

Preliminary Experiment - Measuring Wind Speed



EXPERIMENT OVERVIEW

This experiment demonstrates the proper techniques for measuring wind speed using a La Crosse model EA-3010U handheld anemometer.

Students will become familiar with operating the anemometer alongside a conventional floor fan in order to learn how to correctly measure wind speed for subsequent WindPitch wind turbine experiments.

EXPERIMENT OBJECTIVES

- Students will use the Scientific Process to perform the experiment.
- Students will understand how to setup and calibrate the anemometer
- Students will understand how to correctly place the anemometer in front of a floor fan in order to measure the wind speed in meters-per-second.

SAFETY

Caution must be exercised when using the wind turbine and table fan. Spinning blades can pose a hazard and can cause injury if not careful. DO NOT PLACE YOUR FINGERS, HANDS, ARMS, FACE OR ANY OTHER PART OF YOUR BODY IN THE SPINNING WIND TURBINE OR FAN BLADES!

Wear safety glasses for all experiments



La Crosse model EA-3010U - Features

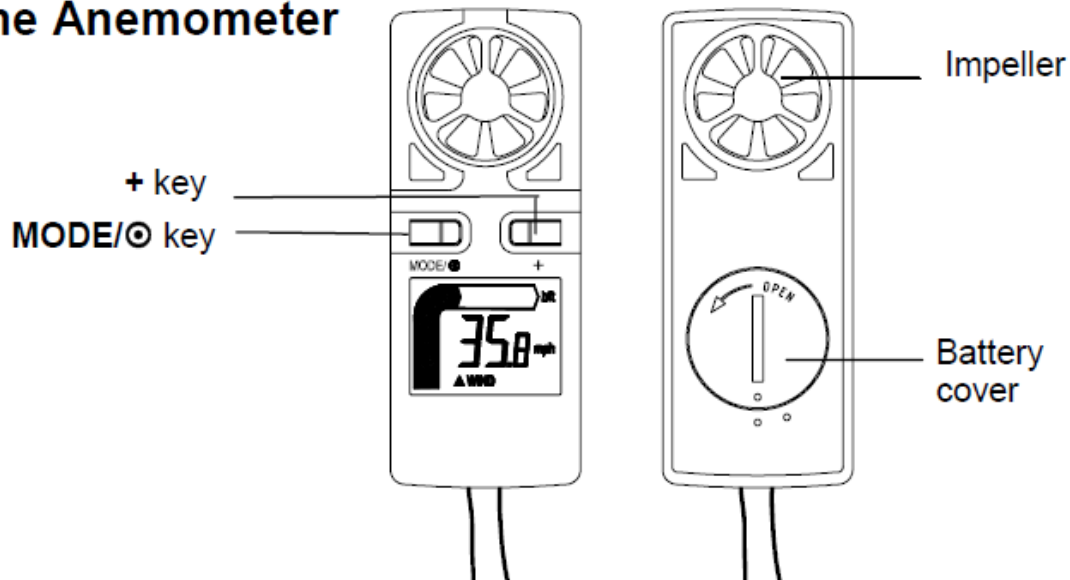
- Wind Speed (mph, km/h, m/s, knots)
- Displays MAX & Average
- Wind Speed Since Power On
- Beaufort Scale Bar Graph (0-12)
- Wind Chill (°F or °C)
- Temperature (°F or °C)
- Backlight with Auto Off
- Battery Saving Auto Off
- Neck Band Included for Easy Carrying

La Crosse model EA-3010U - Specifications

- Maximum measured speed: 67 mph
- Minimum measured speed: 0.44 mph
- Resolution-wind speed: 0.1 for all units
- Temperature measuring range: -21.8 to 138.2 °F (-29.9 to 59 °C)
- Resolution-temperature: 0.2°F (0.1°C)
- Power requirements: 1 CR2032 button cell

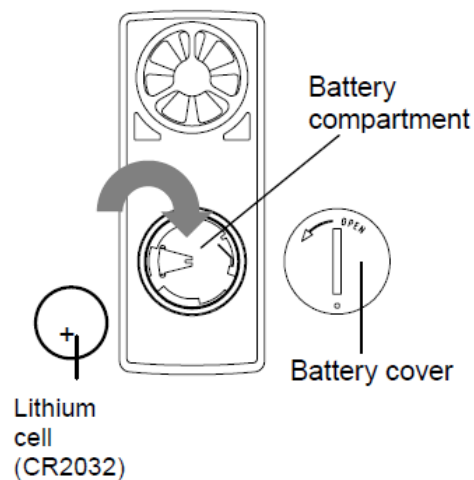
PARTS OF THE INSTRUMENT

The Anemometer



SETTING UP THE INSTRUMENT

1. First use a large coin to open the battery cover at the back of the anemometer as indicated above.
2. Checking the correct polarization, insert 1 x 3V (CR2032) lithium cell, positive (+) pole up into the battery compartment and replace the cover.
3. When the battery is inserted, all the segments of the LCD and backlight will light up briefly.



Your anemometer is now operational.

Note:

After inserting the battery, test the anemometer by blowing directly at the Impeller for about 30 seconds. The reading on the LCD should change. If this does not happen remove the battery, wait for 30 seconds, and re-insert the battery.

POWER AND MANUAL SETTINGS

Power ON/OFF:

Press and hold down the “**MODE/⊙**” key for 4 seconds to switch the unit ON or OFF.

Note:

The anemometer is automatically switched OFF when no key is pressed in 34 minutes.

Manual setting

Note:

Before entering the manual setting mode switch off the anemometer. Press and hold down the “**MODE/⊙**” key for about 6 seconds, the speed unit will start flashing on the right side of the LCD when the manual setting mode is entered.

FUNCTION KEYS

The anemometer uses the following keys:

MODE/⊙ key: To toggle between wind speed and temperature/wind chill display
: Power ON/OFF
: To enter the setting mode
: To turn the backlight On

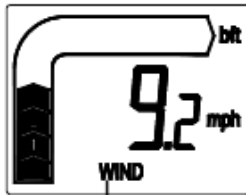
+ Key : To change operation mode
: To change parameters in setting mode
: To turn the backlight On

MEASUREMENT SCALE SETTING

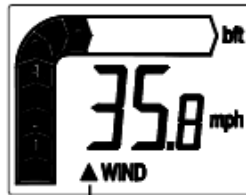
1. After entering the manual setting mode, press “**+**” key to set the measurement scale in Km/h (Kilometers per hour), mph (miles per hour), m/s (meters per seconds) or Kts (Knots).
2. Now press the “**MODE/⊙**” key to confirm and enter the “**°C and °F setting**”.

WIND SPEED MODE

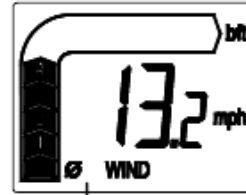
The wind speed mode can be selected to 3 different display modes at any time.



Current wind speed



Maximum wind speed
Since power on



Average wind speed
Since power on

To toggle between current wind speed, maximum wind speed and average wind speed, simply press the “+” key:

Beaufort wind scale (bft)

The Beaufort scale is displayed in bar graph (0-12). This is a system for estimating wind force without the use of instruments based on the visible effects of the wind on the physical environment.

Force	Description	Kts	m/s	Km/h	mph
0	Calm	0	0	0	0
1	Light Air	1	0.5	1.8	1.1
2	Light Breeze	4	2.1	7.4	4.6
3	Gentle Breeze	7	3.6	13.0	8.1
4	Moderate Breeze	11	5.7	20.4	12.7
5	Fresh Breeze	17	8.8	31.5	19.6
6	Strong Breeze	22	11.3	40.8	25.4
7	Near Gale	28	14.4	51.8	32.3
8	Gale	34	17.5	63.0	39.2
9	Strong Gale	41	21.1	75.9	47.2
10	Storm	48	24.7	88.9	55.3
11	Violent Storm	56	28.8	103.7	64.5
12	Hurricane	64	32.9	118.5	73.7

WIND SPEED AVERAGING TIMES

The current wind speed can be measured in average wind speed in a time interval of 2-10 seconds

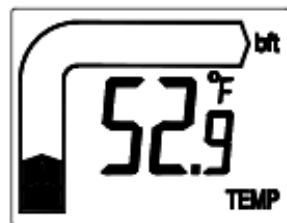
1. Following from the °C and °F Setting, press “+” key to set the desired average time. The range runs from 2 to 10 seconds.
2. Once the desired average time has been chosen, press the “MODE/⊙” key to confirm and back to the normal mode.

CENTEGRADE / FARENHEIT SETTINGS

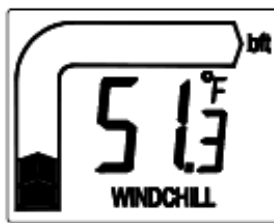
1. Following from the measurement scale Setting °C will be flashing, use the “+” key to toggle °C and °F.
2. Once the desired temperature unit has been chosen, press the “**MODE/⊙**” key to confirm and enter the “**Average time for current speed measurement setting**”.

TEMPERATURE MODE

The temperature/ wind chill modes can be selected to 2 different display modes at any time.



Temperature



Wind chill

By pressing the “+” key the display will toggle between temperature and wind chill.

Note:

When the temperature is outside the range from -29°C to $+59^{\circ}\text{C}$, there will be no wind chill measurement.

Wind chill

The anemometer calculates automatically wind chill, which can provide useful information for preparing outdoor activities in cold weather. “Wind chill” provides an indication of how cold it feels given the combined effects of the actual air temperature and the wind speed.

LCD BACKLIGHT

The LCD backlight is automatically switched ON when any one of the 2 function keys are pressed and held down for 2 seconds. The backlight will be switched on for approximately 8 seconds before automatically switching OFF.

EQUIPMENT

- La Crosse model EA-3010U handheld anemometer
- Large 16" to 20" floor fan with 3 way speed control

EXPERIMENT SETUP

Setup the floor fan in an area where it will ultimately be used to provide wind for the WindPitch wind turbine.

DOING THE EXPERIMENT

1. Turn the instrument ON by pushing and holding the **MODE** button for 4 seconds. Release the **MODE** button after turn ON.
2. Set the instrument into Manual Mode by holding the **MODE** button for 6 seconds. You will see a flashing group of letter on the right.
3. Push the Plus (+) key until the **m/s** is displayed then release the **MODE** button. The display will default to measuring wind speed in meters per second (m/s) in about 6 seconds.
4. Blow on the impeller mechanism for a few seconds and verify that the display indicates wind speed measured in meters per second. The last wind speed reading will remain on the screen until the next reading is taken.

The bar graph on the left side of the LCD that moves up and to the right is the Beaufort Wind Scale reading (bft). It shows in relative terms the general nature of the wind speed based on generalized weather conditions.

The actual wind speed number and the Beaufort numbers are different. For example, a wind speed of 5.8 m/s will generate a bft of 4. Refer to the Table above for wind speed and bft ranges.

5. Turn the floor fan ON to the highest speed setting.

6. Place the anemometer's impeller at various points in front of the moving air from the fan – left, right and middle – and note the readings you obtain.
7. Place the anemometer's impeller closer to and away from the moving air and note the reading you obtain.
8. Find the spot where you obtain the highest wind speed and note that position as the spot to place the WindPitch wind turbine in subsequent experiments.

The wind pattern out of a standard floor or table fan is not laminar meaning that it is not smooth. In fact, the fan blades act like a boat propeller and create a circular wake of air that is delivered from the front of the fan to the wind turbine. It looks something like the patterns in the illustration below. This is why you need to find the correct spot to place the WindPitch wind turbine in order to "catch" the best "wind wave".

