



Region II Student Activities Conference - 2005

# Hardware Competition

The following rules will be observed for the Region 2 Hardware Competition which will take place at Rowan University during the annual Region 2 Student Activities Conference. These rules are identical to those used at the 2004 Student Activities Conference.

## A. Introduction

The Region 2 Hardware Competition is based on the creative aspect of electrical and computer engineering. This competition emphasizes problem solving and engineering economics. The setting of this competition is designed in the interest of challenging undergraduate engineers to devise a creative, strategic, and economic solution to the problem presented, to not only perform the necessary tasks but to also contend with another competitor in the same arena.

During the competition, two robots from opposing teams go head-to-head in the arena trying to attain the most points as fast as possible. Robots gain points by collecting balls and placing them in their ball depository. There are three different types of balls: Steel, Brass and Thermoplastic. The ball depository is a rectangular bin surrounded by boundary walls, located at opposing sides of the arena. A white rectangular grid, which may be used for guidance, is provided on the black surface of the arena. There is also a square pit located in the center of the arena. The steel balls are randomly located at the intersections of the grid, and the single brass ball is located atop a post in the center of the square pit. A map of the steel ball locations will be given out prior to the beginning of each round of the competition so that teams may use them if they wish to program the robots.

The key to winning is strategy. A winning team will not only have to collect the most points, but will also have to account for the opponent on the board.

## B. Specifications

The playing field for this competition is shown in Figure 1.

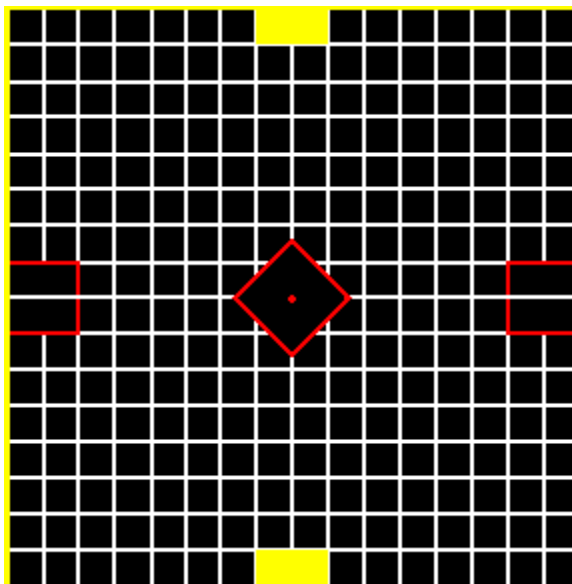


Figure 1. Drawing of Playing Field.

## 1. General

Each round of the competition will take place on an 8' x 8' playing board made of ½" plywood. The entire surface will be painted flat black (**Rust-Oleum –Flat Black, #7776**) with the exception of 1" white lines (**Rust-Oleum –Gloss White, #7792**) laid off in grid fashion every 6" apart, and red lines (**Rust-Oleum –Regal Red, #7765**) denoting the pit area and home bases.

The board will be surrounded by 6.5" walls made of solid pine and painted gloss yellow (**Rust-Oleum –Sunburst Yellow, #7747**). Outside the playing area two lights, one red and one green, will be positioned indicating "HANDS-OFF"/"HANDS-ON" periods respectively. **If a robot is touched while the red light is illuminated a penalty will be assessed.**

The illumination, temperature, and humidity of the room shall be those of an ambient environment. (40 to 120 degrees F, 0% to 95% humidity, non-condensing).

**BEWARE:** Do not make any assumptions about the amount of sunlight, incandescent light, or fluorescent light that may be present at the contest site.

## 2. Pit

At the center of the playing field will be the pit area 1-foot square and 3½" deep whose bottom is also painted flat black. As stated earlier the edge of the pit will be marked with a 1" red line. At the center of the pit, a (7/8)"

dowel rod, also painted red, will be securely anchored to the pit floor. The dowel will extend 17.25" inches above the playing field surface.

### 3. Home Base

The home base area for each vehicle will be a one foot square defined by a 1" red line around its perimeter. Two conducting strips will be placed between the 1"&1.5" marks (the strip occupies the area between 1" and 1.5") and 2" & 2.5" marks on the backside of each home base. The measurements are taken from the bottom of the boards and stretch 4" across.

### 4. Ball Depository

Centered on the wall to the right of a team's home base will be their rectangular shaped ball depository. This will be an 11.75"x 6.125" area (external) and 10.25"x 5.375 (internal), 5.0 inches deep (on the inside) painted completely yellow. Denoting the edges will be a 3/4" board rising (1 and 5/8) inches above the playing surface.

### 5. The Vehicle (Robot)

Each team's robot must fit within a 1.5-foot square, and shall not exceed 1½' in height at the beginning of each round (meaning robots **can** grow, extend, transform, etc.). The robot **shall not** intentionally multiply or divide in any way (including projectiles). It **shall** be totally autonomous, **shall not** transmit or receive signals to or from the outside of the playing area and **shall not** be equipped to intentionally harm its opponent. Malicious robots, designed in part or in whole to damage an opponent, will automatically be disqualified. At the start of each round, robots **shall not** contain objects the same or similar to objects being collected during the competition. Robots **shall not** contain flammable/poisonous gases or liquids, explosives or anything, which may harm spectators or the playing surface.

### 6. The Objects (Balls)

All objects placed on the playing surface, to be picked up by the vehicles, will be ½" diameter steel balls ([McMaster-Carr Catalog Number 96455K56](#)), and 1/2" diameter thermoplastic balls ([McMaster-Carr Catalog Number 1383K55](#)). The object placed atop the wooden dowel in the center of pit will be a ½" diameter brass ball ([McMaster-Carr Catalog Number 9617K43](#)). A total of **36 Steel balls** (9 in each quadrant), **4 Thermoplastic balls** (1 per quadrant), and **1 Brass ball** (atop the wooden dowel); will be placed upon the playing surface at the beginning of each round. Scoring will be as such. One points will be awarded for each steel ball, 10 points for the brass ball, and negative 2 points for the thermoplastic ball in a team's ball depository at the end of a round (so collecting the plastic balls has no penalty unless you put them in your bin).

## C. The Playing Rules

### 1. The Goal

The goal of this competition is to compete head-to-head on the playing board with an opponent and obtain the most points in an allotted amount of time.

### 2. Before the Start

Fifteen minutes before the beginning of each round, a random quadrant map will be generated by a MATLAB program and given to both competing teams. The map will mark the intersection at which each ball is located. This map will be generated randomly based solely on intersections, and each intersection will have an equal chance to contain a ball at the beginning of each round. Each of the four quadrants on the board will have the same ball distribution. It should be noted that the map will show the positions of the balls at the *beginning* of the round, but the balls may move during the round due to the movement of the vehicles. The home base starting contacts described in the specifications will provide a continuous logic high at standard TTL level signals prior to the start of the round.

### 3. The Start

Each vehicle's ball depository will be to the right of its assigned home base. Since the quadrants are all the same, it is not necessary for teams to know their specific starting block ahead of time.

Teams will be informed ninety seconds before the start of the heat, and the TTL high signal will be present at that time. Teams will be informed at this time. Thirty seconds before the start, a "hands-off" period will occur when no one may touch the vehicle, this period will be designated by the green light being extinguished, and the red light being illuminated.

After the red light is illuminated any contact with the robot will result in a penalty. After the robot has left its home base, any contact will result in automatic disqualification from that round. No points will be awarded for that round. The exception to this rule is to allow a team to turn their robot off to prevent, or minimize any damage to either robot. If a robot is disqualified it should still remain on the playing field until the end of the round in head to head competition. So as not to give the other team any advantage over the rest of the field

The start of the round will be signified by a transition from a high to low output level on the starting contacts. Vehicles may go in any direction after the start signal is received.

### 4. The Game

Each round will last for five minutes from the time that the start signal is received. Objects may be gathered and placed in the ball depository in any way. Objects may be collected from any quadrant of the board by either

vehicle. Objects may be stolen from, or placed in, one vehicle's nest by the other vehicle.

Vehicles may not intentionally (as determined by a judge) damage their opponent's vehicles. If a vehicle is found to intentionally damage another vehicle then that vehicle will be disqualified, and removed from the competition. The idea of intentional harm will only be used in extreme cases as determined by the judge. Aggressive physical harm to an opponent's robot is considered extreme. The harmed vehicle will be allowed to play in another round, if able.

Vehicles **will** come in contact in this competition. It is up to participating teams to incorporate defensive strategies into their designs to protect their vehicle from collision damage or other possible damage from the opponent vehicle.

Flash cameras and other video equipment will be permitted at the competition.

Any Robot which intentionally projects an object outside the arena will be disqualified and removed from the competition. This will also be at the discretion of the judge.

## **5. The Completion**

The contest will finish with the red light extinguishing, and the green light energizing. Any objects placed in the nests after the light transition do not count towards the team's total score. Teams must completely clear the floor of their vehicle within three minutes after the end of the round. Only one member of each team is allowed on the floor at one time.

\*NOTE: Robots are NOT required to return to home base before or after the completion of the round.\*

## **6. Bonus Points**

The teams will be required to submit a detailed price list of all components which compose their robots. These price lists should include the retail price of each component. If parts were donated, or already on hand, their retail price must still be included. Each team will be given a bonus each round according to the cost of their robot. The team with the least expensive robot will receive the 20 bonus points where the team with the most expensive robot will receive no bonus points. Other teams will receive points based on a percentage of the difference between high and low cost. Teams not submitting price lists will receive negative 10 points each round. To be eligible to receive the bonus points a robot must function properly. In other words, it must return at least one ball into the proper depository.

Each team will be given a bonus each round according to the weight of their robot. The team with the lightest robot will receive 20 bonus points and the team with the heaviest robot will receive no bonus points. Other

teams will receive points based on a percentage of the difference between high and low weight. To be eligible to receive the bonus points a robot must function properly. In other words, it must return at least one ball into the proper depository.

An additional one point will be rewarded for every steel ball picked up and placed in the bin before 150 seconds after the start of the round. This is valid if and only if there are a minimum of 10 steel balls dropped in the bin before 150 seconds have passed since the start of the round.

## 7. Judging and Scoring

In matters of scoring and judging, the judge's word is **always** final. Each ball that is located in the ball depository will be worth the points stated previously. An additional point will be awarded for every continuous thirty seconds before the end that a vehicle remains in contact (completing the circuit) with its starting contacts after it has placed at least one ball in a nest. All disqualifications as determined by the judge are **FINAL**.

## D. Tournament Format

The competition will consist of five rounds.

1. The first round each robot will be placed on the playing surface alone. The object of this round is for the robot to gain as many points as possible.
2. The second round will be head to head competition. The seedings will be based on the first round totals. In the second round the teams do not need to win to qualify for the finals.
3. To determine the teams that move onto the third round, the scores from rounds one and two will be summed. The top eight teams will advance. The third round will be seeded according to points with the top team head to head with the number eight team, number two against number seven, etc.
4. The semi-final round will take the top four teams from round three only. (NOTE: the points attained in rounds one and two will not be used after the seedings for round three) The four teams will be placed in head to head competition randomly. (Not by total points attained as in round three.)
5. The final round will take the winner of each heat, as determined by head to head score in round four, and place them head to head.

In the event of a tie the following guidelines will be used.

- (a) If the tie is to determine a seeding in which both teams are advancing, a coin toss will ensue.

- (b) If the tie is to determine which team advances, a head-to-head playoff will determine which team advances. If the tie is between three or more teams, each team will go head-to-head against the every team it is tied with. The points will be totaled, and the advancements will be determined from the totals. If two teams still tie, their head to head score will be used to determine which team advances. (NOTE: The points attained in this match will not count toward a team's total at any point. They will only determine the winner of the match.)
- (c) If a tie occurs in the final or semi-final round, the match will be played again with a new map until a winner is determined.
- (d) If tied teams are not eligible for advancement, scores will be recorded as a tie.

Flash and video cameras **will** be allowed in the spectator area but not in the playing area. All designs should take this into account.

## **Contact Information**

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