
OFFICIAL RULES FOR THE 2012 TULSA ENGINEERING CHALLENGE

ELECTRICAL MOTOR CONTEST

NOTE: There are major changes from previous years. Motor Categories are defined and some Categories are not eligible in all Divisions. Rechargeable batteries are permitted.

OBJECTIVE

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

DESIGN STATEMENT

Each entrant will design, build and test an electrical motor. The motor shall be powered by one single 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 basic materials and simple hardware readily available at retail stores or mail order suppliers. Components from commercially available motors or motor kits are not permitted. A design drawing and parts list indicating the source, cost and fabrication operations for each part must accompany the motor. The motor must be built by this year's entrant and not by a previous year's entrant.

CATEGORY SPECIFICATIONS AND COMPETITION LIMITATIONS

The motors submitted for judging will be divided onto Categories based upon their design and construction complexity. Simple motors (Categories B and C) are not permitted in the Upper Division (grades 9 thru 12) and the simple homopolar motor (Category C) is eligible only in the Lower Division (grades 6 and below) and will compete for separate prizes. The Categories and their definitions are:

- Category A – Traditional Electric Motor – A traditional rotating apparatus electric motor with potential for useful mechanical power output having clearly defined and identifiable field, armature and commutation (mechanical or electronic) components and not falling into the simple motor categories. Category A motors may compete in all Divisions.
- Category B – Simple Electric Motor (Beakman) – A simple rotating apparatus electric motor with a mechanically switched commutator which is usually a single segment of bare conductor on the coated magnet wire shaft also used to form the coreless rotating armature, commonly referred to as a “Beakman” motor. Category B motors may not compete in the Upper Division.
- Category C – Simple Homopolar Electric Motor – A simple rotating apparatus electric motor without a commutator using a permanent magnet field source coaxial with the rotation axis, commonly referred to as a “homopolar” motor. Category C motors may

compete in the Lower Division only, and will compete in a separate class and prize structure from the other motors.

Note: The on-line encyclopedia en.wikipedia.org is a good reference for electric motor theory and terminology. Descriptions of the Beakman and homopolar simple motors can be found on YouTube.com and other on-line sources through Google searches.

MATERIAL SPECIFICATIONS

The power source must be a single cell battery of D size or smaller. The maximum nominal voltage shall not exceed four (4.0) Volts. Rechargeable batteries including lithium technology are permitted. Sizes up to D size [33.2 mm (1.31 inches) diameter by 61.5 mm (2.42 inches) long] may be used. 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.

CONSTRUCTION SPECIFICATIONS

The motor must be constructed within the material constraints listed. Hobbyist, toy and readily available retail (local or 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, parts list and visual inspection will be the primary source for judging decisions. There must be a 25 mm (1.0 inch) or larger diameter disc or 6.4 mm (0.25 inch) or larger diameter cylinder supplied by the entrant, attached to the motor shaft and painted black so that a reflective tape marker may be attached by the judges and readily viewed by the optical tachometer. This mark will be viewed by an electro-optic tachometer to determine rotation speed.

COMPETITION SPECIFICATIONS

All power for operating the motor must come from the battery. Only single cell batteries are permitted with a nominal battery voltage not exceeding four (4.0) Volts. A single cell battery up to and including 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. 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 maximum stable no-load rotation speed of the motor will be determined by the judges 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 the Construction Specification, above, regarding the required black disk or cylinder. 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 competition hours. A table will be provided for the inspection and staging. The design drawing and parts list must be provided at inspection. The judges will determine the Category designation. 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.

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 having the required black disk or cylinder for the reflective timing tape and 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, assigned a Category and marked 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 assigned a Category and 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.

PRIZES

Prizes will be awarded for three divisions as follows: Upper Division (9th thru 12th), Middle Division (7th thru 8th), and Lower Division (6th grade and under). In the Lower Division prizes will

be awarded for both the Category C and the all other Categories class. In the event of a tie, prizes will be equally distributed between winning entries.

Division, Category and Prize Scheme:

- Upper Division (9th-12th grade) – Category A only – 1st, 2nd & 3rd Places
- Middle Division (7th & 8th grade) – Category A & B – 1st, 2nd & 3rd Places
- Lower Division (6th grade & under) – Category A & B – 1st, 2nd & 3rd Places
- Lower Division (6th grade & under) – Category C only – 1st, 2nd & 3rd Places

First Place: \$100 cash and \$25 cash for their classroom.

Second Place: \$75 cash and \$25 cash for their classroom.

Third Place: \$50 cash and \$25 cash for their classroom.

Cash prizes will be awarded by a bank check and issued to the teacher/school listed on the registration to be cashed and distributed to the winning student(s). 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 or certificates within a few weeks, please email tech@tulsaengineer.org with your team name, school, and competition won.

GENERAL

The contest is limited to six (6) entries per division per school. Each entry may be an individual or a team project of two to four students.

Registration will be done via the TECh web page which can be accessed through www.tulsaengineer.org.

Questions? E-mail: techallenge@yahoo.com.