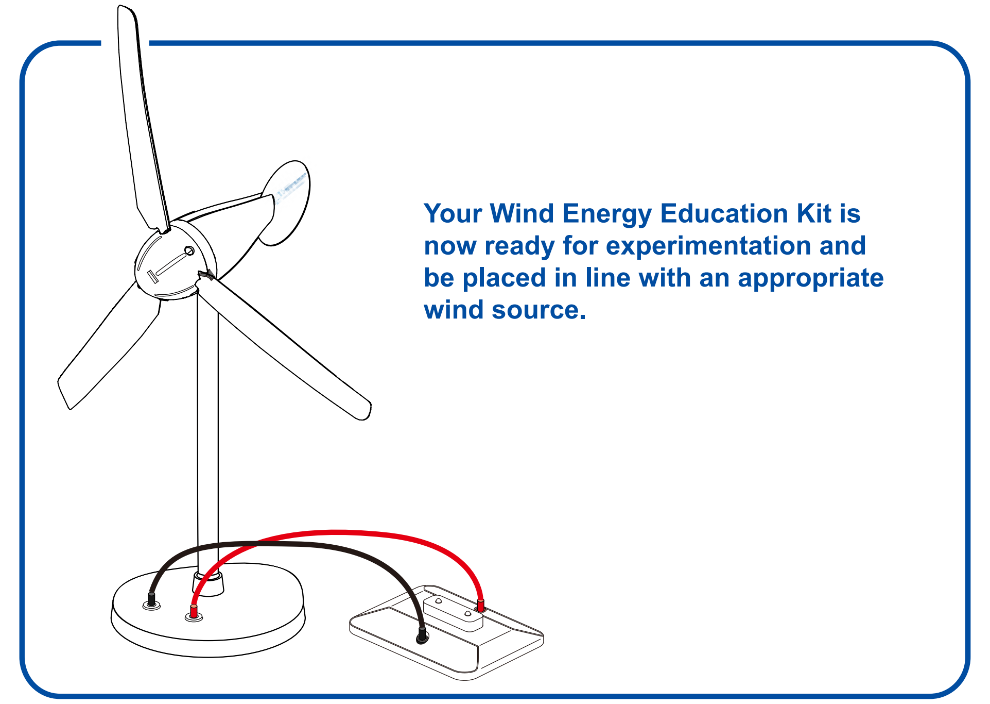
The difference between these 3 profiles is the amount of material on the side facing the wind. All of them have a much more curved profile on the Rear side (down wind side) to increase the distance for the wind to travel. The Blade Type no. is engraved on the root part of the Blade for your reference.

Changing the Number of Blades

There are 6 positions for the installation of blades and it is possible to install up to 6 blades. However, with 6 blades installed the pitch adjustment is limited. It is recommended to experiment with numbers of 2, 3, 4, and 6 blades installed under various wind speeds and blade pitch settings.

If you have enough wind try reducing to 2 blades as you may get a little more power than using 3 blades. More blades installed will allow the turbine to start rotating more quickly under low wind conditions.





Your Wind Energy Education Kit is now ready for experimentation and be placed in line with an appropriate wind source.

Most commonly a floor or basic desk fan is the source of wind used for experimentation with the Wind Kit. A larger fan allows you to test the performance of the turbine at higher wind speeds. You can switch the fan to a lower setting or increase the distance between the fan and the turbine to achieve low wind speeds. It is difficult to achieve high wind speeds with a small fan. A fan of 16” diameter is suitable for doing most wind power experiments.
For optimum performance, align the centre of the fan with that of the nacelle of the turbine. Therefore, it will be better if the height of the fan is adjustable.

Wind from a natural source is never steady. Therefore, the output power of the turbine is always varying. This may lead to uncertainty in taking readings and measurements in the experiments. In order to reduce the variation of wind speed due to turbulence, operate the setup at the middle of a hall or use a wind tunnel. The wind speed will be more stable under these conditions.

With the included LED Module you can demonstrate the output power created by the Wind Kit and use this power to illuminate the LED Lights on the Module. You can use the Renewable Energy Monitor FCJJ-24 (not provided) to measure the LED.

To connect the LED Module simply connect the red and black cable leads from the module to the red and black input jacks on the Support Base. It is highly recommended that you connect the module while the Wind turbine is not in motion and has not been placed in source of wind. Take care to arrange the wires so that they will not be tangled by the rotating blades. Use REM to measure how much voltage is being produced under your experimental conditions.

This LED Module is intended as a basic demonstration device. To perform much more detailed experiments and explore the full educational value of your Wind Kit we recommend purchasing the Horizon Renewable Energy Monitor. With the device and in combination with Horizon’s PEM electrolyzers you can perform a multitude of experiments including:

Take your Wind Kit experimentation to the next level !

Listed below are additional wind experiments that can be performed with the Wind Kit wind turbine using a multimeter or with Horizon’s Renewable Energy Monitor Lab and your computer.

- Using Different Blade Shapes Create Power
  This experiment demonstrates how blades with different curvatures produce different degrees of power output. Wind turbine blades are shaped like airplane wings, and one size does not fit all requirements. You will measure and understand how using the right blade shape can produce optimum power for different wind conditions.
- How Many Blades Are Best? 1, 2, 3, 4…
  Using the right number of blades for a given wind condition is important in extracting the maximum electrical power from a wind turbine. You will measure and understand the choices between the numbers of blades that are necessary to produce best results.
- Adjusting Blade Pitch for Best Performance
  Angling the blades into and away from the wind are important elements in creating maximum power – or slowing the speed of rotation. This experiment will show you the techniques for stalling and furling as well as adjusting the blade pitch to extract the maximum degree of power from the wind.
- How Much Power Can Be Extracted from the Wind
  While power from the wind is free as long as it blows, it is still limited to certain physical laws. This experiment will show you how to measure wind speed versus extracted wind power.
- Using Wind Power to Generate Hydrogen
  One important use of wind power is to generate hydrogen in a clean, non-polluting manner. This experiment shows you exactly how to do it.
- Measure Wind Turbine Performance Using RPM
  Using our electronic measurement tool you can measure the voltage, current, power and RPM (revolutions per minute) rotational speed of the wind turbine and see it displayed on the measurement tool as well as your computer. Watch the RPM as it changes with wind speed and resistor loading and witness how to slow down and even stop the wind turbine spinning without even touching it – just by adding the right resistor combinations. Make measurements for wind power and turbine efficiency to really understand how this remarkable device works.
- Build a Wind Farm
  Arrange multiple Wind Kit turbines in series and parallel configurations in order to study the voltage, current, and power generated. Design a simulation of a commercial wind farm in model scale and learn the potential of wind power as a mass energy source.

Purchase additional Wind Energy Education Kits and Circuit Board Module Base and red/black hookup leads needed to connect multiple turbines in series and parallel here-
http://www.horizonfuelcell.com/store.htm

Safety

Before you proceed to perform experiments with the turbine, please note that the rotor can rotate at a few thousand RPM’s (Rotations per Minute), especially when no load is connected. When the wind speed is high and the turbine is set to output high power, the rotating speed of the rotor can also be very fast. Bodily injury may result if struck by the rotating blades. Wearing goggles is suggested in the case that your head will be close to the rotating blades. You should also install the turbine properly so that it will not “walk” or topple over. The weight of the base has been increased from previous versions to prevent the turbine from “walking”. Placing a rubber mat, polyfoam, or a thin book under the base helps stabilize the turbine if the surface of the table is too hard. In the case that the turbine topples at high rotational speed, to avoid being hurt, do not try to catch it. Arranging the wires from the turbine to run inside the aluminium tube through the opening on the post and base prevents the wires from tangling by the rotating blades. All of the above measures help to reduce accidents during operation of the turbine. However, you have to make sure that the environment is safe for doing experiments. Adult supervision is required. This wind turbine is not suitable for children under 14 years old.

FCJJ-39_WEEK_AG_V1.0_EN