ELECTRIC VEHICLE

1. **DESCRIPTION**: Teams will construct a vehicle that uses electrical energy as its sole means of propulsion and predict the time it will take to travel a specified distance.
   A TEAM OF UP TO: 2 **IMPOUND**: Yes **RUN TIME**: **10** minutes
2. **CONSTRUCTION**: The vehicle should be designed to travel between 5 and 10 meters and come to a complete stop without straying from the track's center. The exact distance (in 0.5-meter intervals for regional, 10 cm intervals for state and 1 cm intervals for national tournaments) will be chosen by the judges and will not be announced until all vehicles have been impounded on the day of the competition.
   a. Electrical energy used within the vehicle for any purpose must be stored in common, commercially available batteries labeled with their voltage by the manufacturer. **The vehicle may use no more than 4 individual cells (labeled 1.5 volts or less each) or a single battery pack (labeled 4.8 volts or less) at one time (no more than 4 additional cells or one additional battery pack may be impounded for replacement purposes only).** Batteries need not be installed until immediately prior to the run. Only energy stored in these batteries may be used to propel the vehicle.
   b. The allowed batteries and/or additional non-electric energy storing devices may be used to operate other functions (e.g., braking system) provided these functions do NOT help propel the vehicle in any way. All sources of energy shall be in a location as to be available for inspection by the event supervisor.
   c. Components may be purchased or made by the contestants (e.g., motors, gearboxes, motor controls, bodies, and chassis). Electronic components are allowed (i.e., solid-state devices such as transistors, integrated circuits, diodes, and microprocessors). **A Bonus Score will be awarded to vehicles that do not use electronic components.**
   d. Sighting devices that do not use electricity are allowed (electrical/electronic sighting devices, including lasers are prohibited). All sighting devices must be permanently attached in a fixed position and travel with the vehicle.
   e. The vehicle's wheel base (distance measured parallel to the direction of travel between the center of rotation of the front and rear axles) must be **28-32** cm and the vehicle's track/width (distance measured perpendicular to the direction of travel between the outermost side of the left tire and the outermost side of the right tire of the vehicle's widest axle) may not exceed **20** cm.
   f. The vehicle must have a stationary, pointed object, such as a toothpick, extending forward of all other parts of the vehicle (including the wheels) and to within 1 cm of the track's surface. The tip of this pointer nearest the track surface will be used as the reference point on the vehicle for all distance measurements.
   g. The braking system (except for the vehicle's wheels) **may not** contact the floor or tape defining the track.
3. **THE TRACK**: The track will be on a smooth, level, and hard surface. Space is needed on each side of the track's center and beyond the finish line to allow for error in the vehicle's path.
   a. One-inch tape will be used to define the track's center, the Starting Line, and Target Distance (finish line). The inside edge of the tape will define the Starting Line and the Target Distance. The start and finish lines should extend as far as practical on either side of the track's center.
   b. At the event supervisor's discretion, more than one track may be used. Teams will be given the option to choose which track they will use. All runs by a team will be made on the same track.
4. **THE COMPETITION**: The vehicle and batteries must be impounded before the start of the competition. Tools, data and calculating devices need not be impounded. **Teams may remove their vehicle after competing, unless they wish to file an appeal. No appeals are allowed after the vehicle has been taken.**
   a. Only contestants and judges are allowed in the impound and track areas while teams are competing. Contestants may bring tools for adjusting the vehicle, test data and electronic calculating/computing devices to assist in making accurate time/distance predictions.
   b. The contestants must predict a time of 45 seconds or less that the vehicle will take to travel the Target Distance. The Predicted Time may not be changed for the second run, but they may adjust their vehicle. **National Tournament only**: The event supervisor will choose a Predicted Time between 1.5 and 4 seconds per meter **in increments of 0.1 seconds** (15.0-40.0 seconds for a 10M Target Distance) and the contestants must adjust their vehicle to travel the Target Distance as nearly as possible to that Predicted Time.
   c. Teams will be given 10 minutes to perform the following actions and complete up to 2 runs. Time used by judges for measuring will not be included in the 10 minutes. Vehicles will be permitted to complete a run if they are in motion before the end of the 10-minute time period.
      i. Adjust their vehicle before each run (e.g., change its speed, distance, directional control, **change batteries, or make changes from impounded parts).**
      ii. Use their own measuring devices to verify the track dimensions. They may not verify the distance by rolling the vehicle on the track surface (floor) between the start and finish line at any time prior to or during the competition.

iii. Place the tip of the vehicle's pointer even with the Starting Line and align the vehicle. A target may be placed at the finish line to aid in aligning the vehicle, but must be removed before starting each run.

iv. Contestants must start the vehicle using a pencil, pen, dowel or similar device (which is not part of and does not travel with the vehicle) to actuate some sort of switch. They may not touch the vehicle to start it, hold it in place while actuating the switch or "push" the vehicle to get it started. The entire vehicle, including batteries, must move forward together. It is considered a run if the vehicle moves after the switch is actuated. Contestants may not follow their vehicle down the track. They must wait until called by the Event Supervisor to observe their finish distance and retrieve their vehicle.

d. The Measured Time will start when the vehicle begins forward motion and stops when the tip of the pointer crosses the finish line or the first time forward motion of the vehicle stops, whichever occurs first.

5. **SCORING**: Each Run Score is the sum of **4** Components: Distance Score, Time Score, Finish Line Score, Center Line Score **plus a Bonus Score if applicable.** The minimum for each score component is zero (0). The maximum Run Score is 200 points.

a. The Distance Score is the Target Distance minus the absolute value of the difference between the Target Distance and the Distance Traveled divided by the Target Distance, multiplied by 100. These distances are measured **to the nearest millimeter**. The Distance Traveled is measured from the Starting Line to the tip of the vehicle's pointer, perpendicular to the Starting Line (point-to-line distance).

$$\text{Distance Score} = \frac{\text{Target Distance} - |\text{Target Distance} - \text{Distance Traveled}|}{\text{Target Distance}} \text{ X } 100$$

b. The Time Score is the Predicted Time minus the absolute value of the difference between the Predicted Time and Measured Time divided by the Predicted Time, multiplied by 50. All times are measured to **the nearest hundredth of a second. It is suggested that 3 timekeepers per run be used with the middle time used as the Measured Time.**

$$\text{Time Score} = \frac{\text{Predicted Time} - |\text{Predicted Time} - \text{Measured Time}|}{\text{Predicted Time}} \text{ X } 50$$

c. Up to 40 Finish Line Score points will be awarded based on the Final Distance, measured from the center of the finish line (the point where the center of the track's center tape and the finish line intersect) to the tip of the pointer on the vehicle. The Final Distance is a direct straight-line (point-to-point) measurement to the nearest millimeter within a 40 centimeter radius circle.

$$\text{Finish Line Score} = 40 - \text{Final Distance (cm)}$$

d. A Center Line Score of 10 points will be awarded if the center tape remains completely within the vehicle's track while the vehicle travels between the start line and the finish line. This bonus will be awarded even if the pointer or the entire vehicle crosses the finish line.

e. **A Bonus Score of 1/3 the difference between 200 and the sum of 5a, b, c, and d will be awarded if the vehicle does not use any electronic components. (See: Para. 2.c.)**

f. The final score for the event will be the higher of the Run Scores. Violation of any rule requirement will result in the team being ranked by their Run Score in a second tier below all teams without rule violations.

g. Ties will be broken by the better Time Score and if a tie still exists, in favor of the better Distance Score.

Scoring Example: The contestants predicted it would take 5.9 seconds to travel 9 meters. Measured Time: 7.45 sec. Distance Traveled: 8.85m. Distance from the center of the finish line to the tip of the pointer = **31.4** cm**.** Vehicle did not stay on the track's center tape. It did not use any electronic components.

Distance Score	98.33 pts.	[(9 - |9 - 8.85|) / 9] x 100 = 98.33 pts.
Time Score	36.86 pts.	[(5.9 - |5.9 - 7.45|) / 5.9] x 50 = 36.86 pts.
Finish Line Score	**8.6 pts.**	**40.0-31.4 = 8.6 pts.**
Center Line Score	**0 pts.**	
Total	**143.79 pts.**	**98.33 + 36.86 + 8.6 + 0 = 143.79 pts.**
Bonus Score	**18.74 pts.**	**0.33 x (200 – 143.79) = 18.74 pts.**
Run Score	**162.53 pts**	**143.79 + 18.74 =162.53 pts.**

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