

PVC Turbine Building Instructions

Kidwind Project

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PVC Turbine Classroom Kit

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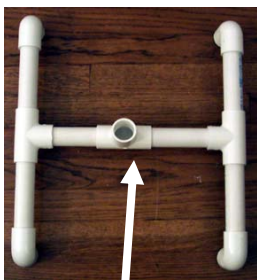
Kit Contents

- (6) 6" PVC pipe connectors
- (1) 2" PVC pipe connector
- (1) 30" PVC pipe tower
- (5) 90° pipe fittings
- (3) Ts pipe fittings (1 drilled)
- (1) Tinkertoy Hub w/adaptor
- (1) DC Motor
- (40) 4" Dowels
- (10) Balsa Sheets
- (1) Multimeter
- (1) Sandpaper Sheet

These instructions will show you how to build your PVC turbine and show you how to use the multimeter to record electrical data that your turbine generates. The Blade Design Experiments document offers you some ideas for lessons and experiments that you can execute with the wind turbine. It also offers some background information about wind turbines and blade design.



(2) Identical Base Sides



Sides joined together.

Make sure to use the PVC tee with the hole so you can get the wires out!

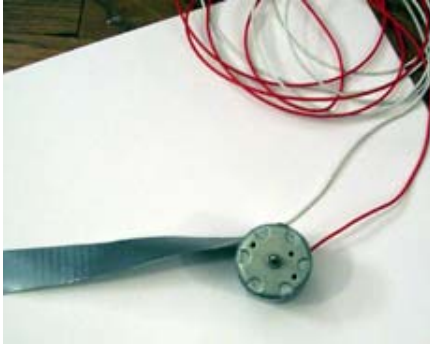
PVC tee with hole

Part A: Building the PVC Tower Base

1. Using (4) 90° PVC fittings, (2) PVC tees and (4) 6" PVC pipe sections construct the two sides of the PVC turbine base. Make sure in this step to use the PVC tees that **DO NOT** have a hole drilled in them.
2. Fit the parts together without using glue (PVC glue is really nasty stuff). To make them fit snugly you can tap them together with a hammer, or bang them on the floor once assembled.
3. Next you need to connect the two sides. Use the PVC Tee with the hole to do this. You need the hole to snake the wires from the DC motor out.

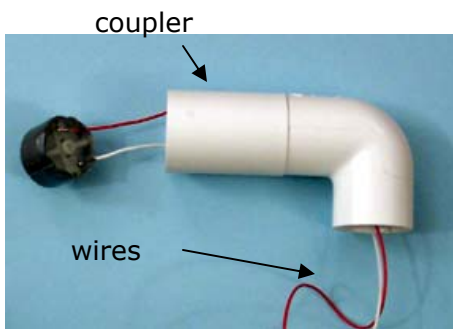


Part B—Building the Rotor & Hub



1. For this step you need (1) PVC 90 fitting, (1) PVC coupler, (1) 3" piece of PVC pipe and the DC motor.
2. First you need to wrap a piece of duct tape around the outside of the motor. This piece of tape should be about 1" wide and 20" long. This will help the motor fit securely into the PVC coupler.

3. Arrange the pieces like the image to the right. Then push them together to form a solid piece. This is called a **nacelle** it holds the DC motor, blades and other equipment.



Make sure the wires come out the bottom!

4. Insert the wires attached to the DC motor through the nacelle. They should come out of the 90° PVC fitting. Your motor will rest in the coupler.

5. Insert the motor into the coupler. It should fit very snugly. If it loose you should wrap some more duct tape around the outside. As you are frequently pushing on the motor you need to make sure this is tight!



Notice the motor is straight and not pushed all the way in!



Motor secured into the coupler. STRAIGHT!

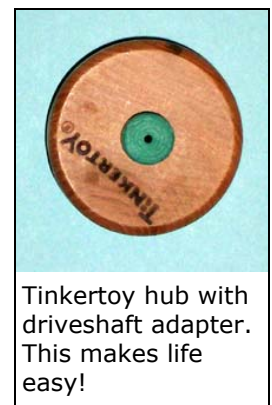
6. When you insert the motor you also should make sure that it is straight and not too far in. If it looks cockeyed you should straighten it out as it will cause your hub and blades to wobble while spinning.

7. I recommend gluing the motor in place using some epoxy or other strong glue.



Nacelle complete with rotor hub.

8. After you have secured the motor attach the Tinkertoy hub. Press the hub onto drive shaft. It should fit very snug. Do not press it on so hard that the adapter rubs on the motor body. This would slow your drive shaft.



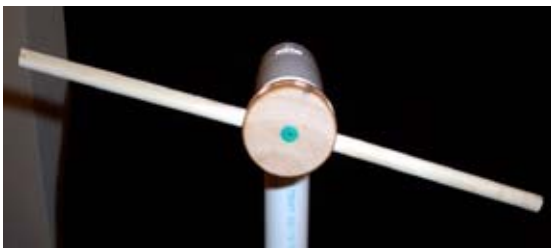
Tinkertoy hub with driveshaft adapter. This makes life easy!

Part C— Attaching the Tower to the Base

1. Snake the motor wires through down the tower and through the hole that is drilled in the PVC tee at the base of the wind turbine.
2. Attach the nacelle to the top of the tower.
3. Insert the bottom of the PVC tower into the tee at the center of the turbine base.
4. It should look just like the wind turbine to the right!
5. Make sure the PVC pipe has seated well into the fittings by tapping together with a hammer, or by banging on the floor.
6. Make sure that you didn't use any glue! Because once you are done you can take it apart and then store it away for next year.
7. To make your life easier you should attach alligator clips to the wires coming out of the turbine. This will make it easy for you to hook your turbine up to a multimeter!



Part D - Attaching Blades to the Rotor



1. Attach blades to the hub using the short dowels included in your kit.
2. These 3/8" dowels are designed to fit very securely into the Tinkertoy holes. If they are too tight then you might need to use the sandpaper to make them fit more easily. Don't sand too much though

because you do not want your blades to be loose. If they are too loose they can fly out during testing.

3. To make blades you can carve different shapes and sizes out of a variety of material (wood, cardboard, felt, fabric) and hot glue or tape them to the dowel.
4. You can add up to 8 blades and set them at any angle on the hub. The only problem with the Tinkertoy hub is you can only use even numbers of blades. If you want to use odd numbers check out our 6 hole hubs at the KidWind shop.
5. For more details about what you can test with the blades see the Blade Design Experiments document.



Part D—Multimeter Basics

These small DC motors do not make much power. Unless you gear them up or use a special type of circuit that doubles the voltage you will be unable to light a bulb or an LED.

Voltage



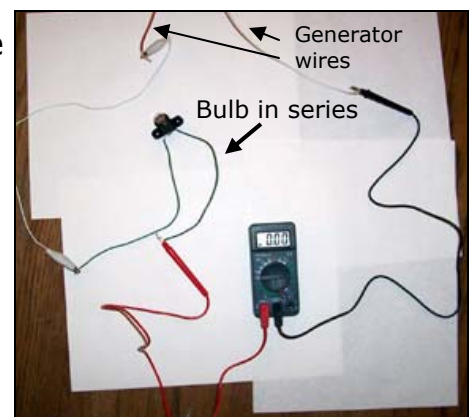
1. Attach the wires from the motor to the multimeter. Alligator clips will make this much easier.
2. To check the voltage select DC Volts.
3. These turbines will produce a voltage typically less than 1 volt. So choose a setting that will allow you to read the decimals.

4. Place your turbine out in the wind or in front of a fan and record the voltage.
5. A set of very well designed blades will make around 1 volt. Typical blades will be in the .1-.5 volt range.
6. When you are measuring voltage you are measuring how fast the DC generator is spinning. The faster it spins the higher the voltage. As there is no load on the generator it has very little resistance so it can spin very fast.



Amperage

1. To get a more accurate picture of the power of your turbine you should measure amperage as well. To accurately measure the amperage you need to hook up your multimeter differently.
2. You need to place a load (or a resistive object - small bulb, etc.) in series with the meter so that the generator is "loaded" and has to do work. In the image below we have placed a small incandescent bulb in series with the wires from the generator.
3. A set of very well designed blades will make around .15 amps (150 milliamps) with this motor volt. Typical blades will be in the .03-.07 amp (30 -70 milliamp) range.
4. When you are measuring amperage you are measuring how much torque your blades are generating. This becomes important when you add gearing or large generators to your turbine.



To accurately record amperage you need to put a load in series. In this picture you can see the small bulb between the connection with the meter and the turbine