

WIND POWER – C Division

1. **DESCRIPTION:** Teams will build a blade assembly that consists of any kind of propeller/pinwheel/rotor attached to a compact disc (CD), which will be used to capture wind power. Students will also be tested on their knowledge regarding alternative energy.

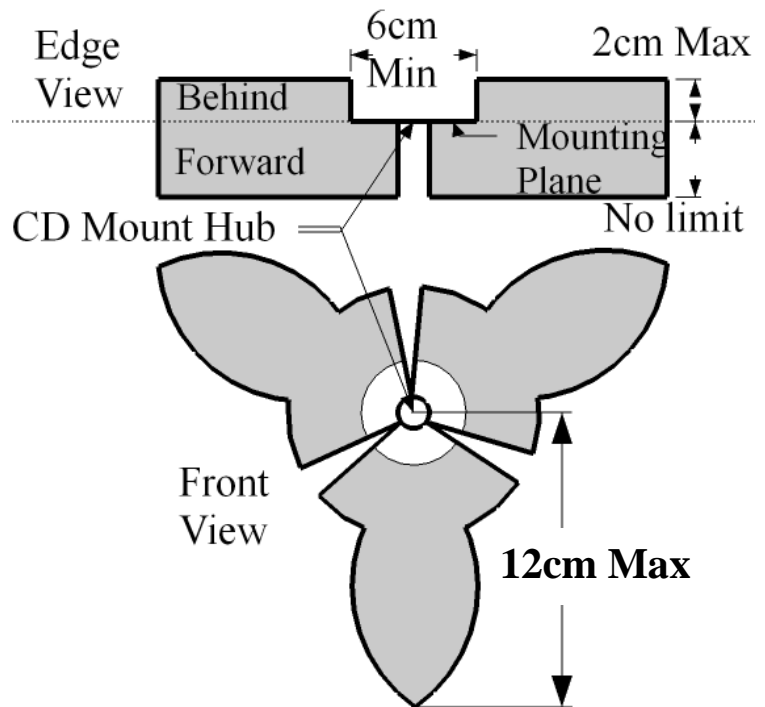
A TEAM OF UP TO: 2 EYE PROTECTION: #2 IMPOUND: Yes APPROX. TIME: 50 minutes

2. **EVENT PARAMETERS:**

- a. All reference materials to be used during Part II of the competition must be secured in a 3-ring binder, must be 3-hole punched and inserted in the binder so that regardless of orientation none can fall out. Materials such as pencils, pens, protractors, rulers, nonprogrammable calculators, and any other similar tools may also be used during the set up and activity.
- b. Blade assemblies must be placed in a box (assemblies and box must be labeled with the team #) and must be impounded.
- c. Team members must bring and wear Safety Spectacles with Side Shields during Part I of the event, but they need not be impounded.
- d. The supervisor will provide a 20" multispeed box fan to be used as the wind source for testing the blade assemblies and all testing materials, which will be the same for all teams, including:
 - i. the fan(s)
 - ii. support stand(s) (which allows for vertical and horizontal adjustments of the blade assembly)
 - iii. clamp(s) (to allow teams to orient the mount to any angle with reference to the fan)
 - iv. motor/generator(s) (a portable CD player motor will be used at Nationals)
 - v. load resistor(s) (in parallel with the motor/generators, the value of the load resistance must be between 5 and 7.5 ohms. The load resistance value must be the same for all contestants.)
 - vi. computer probe(s) (to record voltage measurements across the load resistor.)
- e. Teams may not know any details of the materials listed above until after impound is complete.
- f. The motor/generator must be equipped with a spring-loaded type CD clip mount such as those found on portable battery powered CD players. The motor/generator must be removed from the CD player and mounted on a support rod.
- g. Consult www.soinc.org for a sample setup.

3. **CONSTRUCTION:**

- a. Each team may bring one pre-constructed blade assembly attached to a CD.
- b. The CD must fit on the mount found in a standard CD player. Modification of the CD (except for the center hole) is allowed. When mounted, no part of the blade assembly may have a radial distance from the center of the axis of rotation of more than **12 cm**. The blade assembly may be made of any nonmetallic substance. Commercial blades (modified or unmodified) are not permitted.
- c. When mounted no part of the blade assembly may extend behind the mounting plane of the CD for a radial distance of 3 cm. Beyond a radial distance of 3 cm the blade assembly must not extend more than 2 cm behind the mounting plane of the CD. This is to ensure clearance with the motor/generator, clamp and support stand. There is no limit on how far forward the blade assembly may extend.



4. **THE COMPETITION:**

Part I:

- a. There may be one or two test stations. If there are two, one will be used to test at higher wind speed and one will be used to test at lower wind speed.
- b. The fan(s) must be mounted in a fixed position with the bottom of the grill at least 15 cm above the table.
- c. The blade assembly may be oriented and placed in any position or angle in front of the fan. Teams must mount their blade assemblies to the motor/generator and position/orient them.
- d. At the request of the students, the event supervisors may turn on or off the fan during the set-up to assist the students in positioning and/or orientating their blade assembly.
- e. The teams may modify the blade assembly during the set-up, but not during the testing.
- f. When the students are ready, they must tell the event supervisor who will then start the fan and/or begin the data collection and storage of the voltage across the load resistance during a one-minute time period. A computer should be used to record and store voltage data. If a computer recording is not available, then the maximum voltage occurring during the one minute period is recorded.
- g. Teams must complete set-up and testing in no more than 4 minutes at each testing station. If only one station is used, set-up and testing for both runs must be completed in no more than 8 minutes.
- h. When both a high speed and a low speed test station are used, the load resistances may not be exactly the same value, however, all contestants must use both stations.
- i. The team may give their blade assembly a single tap to start it spinning once the testing phase has begun.

Part II:

- j. Teams will be given a set amount of time (20-30 minutes is suggested) to complete a written test.
- k. The following topics may be included:
 - i. Basic information and definitions about energy, work, power, heat and heat transfer including: the concepts of heat, temperature, temperature scales, thermal energy, conduction, convection, radiation and insulation.
 - ii. General information about renewable energy including: solar, wind, hydroelectric, tidal, ocean thermal energy conversion, and geothermal.
 - iii. General information about energy conservation practices including: recycling, reusing, and using materials with greater efficiency.
 - iv. Mathematical relationships and equations used in determining heat loss and heat gain, specific heat, power, efficiency, intensity (power per area), and heat transfer calculations.

5. **SCORING:**

- a. The power output of the blade assembly is calculated using the equation below (If the Mean Voltage is not available, then use the Maximum Voltage): $\text{Power} = (\text{Mean Voltage})^2 / \text{load resistance}$
- b. The raw score for Part I is the sum of the low speed Power + high speed Power.
- c. If the device fails during a run or stops turning for a period of 15 seconds, the score at that speed will be zero.
- d. The Part II written test will be worth a total of 50 points.
- e. A team's final score will be determined as follows (with highest score winning):
$$\text{Final score} = 50 \times (\text{Part I raw score} / \text{Highest Part I raw score of all teams}) + \text{Part II score}$$
- f. Teams will be ranked in tiers based upon:
 - i. Teams whose devices meet all specifications will be ranked, by score, in Tier 1.
 - ii. Teams whose devices do not meet specifications listed in section 3 will be ranked in Tier 2.
 - iii. Teams who missed impound will be ranked in Tier 3
- g. Ties will be broken 1st by the highest high speed mean voltage and 2nd by the highest low speed mean voltage.

Recommended Resources: All reference and training resources including the Wind Power DVD are available on the Official Science Olympiad Store or Website at <http://www.soinc.org>