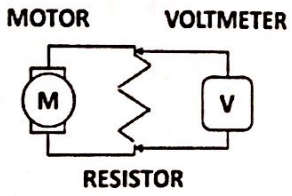
WIND POWER

See General Rules, Eye Protection & other Policies on www.soinc.org as they apply to every event.

1. **DESCRIPTION:** Teams may 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. Teams must also be tested on their knowledge regarding alternative energy.

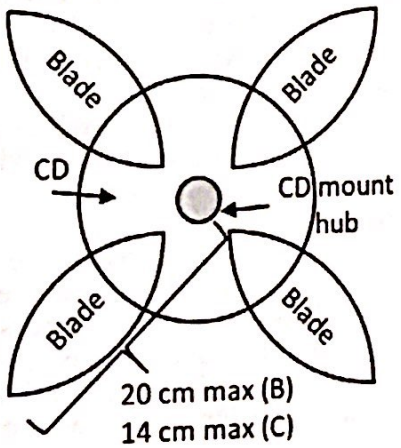
A TEAM OF UP TO: 2 **EYE PROTECTION:** B **IMPOUND:** Yes **APPROX. TIME:** 50 minutes

2. **EVENT PARAMETERS:**
   a. All reference materials to be used during **all parts** of the competition must be **initially** secured in a 3-ring binder so that regardless of orientation none can fall out. Materials such as pencils, pens, protractors, rulers, **any type of** calculators, and any other similar tools may also be used during the **event.**
   b. The blade assembly must be placed in a box (assembly and box must be labeled with the team name and competition #) and must be impounded. Tools and supplies do not need to be impounded.
   c. Competitors must wear eye protection during Part I. Teams without proper eye protection must be immediately informed and given an opportunity to obtain eye protection if time allows.
   d. The supervisor must provide the testing materials listed below (Example setups are provided on the event page on www.soinc.org), which must be the same for all teams:
      i. One or two 20" multispeed box fan(s) to be used as the wind source **(recommended fans listed on www.soinc.org)**
      ii. Support stand(s) that allow for vertical and horizontal adjustments of the blade assembly
      iii. Motor/generator(s) mounted to the support stand(s), **with axis of rotation approximately parallel to that of the fan**
      iv. Load resistor(s) between 5 and **25** ohms **(1/4 Watt or greater)** wired in parallel with the motor/generator that must have the same value for all teams
      v. Device(s) to measure voltage across the load resistor
   e. The motor/generator must be equipped with an adapter to accommodate a standard 12.0 cm CD or if the motor/generator is from a CD player, it must be removed from the CD player and mounted on the support stand.

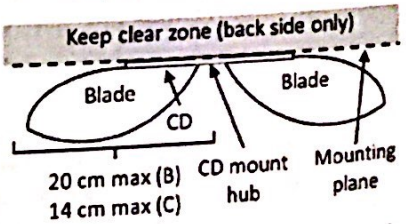


3. **CONSTRUCTION:**
   a. Each team may bring one pre-constructed blade assembly attached to a 12.0 cm **diameter** CD **(teams must not bring the testing materials listed in 2.d.)**. Note: adjacent diagrams do not show CD to scale.
   b. The CD must fit on the mount found in a standard CD player. Modification of the CD is not allowed (except to affix the blades **via tape, glue, etc.**).
   c. When mounted, no part of the blade assembly may have a radial distance from the center of the axis of rotation of more than 20 cm (Div B) / 14 cm (Div C).
   d. The blade assembly must be made of only nonmetallic substance(s).
   e. Commercial kits or third party designs may be used, but must have at least one functional modification, defined as a modification such that the lack of it will result in the assembly working differently or not working.
   f. When **initially** mounted, no part of the blade assembly may extend behind the mounting plane of the CD. This is to ensure clearance with the motor/generator and support stand. There is no limit on how far forward the blade assembly may extend.
   g. Competitors must be able to answer questions regarding the design, construction, and operation of the blade assembly per the Building Policy found on www.soinc.org.

Example Assembly Front View



Example Assembly Side / Top View



4. **THE COMPETITION:**

Part I: Device Testing

   a. The blade assembly must be tested once with the fan at a high wind speed and once at a low wind speed. There may be one or two test stations. If there are two, one must be used for all high wind speed tests and the other for all low wind speed tests. The load resistors at each station are allowed to be different, but must be consistent for all teams.
   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. Event supervisors must **check** the blade assembly **specifications during impound or right** before a team's **blade** testing period begins. Teams must be notified as soon as possible if a blade assembly does not meet specifications. **Event supervisors may prohibit blade assemblies from being tested if they will damage the testing setup (e.g. due to excessive weight/torque, residue on the CD mount, etc.)**
d. Teams may modify the blade assembly during the impound period **or** their Part I testing periods, if time is available. **This may be to bring the blade assembly into compliance with the event specifications. Blades not meeting construction specifications at the beginning of the 30 second measurement period must receive a Max Voltage score of 0 for that wind speed.** Modifications are not allowed during the 30 second measurement periods.
e. Teams must complete set-up and device testing in no more than 3 minutes per wind speed. At 2 minutes, the event supervisor must give the team a warning. **Teams that do not complete testing in this time must receive a Max Voltage score of 0 for that wind speed.**
f. Once the 3 minute testing period begins, teams must attach their blade assembly to the motor/generator mount and position it. At the request of the students, the event supervisor must turn on or off the fan during the set-up to allow the students to better position the blade assembly relative to the fan. No voltage measurements are allowed **to be made by or seen by the competitors** during **the testing period**. Teams are allowed to adjust, modify, start and stop the blade assembly rotation **and reposition the support stand** during the testing period.
g. No later than 2 minutes **15 seconds** into the testing period, with the fan already on and the blade assembly **already** rotating **for at least 10 seconds**, the students must tell the event supervisor to begin a 30 second measurement period. The team must not touch **or reposition** the blade assembly **or support stand** during the measurement period.
h. The event supervisor must record the maximum voltage that occurs during the 30 second measurement period **and inform the team of the result.** Voltage measurement devices that have 'peak hold' or 'max hold' functions are recommended.
i. **Teams filing an appeal regarding Part I must leave their blade assembly in the competition area.**
j. **The supervisor must verify with the team the correct recording of Part I data on the team scoresheet.**

Part II: Written Test

k. Teams must be given a **minimum of** 20 minutes to complete a written test.
l. Questions may be multiple choice, true-false, completion, or calculation problems.
m. Unless otherwise requested, answers must be provided in metric units with appropriate significant figures.
n. The test must consist of at least 5 questions **from** each **of** the following areas:
   i. Wind power rotor/fan blade design (e.g., types of designs, pros/cons of designs, ways to improve designs, sources of loss)
   ii. Power generator general questions (e.g., generator design for wind, nuclear, coal, gas, solar, or hydroelectric power plants)
   iii. Power storage questions (e.g., how is the power stored during charging and how is it used during discharge, concepts relating to methods of power storage)
   iv. Power transmission questions (e.g., ways electricity is transmitted, how power is lost in transmission, ways to reduce power loss)
   v. Historical wind power designs (e.g., types of windmills, usage, design pros/cons)

5. **SCORING: A scoring rubric is available on the event page on www.soinc.org**
   a. If the blade assembly stops turning for a period of 10 or more seconds during the measurement period, has any pieces that detach from the assembly, or the team **violates any of THE COMPETITION rules**, the **Max Voltage** at that wind speed must be multiplied by **0.9** when calculating the **Final** Score.
   b. **Both Max Voltages must be multiplied by 0.7 when calculating the Final Score if any construction violation(s) are corrected during either Part I testing periods or if the team misses impound.**
   c. A team's Final Score must be determined as follows (with highest score winning) =
      25 x (Part I low speed Max Voltage / Highest Part I low speed Max Voltage of all teams) +
      25 x (Part I high speed Max Voltage / Highest Part I high speed Max Voltage of all teams) +
      50 x (Part II score / Highest Part II score of all teams)
   d. The **Max Voltages** must be zero if a team is disqualified for unsafe operation, modifying a CD, or fails to bring a blade assembly. Teams must still be allowed to compete in Part II.
   e. Ties must be broken by: 1st the highest high-speed voltage; 2nd the highest low speed 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