GREAT ENGINEERING CHALLENGE 2009
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# Challenge 2:
# The UNSW Wind Turbine Challenge

**BACKGROUND**

Electricity has been generated using wind power since 1888. Now wind turbines are used worldwide, generating 260 million MWh per annum, which is equivalent to just over 1.5% of all world energy consumption[1]. Small wind turbines are frequently used in isolated locations to provide a cheap and easy to install source of electricity, while their larger counterparts connected to national electricity networks can produce up to 6MW of power each, and have blade diameters up to 126m[2].

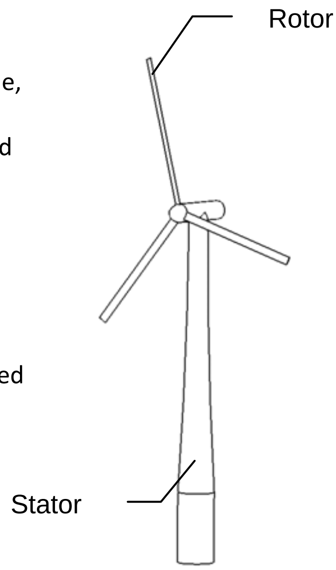


***Figure 1: Example of a wind turbine***

**TASK**

Your team is required to construct a prototype for a small horizontal axis wind turbine *rotor*, made from basic and widely available materials, in order to provide small scale electrical power for isolated communities. The performance of the rotor will be evaluated, both for safety and efficiency.

**MATERIALS**

Each team is provided with materials with which to construct the turbine rotor.

Included with these materials is a section of foam tube, to be used as the hub of the rotor. This hub attaches to the testing rig in the following manner:

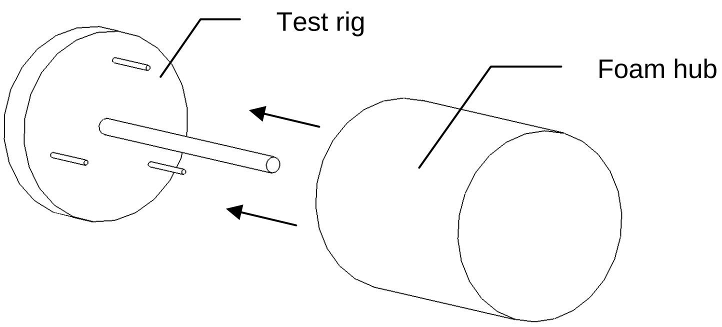


***Figure 1: Hub attaches to testing rig***

**RULES OF THE COMPETITION**

1. The rotor should not extend more than 10mm behind the hub, as this will collide with the support! However, there is no restriction on how far the rotor may extend in front of the hub.
2. The rotor may not be more than 2m in diameter, as it will collide with the floor!
3. The foam hub may be modified in any manner your team wishes, except if your modifications prevent it from being attached to the test rig. If you're unsure of any modification, ask one of the volunteers. Spare hubs are available...

**TESTING**

1. Teams will be asked to provide their rotors to the tester, who will attach the hub to a testing rig.
2. The rotor will be checked to make sure it spins without interference.
3. The fan will be switched on to full power.
4. Once the rotor has begun spinning at a relatively constant rate, the performance score will be read from the test rig.

**SCORING**

Your performance score is the value from 0 to 99 determined by the specially designed test rig.

Your safety score depends on whether your rotor fails during testing, and how it does:

- If your rotor remains intact throughout testing, your safety score will be 200
- If your rotor suffers any form of breakage or collapse, but continues spinning, your safety score will be 100
- If any part of your rotor falls off, your safety score will be 50
- If your rotor collapses such that it does not continue operating, your safety score is 0

Your final score is given by:

**[Final Score] = [Safety Score] + ( 8 x [Performance Score] )**

*e.g. If your rotor performs without failure, and gives a reading of 58, then your score is: 200 + (8 * 58) = 664*

**HINTS**

- A bigger rotor will collect more wind energy, but at the same time has more drag...
- Big and/or heavy rotors have lots of *rotational inertia*, which will make them slow to get moving...
- Rotors like to pull themselves apart when they rotate: consider strength as well as efficiency...

**REFERENCES**

[1] World Wind Energy Association (WWEA), *World Wind Energy Report 2008*, WWEA, 2009
[2] Enercron E-126, www.enercon.de