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# OFFICIAL RULES FOR THE 2011 TULSA ENGINEERING CHALLENGE

## ELECTRICAL MOTOR CONTEST

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### OBJECTIVE

Design, build and test an electrical motor powered by a dry cell battery that rotates at the highest possible speed.

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### DESIGN STATEMENT

Each entrant will design, build and test an electrical motor. The motor shall be powered by one readily available non-rechargeable dry cell battery. The motor is judged on its highest rotation speed with no load. The motor may be started by hand. The motor is to be constructed from materials and simple hardware readily available at retail stores or mail order suppliers. A design drawing and parts list indicating the source, cost and fabrication operations for each part must accompany the motor. (NOTE) The motor must be built by this year's entrant and not by a previous year's entrant.

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### MATERIAL SPECIFICATIONS

The power must be derived from one non-rechargeable dry cell battery. The maximum nominal voltage shall be one and one-half (1.5) Volts. A single flashlight battery up to D size may be used. Batteries may not be paralleled. The battery is supplied by the entrant and may not be replaced during a timed contest. The battery may be replaced between the first and second trial. Readily available permanent magnets may be used. Industrial quality or other professionally manufactured components are not permitted. Manufactured kits will not be allowed.

Electrical and electronic components such as switches, resistors (variable and fixed), capacitors, inductors, relays, transistors, integrated circuits and interconnection hardware readily available through local retail or mail order sources may be used. Pre-manufactured subassemblies such as armatures, field structures, computer, or controller modules will not be permitted. Materials such as wire, cable, string; wood, plastic, permanent magnets, metal sheet; bar and rod stock; common fasteners such as nails, screws, adhesives, staples and rivets; wheels, pulleys, bearings; and other common items readily available in local retail stores may be used. Toy or hobbyist type articles such as erector set structural components may be used. Major components such as armatures, commutators, or field structures from motors or motor kits may not be used. A design drawing clearly labeling each component and a corresponding parts list must accompany each motor. The parts list must indicate the source (vendor), cost, machining and fabrication procedure for each component.

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## CONSTRUCTION SPECIFICATIONS

The motor must be constructed within the material constraints listed. Hobbyist, toy and readily available retail (local and mail order) hardware materials may be used. The judges will be the final authority for determining if unacceptable professional quality special purpose or manufactured components or subassemblies violate the spirit of the competition. The design drawing and parts list will be the primary source for judging data. There must be a 1 " or larger diameter disc attached to one end of the motor shaft and painted black so that a reflective tape marker may be readily viewed by the tachometer. This mark will be viewed by an electro-optic tachometer to determine rotation speed.

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## COMPETITION SPECIFICATIONS

All power for operating the motor must come from the battery. Only non-rechargeable dry cell batteries are permitted. The total nominal battery voltage shall not exceed one and one-half (1.5) Volts. A single flashlight battery up to and including D size may be used. Batteries may not be replaced during a timed contest. Batteries are to be supplied by the entrant. The motor may be operated by the entrant(s) through manual electrical controls such as switches, variable resistors or other electrical interface devices, or the system may operate automatically after starting. The stable no-load rotation speed of the motor will be determined using an electro-optic tachometer. An electro-optic tachometer observes and measures the rate alternate light and dark reflective areas pass by a light sensitive detector. NOTE Construction Specification, above, regarding the required black disk. The reflective tape and tachometer will be supplied by the judges.

The objective is to achieve the maximum possible rotation speed for the motor when operating with no load. Each entry will have two (2) one (1) minute timed runs. The higher observed speed score will be used. The entrant will have a one (1) minute setup and test period prior to the first run. No more than one (1) minute may elapse between the end of the first timed run and the beginning of the second timed run.

No intervention with the motor's operation is permitted during the timed run except through the electrical control panel or for starting. The motor may be started by hand or other auxiliary means. The motor must accelerate to a final stable speed if started by auxiliary means - it cannot "coast down" from a starting impulse. Repairs and adjustments are permitted between timed runs and during the setup period. Competition will run continuously during the Challenge hours, between 8:30 a.m. and 1:00 p.m. A table will be provided for the inspection and staging. The design drawing and parts list must be provided at inspection. The motor will be placed on the competition table and operated by the entrant.

The judges will observe the rotation speed with the electro-optic tachometer during each of the one (1) minute timed runs and determine the maximum observed speed. The competition area will be off limits to everyone except the competitors and officials.

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## JUDGING AND SCORING

The score will be the maximum observed stable no-load rotation speed of the motor in revolutions per minute (rpm) reduced by any penalties. A penalty equal to 50% of the observed speed will be applied for any entry not providing a complete and accurate design drawing and parts list. Any motor using manufactured components from motors or motor kits will be

disqualified. Each entrant is responsible for providing batteries, supplies and tools as required. The judges will provide the tachometer and reflective tape. Prior to the testing, each motor will be inspected and initialed by the judges to indicate compliance with contest construction specifications. A motor shall be registered and operated by one and only one team. No re-registration is permitted. A team may register only one motor. After inspection by the judges, the motor will be placed in the contest queue.

Each team is responsible for the security of its entry. No time will be spent looking for or waiting for teams not present when it is their turn. Teams not present will go to the end of the queue if time permits. Decision of judges, during all phases of competition, will be final. Judges will determine winning entries at the close of the competition. Winners need not be present. In the event of a tie, the motor determined to have the most creative design will be declared the winner.

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## GENERAL

The contest is limited to four (4) entries per division per school or up to two entries per grade (if it has more than one grade at the school) for a total of (6) entries. Each entry may be an individual or a team project of two to four students. Exception: "Centers" such as an eighth grade center will be treated as a school, so an "8<sup>TH</sup> Grade Center" may send up to six entries.

**Registration will be done via the TECh website which can be accessed through [www.tulsaengineer.org](http://www.tulsaengineer.org). Registration deadline is March 15, 2011. Questions? E-mail: [techallenge@yahoo.com](mailto:techallenge@yahoo.com).**

**No Walkups allowed.**

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## PRIZES

Prizes will be awarded for three divisions as follows: Upper Division (9<sup>th</sup> thru 12<sup>th</sup>), Middle Division (7<sup>th</sup> thru 8<sup>th</sup>) and Lower Division (6<sup>th</sup> Grade and under).

First Place: \$100 cash or equivalent gift.

Second Place: \$75 cash or equivalent gift.

Third Place: \$50 cash or equivalent gift.

Cash prizes will be awarded by a bank check and issued to the teacher/school listed on the registration. We will mail a check to the address listed on the registration within a few weeks of the competition. If you do not receive your prize within a few weeks, please email [techallenge@yahoo.com](mailto:techallenge@yahoo.com) with your team name, school, and competition won.

**For all schools that bring 100% of their pre-registered teams to the final competition, their school will be awarded a \$25 STEM grant.**