# ASSEMBLING YOUR ANEMOMETER

***How fast is the wind? Your anemometer will let you know from zephyr to gale!***

## Have Fun!

When finished you will have a sensitive, rugged, great looking wind instrument **that you have built yourself!** Take your time, work carefully, and enjoy the project.

## Check (✔) the Parts List

Before you start construction, match the parts that came in your kit with the parts list below. If any parts are missing, call us at 1-800-683-5487. We will mail a replacement part immediately, along with our profuse apologies.

- ❑ (3) aluminum wind cups, 2-½" diameter (matched set)
- ❑ (1) magnetic switch, 1-½" x 5/16"-24 with hex nuts
- ❑ (2) disk magnets, ½"
- ❑ (1) ½" diameter x 1" long nylon spacer
- ❑ (1) PVC cap, 2" schedule 40 (precision drilled, tapped)
- ❑ (1) PVC cap, 1-½" schedule 40 (precision drilled)
- ❑ (12) #8 nylon washers
- ❑ (1) ball bearing, ¼" ID, ¾" OD, shielded

The following components are stainless steel:

- ❑ (1) ¼-20 machine screw, 1-¾" long
- ❑ (1) ¼-20 acorn nut
- ❑ (1) #12 flat washer
- ❑ (3) #8-32 machine screws, 4" long
- ❑ (15) #8-32 hex nuts
- ❑ (6) #8 internal tooth lock washers

Also available (not included in the anemometer kit):

- ❑ CAB-ANWV100, 100' cable with modular plug and heatshrink. Or CAB-AN25, 25' cable with modular plug and heatshrink.
- ❑ WEA-WTKIT-A, "T" mount kit for anemometer and wind vane.

Also required (not included in the kit):

- ❑ metal to plastic two-part epoxy (Devcon Plastic Welder or similar)
- ❑ thread locking adhesive (Loctite or similar)
- ❑ alcohol for cleaning the bearing

## Mechanical Assembly

As you build the anemometer you may wish to refer to the mechanical drawing on page 4.

**Epoxy components in place:**

We recommend Devcon Plastic Welder, a two-part epoxy with solvents that make it bond tightly to plastic. Do not use PVC pipe cement, as this does not bond to steel. The epoxy hardens very quickly, so be prepared to use it.

- ❑ Using a tissue moistened with alcohol, clean any grease from the **outside** of the bearing. Lay the bearing on a sheet of **wax paper**.
- ❑ Mix a small amount of plastic welder epoxy. Use a toothpick to spread a small amount of epoxy around the **inside** of the ¾" hole **in the 1-½" cap**.
- ❑ Grasp the 1-½" cap, and press it onto the ball bearing. Press until the bearing is flush with the top of the cap.
- ❑ Inspect the 1-½" cap and verify that the bearing is flush with the top of the cap. Set the cap aside for a few minutes so the epoxy hardens.
- ❑ Mix up a fresh bit of epoxy and install the two ½" diameter disk magnets in the predrilled recesses on the inside of the 2" cap. Install one magnet with the white face up, the other with the dark face up.

**Build the rotating assembly:**

- ❑ The wind cups secure to the 2" cap using 4" long #8-32 machine screws. Slip a #8 nylon washer on a 4" screw, then push the screw through one of the holes into a wind cup. Slip on another #8 nylon washer, then thread **two** #8 hex nuts about 1-½" on the screw. Slip on another #8 nylon washer, then push the screw through the other hole and out of the wind cup. Slip another #8 nylon washer on the screw and thread another #8 hex nut on the screw.
- ❑ Put a tiny amount of thread locking adhesive on the screw threads, then tighten the nut next to the head of the screw. Excess thread locking adhesive should not be used, as some chemicals can make the nylon washer brittle. Apply a tiny amount of thread locking adhesive on the screw and tighten the two remaining nuts to clamp the wind cup in place.
- ❑ Repeat these two steps for the other two wind cups.

If the wind cups are oriented on the 2" cap so that the cap rotates clockwise (when viewed from above) the tendency will be for the cap to screw down more tightly onto its mounting bolt (rather than unscrewing). We recommend this orientation.

- ❑ To attach a wind cup to the 2" cap, thread a #8 hex nut about ½" on a 4" screw, then slide on a #8 internal tooth lock washer. Thread the screw into one of the holes in the side of the 2" cap. On the inside of the cap, slip a #8 internal tooth lock washer onto the screw, then thread on a #8 hex nut. **Adjust the screw so the <u>end</u> of the screw is <u>flush</u> with the side of the nut.** If the screw extends beyond the nut it may rub on the stationary cap.
- ❑ Remove the inside nut. Apply a tiny amount of thread locking adhesive to the screw for both the inside nut and the outside nut. Again install the inside nut and make sure the end of the screw is flush with the side of the nut. Tighten both the inside and the outside nuts onto the cap so that the wind cup is secure and adjust so that the wind cup is vertical. Also make sure that a flat side of the nut is facing down, not a point. Clearances between the rotating and stationary cap are tight, and if a point on the nut is facing down it may rub on the stationary cap or magnetic switch.
- ❑ Repeat these two steps for the other two wind cups.

**Install and adjust the rotating assembly:**

- ❑ Set the rotating assembly on a table and use a square to adjust all three wind cups as necessary so they are exactly vertical.
- ❑ Remove one plastic nut from the magnetic switch. Adjust the remaining nut to about 0.95" from the end of the magnetic switch. Install the switch through the hole in the 1-½" cap with a **flat side** of the nut adjacent to the side of the cap. Adjust the nut position as necessary so that the switch extends 0.60" beyond the top of the cap. Secure the magnetic switch in place with the remaining plastic nut, tightening **gently**.

  **Caution:** Tightening with too much force bends the plastic switch case and may crack the glass ampule enclosing the magnetic switch contacts. If you are concerned about the switch coming loose, **after completing the next three steps** mix up a bit of plastic welder epoxy and put a dab between the nuts and the threads on the magnetic switch.
- ❑ Slide the 1-¾" bolt through the ball bearing, #12 flat washer and through the nylon spacer. The flat washer is important, as it prevents the bottom of the nylon spacer from deforming and rubbing on the shields on the bearing.
- ❑ Thread the 1-¾" bolt into the rotating cap. Tighten, but do not over tighten as it is possible to strip the threads in the rotating cap. Secure with the ¼-20 acorn nut.
- ❑ Verify that the 2" cap turns freely, without rubbing on the 1-½" cap. Also verify that the magnetic switch does not rub against the magnets or hit the 4" screws or nuts.
- ❑ With an ohm meter across the magnetic switch, turn the rotating assembly and verify the switch toggles twice in each rotation.
- ❑ For best reliability you may wish to remove the acorn nut and rotating cap and apply a dab of epoxy to the inside and outside nuts on the magnetic switch to keep it from coming loose. Reassemble, and when you install the acorn nut use a dab of threadlock to secure it.

**Make electrical connections:**

The type of wire you use to connect your anemometer to the weather station is not critical, and you may use just about any type of wire. Fascinating Electronics has two types of anemometer cables available, a four conductor cable for the anemometer alone (CAB-ANxxx, where xxx is the length in feet) and a six conductor cable for use with both the anemometer and the wind vane (CAB-ANWVxxx). Each of these cables has a modular plug for directly plugging into the weather station electronics and heat shrink for covering the connections to the magnetic switch. Be sure to follow the instructions for the type of cable that you are using.

**Six Conductor Anemometer and Wind Vane Cable:**

The following instructions are written for the optional six conductor anemometer and wind vane cable for use on a "T" mount. Build the "T" mount and route the wire through it before attaching the anemometer to the cable. Note that the "T" mount kit includes one 5" pipe for the anemometer to mount on. The wind vane kit includes a 5" pipe with holes drilled for attaching the potentiometer mounting bracket. So be sure to install the anemometer on the pipe that does not have the two drilled holes.

- ❑ The white and black wires in the cable connect to the magnetic switch (in either order). The red, green, yellow and blue wires are used by the wind vane. The silver jacket on the cable has been cut to expose these wires about 2 feet from the end. Clip the white and black wires, on the end furthest from the modular connector. Leave the other four wires intact to continue on to the potentiometer in the wind vane.
- ❑ Using plenty of fresh solder, melt back the insulation and tin about ⅛" of the white and black wires.
- ❑ Tin the exposed ends of the magnetic switch leads, and trim the tinned sections to about ¼".
- ❑ Slide a 1" piece of 3/16" diameter heat shrink (clear, hot melt adhesive lined) over the pair of magnetic switch leads and slide it up a few inches. Slide ½" long pieces of 3/32" diameter (white) heat shrink tubing over each magnetic switch lead, and slide them up also.
- ❑ Solder the white and black wires to the magnetic switch leads. When the solder has cooled, slide the 3/32" diameter heat shrink over the connections and shrink in place with a hot air gun.
- ❑ Now slide the hot melt adhesive lined heat shrink over the connections and shrink with a hot air gun. If an end does not seal completely, while the glue is still molten use pliers to **gently** squeeze it shut.
- ❑ Grasping the stationary cap, press it onto the vertical pipe of the "T" mount. **Do not glue the stationary cap to the pipe!**

**Four Conductor Anemometer (Only) Cable:**

The following instructions are written for the optional four conductor anemometer cable (WEA-ANxxx). If you are building both the anemometer and wind vane use the six conductor cable (WEA-ANWVxxx).

- ❑ The black and red wires in the cable connect to the magnetic switch (in either order). The green and yellow wires are not used. The silver jacket on the cable has been cut to expose these wires. Clip off the unused green and yellow wires.
- ❑ Using plenty of fresh solder, melt back the insulation and tin about ⅛" of the black and red wires.
- ❑ Tin the exposed ends of the magnetic switch leads, and trim the tinned sections to about ¼".
- ❑ Slide a 1" piece of 3/16" diameter heat shrink (clear, hot melt adhesive lined) over the pair of magnetic switch leads and slide it up a few inches. Slide ½" long pieces of 3/32" diameter (white) heat shrink tubing over each magnetic switch lead, and slide them up also.
- ❑ Solder the black and red wires to the magnetic switch leads. When the solder has cooled, slide the 3/32" diameter heat shrink over the connections and shrink in place with a hot air gun.
- ❑ Now slide the hot melt adhesive lined heat shrink over the connections and shrink with a hot air gun. If an end does not seal completely, while the glue is still molten use pliers to **gently** squeeze it shut.

# Test

- ❑ Connect a continuity tester (ohm meter) across the wires from the anemometer. Slowly rotate the rotating assembly. In one rotation you should see the switch close and open twice. If all seems well, rapidly spin the rotating assembly and make sure it spins freely.

The anemometer is complete!

# Electrical Interface

If you are creating your own electronics, you will probably interface the magnetic switch to a digital input. The way this is usually done is by connecting one side of the magnetic switch to digital ground, and the other side to the digital input and through a 10K resistor (in parallel with a 0.1 µF capacitor) to +5 volts. The 10K resistor pulls the digital input to logic high when the switch is open, and the capacitor helps reduce the "contact bounce" of the magnetic switch as it opens and closes.

# Installation

Before installing the anemometer outdoors, be sure to connect it to your measurement electronics and test it. The wind "T" is designed to mount on a vertical 1-½" schedule 40 PVC pipe. The pipe should be mounted solidly. Since PVC pipe is somewhat flexible, you should not make the PVC pipe too long. About four feet is a reasonable upper limit. For greater heights mount the wind "T" on a wood post or galvanized steel pipe. The wind instruments must obviously be located away from obstructions that would block the wind.

If you live in an area where lightning is common, site your wind instruments conservatively. Don't make them the best target around. And for best protection, unplug your wind instruments before lightning comes near.

# Creating Your Own Software

Many of our customers build their own measurement electronics and write their own software. Here are some hints to help you.

The magnetic switch toggles at a rate that is linearly proportional to wind velocity. You can either count the number of pulses over time, or measure the period between pulses. For greatest accuracy, you should measure the period between every-other pulse, as this provides one complete rotation of the wind cups.

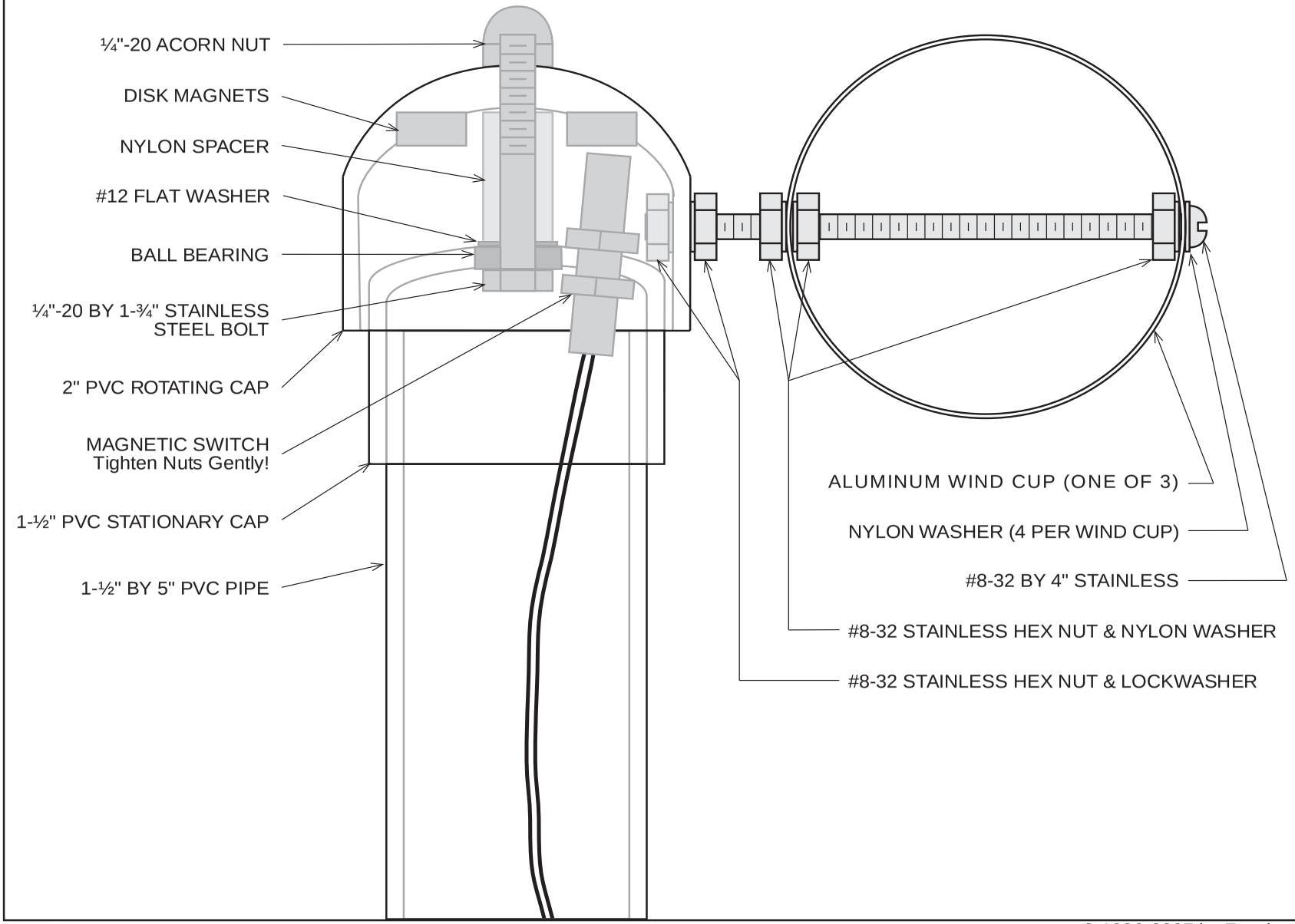
Wind tunnel data has given us new, more precise calibration factors. If you count the number of pulses in 1.758 seconds, then add an offset of 2.121, that will give you the wind speed in MPH. Or if you count the number of pulses in 1 second, then multiply that number of pulses by 1.758 and add 2.121, that will also give you the wind speed in MPH.

If you divide 1.758 by the period between pulses, then add 2.121, that will give the wind speed in MPH. Or, if you measure between every-other pulse (for the complete rotation time), divide 3.516 by the complete rotation time and add 2.121 for the wind speed in MPH. ■

Table 1: Wind Instrument Connections

| Wire Color | Signal | Modular Pin |
|---|---|---|
| White | Anemometer Switch | 1 |
| Black | Anemometer Switch | 2 |
| Red | Potentiometer +5 Volts | 3 |
| Green | Wiper 1 | 4 |
| Yellow | Wiper 2 | 5 |
| Blue | Potentiometer Ground | 6 |

# ANEMOMETER




Rev. K