Turbine Performance Scoresheet
2024 Kansas KidWind Challenge

School Name: _____

Team Name: _____

Division: ☐ 4th-8th ☐ 9th-12th

First Testing Period

1st Run (J): _____ 2nd Run (J): _____ 3rd Run (J): _____ 4th Run (J): _____

5th Run (J): _____ 6th Run (J): _____ 7th Run (J): _____ 8th Run (J): _____

Is the 30-ohm resister turned on? ☐ Yes ☐ No

Wind Speed (m/s): _____ Horizontal Axis Rotor Radius (cm): _____

Vertical Axis Width (cm): _____ Vertical Axis Height (cm): _____

Second Testing Period

1st Run (J): _____ 2nd Run (J): _____ 3rd Run (J): _____ 4th Run (J): _____ 5th Run (J): _____

Is the 30-ohm resister turned on? ☐ Yes ☐ No

Wind Speed (m/s): _____ Horizontal Axis Rotor Radius (cm): _____

Vertical Axis Width (cm): _____ Vertical Axis Height (cm): _____

Additional Information

Scoring is based on 35 points for energy output and 5 points for efficiency (40 points total). See the Rules & Logistics document for more details about scoring. Only the best run is used (there is no penalty for a bad run). Runs are measured in units of joules over a 30-second period. ***Once the second testing period is completed, please circle the top run. Most turbines are horizontal axis. Fill in the axis measurements above for the correct type of turbine design. Examples of each type are shown below.***

Efficiency Calculation

Efficiency of Wind Turbine (%) = actual power generated ÷ available power × 100

Actual Power Generated = energy production (Joules) of the turbine's best run ÷ 30 seconds
Explanation: Joules = Watts × Seconds; therefore Power (Watts) = energy production (Joules) ÷ time of run (30 seconds)

Available power (P) = $0.59 \times \frac{1}{2} \times \rho \times A \times V^3$

Horizontal Axis   Vertical Axis

- P = power in the wind (watts)
- 0.59 = 59% = Betz limit (theoretical maximum efficiency of wind turbine)
- ρ = density of air (assumed to be 1.28 kg/m³) See Note 1
- A = swept area of turbine (square meters)
  - Horizontal axis turbine = $\pi \times Radius^2$ (where π = 3.14)
  - Vertical axis turbine = Width × Height
- V = wind velocity (meters/second)
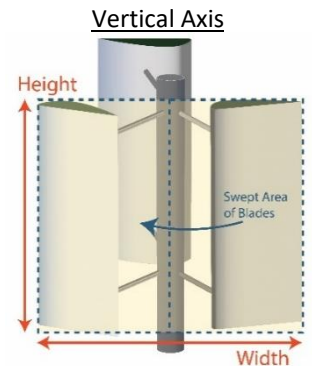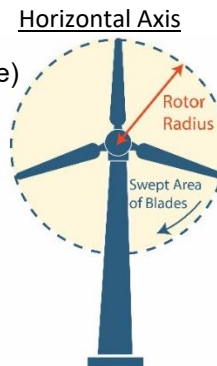
Note 1: Based on Wichita, KS data from *http://myweather.southwindweather.com* on 1/4/24 (temp = 39.9°F; dew point = 30.19°F; pressure = 30.184 in. mercury; humidity = 68%)

KANSAS ENERGY PROGRAM