OFFICIAL RULES FOR THE

2016 TULSA ENGINEERING CHALLENGE

ROBOT COMPETITION

NOTE: There are changes from previous years. Rules are clarified to allow controllers and components from construction kits such as Lego© Mindstorm NXT products. Rechargeable batteries of higher voltage and capacity are permitted.

OBJECTIVE

Design, build and test an electrically controlled and powered robot which moves steel washers in sequence from one location to another.

DESIGN STATEMENT

Each entrant will design, build and test an electrically controlled and powered robot. The robot shall be battery powered and operated through electrical controls. The robot's objective is to rapidly and accurately move steel washers in sequence from one location to another. The robot must be remotely controlled manually by the operator through switches and other electrical input/output devices or automatically by internal logic circuits.

The robot is to be constructed from readily available hobbyist and home hardware, including small toy motors. Washers will be stacked on source pegs. The robot shall move the washers from the source peg to a target peg twenty (20) centimeters away, placing them in a specified sequence. Indexing holes will be available for positioning the robot relative to the source and target pegs. Points will be awarded for the quantity and rate of washer transfer within a time period. Penalties will be assessed for dropped or improperly sequenced washers.

MATERIAL SPECIFICATIONS

The power must be derived from small batteries readily available in local retail stores or with controller or actuator kits. The maximum nominal voltage shall not exceed twelve (12) Volts. Batteries may not be paralleled. The batteries are supplied by the entrant and may not be replaced during a timed contest.

Motor(s) or other electromechanical actuators may be of the hobbyist or toy type readily available from local retail or catalog stores, within hobbyist construction kits such as Lego©, or fabricated from raw materials. Readily available electromagnets and permanent magnets may be used. Industrial quality or other professionally manufactured components are not permitted. It is anticipated that an electromagnet may be used to grip the washers, but any method is acceptable.

Controls and operator interfaces may be fabricated from 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 catalog sources. Pre-manufactured subassemblies such as computer or controller modules will not be

permitted, except that hobbyist construction kit controller bricks such as the Lego© NXT, a keyboard subassembly with no more than 12 keys and/or game/toy joysticks will be allowed. Wired or wireless links to a personal computer, tablet computer or cell phone are not allowed during the timed event.

Materials such as wire, cable and string; wood, plastic and metal sheet; bar and rod stock; common fasteners such as nails, screws, adhesives, staples and rivets; wheels, pulleys and bearings; and other common items available in local retail stores may be used. Toy or hobbyist type articles such as erector set components may be used. Toy and hobbyist robots or robot assemblies are not allowed, except that minor subassemblies may be incorporated into the total system.

The washers will be 5/16 x 1 ¼ inch zinc coated steel fender washers readily available in local hardware stores (Lowe's #68883). The inside diameter is 8.71 +/- 0.13 mm (0.343 +/- 0.005inch), outside diameter is 32.06 +/- 0.40 mm (1.262 +/- 0.016 inch) and the thickness is 1.60 +/- 0.13 mm (0.063 +/- 0.005 inch). The washers have soft ferromagnetic properties. The washers will be supplied by the judges during the contest. Not all washers have the same dimensions, you are to use the dimensions provided to find the correct washers.

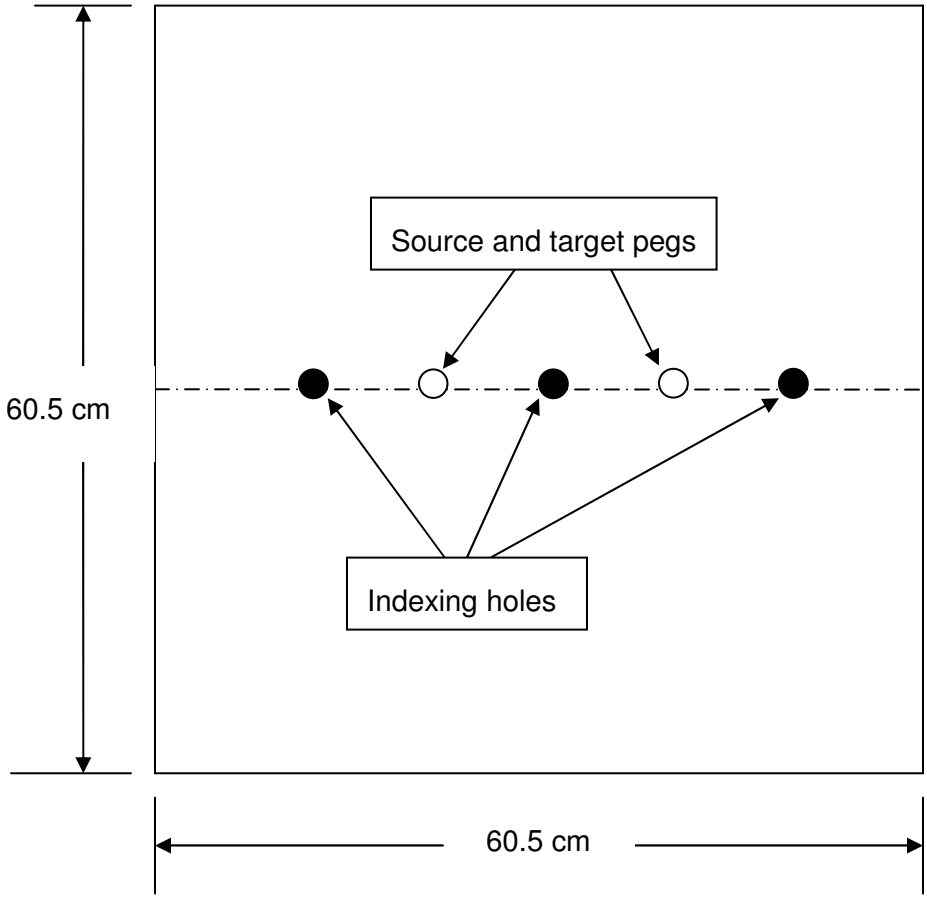
The robot is to use the board provided by the judges. See Figures 1 and 2. This board will have the source and target pegs on it. The board's dimensions are approximately 60.5 cm (23.6 inches) by approximately 60.5 cm (23.6 inches) by 1.8 cm (0.71 inch) thick. The source and target pegs will be nominal ¼ inch diameter (6.4 mm) wooden dowel pins extending 20 (+/- 1) mm (0.79 +/- 0.04 inch) above the base board. The pegs will be separated approximately 20.0 (+/- 1) cm (7.87 +/- 0.04 inches) center to center. Three (3) indexing holes which are approximately ¼ inch (6.4 mm) in diameter will be available in the base board. The indexing holes will be on line with the pegs, with one midway between the pegs and the others approximately 10.0 (+/- 1) cm (3.94 (+/- 0.04) inch) outside of the pegs. The contestants are to use the base board, pegs, and washers supplied by the judges. No exceptions will be allowed. **Contestants are advised to allow for adjustments in their design to accommodate the dimensional variations of the judging board within these tolerances.**

CONSTRUCTION SPECIFICATIONS

All power for operating the robot must come from the batteries. Chargeable batteries up to 2 Ampere-hour capacity are permitted. The total nominal battery voltage shall not exceed twelve (12) Volts. Batteries may not be paralleled. Batteries may not be replaced during a timed contest, but can be replaced between trials. Batteries are supplied by the entrant. The robot must be constructed within the material constraints listed. Hobbyist, toy, and readily available retail (local and mail order) hardware materials and components may be used.

Figure 1 – Board configuration

Figure 2 – Board configuration specifications



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 robot must be remotely operated by the entrant(s) through manual controls such as

switches, variable resistors or joysticks, or the system may operate automatically when started by an operator's command. All controls must be electrically interfaced; no mechanical operator-to-robot links are allowed. The entrant may not touch any moving part of the robot during a timed run.

COMPETITION SPECIFICATIONS

The contest will start with five (5) numbered washers on each peg. The objective is to move all of the washers from the left peg to the right peg, and all of those from the right peg to the left peg in the shortest time. The washers are to be stacked in inverted order on the target peg. Each entry will have two (2) timed runs of one minute (60 seconds) duration each. The higher score will be used. The entrant will have a five (5) minute setup and test period prior to the first run. No more than five (5) minutes may elapse between the end of the first timed run and the beginning of the second timed run, unless approved by the judge. No intervention with the robot's operation is permitted during the timed run except through the electrical control panel.

Repairs and adjustments are permitted between timed runs and during the setup period. Each entrant is responsible for providing batteries, supplies and tools as required. Contestants are required to use the board, washers, and pegs supplied by the judges. A table will be provided for inspection and staging. The base board with the source and target pegs will be centrally located on the competition table.

The washers and the peg board will be supplied by the judges. A stop watch will be used to time the event. Competition will run continuously during the Fair hours, between 8:30 am and 12 noon. The robot will be placed on the competition table and will be operated by the contestant. The competition area will be off limits to everyone except the competitors and officials. A practice board will be provided by the judges and may be used by all groups, but limited to 15 minutes per group, until all groups have had the opportunity to use the board. The time may be shortened by the judges if a large number of groups request use of the practice board.

JUDGING AND SCORING

Judging: Prior to the testing, each robot will be inspected and initialed by the judges to indicate compliance with contest construction specifications, and placed in the contest queue. A robot shall be registered and operated by one and only one team. No re-registration is permitted. A team may register only one robot. After inspection by the judges, the robot shall be placed on designated staging tables. 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 back of the queue if competition hours allow. The second timed run may be moved to the back of the queue if requested and if time permits.

Scoring: One hundred (100) points will be awarded for each washer successfully transferred from the source peg to the target peg within the one (1) minute time limit. Fifty (50) points will be deducted for each washer that is out of sequence on the target peg (i.e., if the third washer from the top on the source stack is not the third from the bottom on the target stack). Twenty-five (25) points will be awarded for each washer removed from the source stack that does not reach the target stack. A washer must be completely on the target peg with no part of the washer above the top of the peg to be scored on the peg. The time required to successfully move all the washers will be noted and the shortest time used to break ties.

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 robot determined to have the most creative design will be declared the winner.

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: tulsatechchallenge@gmail.com

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 event of a tie, prizes will be equally distributed between winning entries.

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 within a few weeks, please email info@tulsaengineer.org with your team name, school, and competition won.