

Robo Cross



North Carolina Science Olympiad Coaches Institute

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presented by

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Robot Ramble statistics provided by
Michael Kobe, Robot Ramble National Event Coordinator

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BACKGROUND: A few years back it was decided to have a robot event in Division B in the 2008 competitions. The Science Olympiad Technology Committee met in May 2007, to finalize the 2008 Science Olympiad technology events. The committee decided the Division B robot event was to be a modified version of the Robot Ramble event that had run in Division C for many years. The committee outlined the basic tasks and playing field for the event. Following that meeting, Dr. Jeffrey Hagen, Robert Schumacher, and myself (the State Directors from Minnesota) wrote the detailed rules of what became named RoboCross. Two weeks ago I was asked to be the 2008 National Event Coordinator for RoboCross based on my 6 years as an assistant to Michael Kobe in running Robot Ramble at the National Tournaments.

Review of RoboCross 2008 Rules

1. **DESCRIPTION:** The object of this event is to design and build a robot capable of performing certain tasks on a prescribed playing field.

A TEAM OF UP TO: 2

IMPOUND: Yes

APPROXIMATE TIME: 5 minutes/team

2. **MATERIALS:**

- a. Each team may enter only one robot that must be built prior to the competition.
 - Even though the rules say one robot per team is allowed in Robot Ramble, two teams showed up at the 2005 National Tournament each with two robots on the playing field.
- b. The robot may be controlled remotely by radio control, infrared, or by a control box with wires leading to the robot. Batteries used in the controller shall be as stipulated by the manufacturer without modification. Controllers constructed by the competitors shall be powered by a battery not exceeding 9.6 volts.

2002, 2003, 2004, and 2005 Robot Ramble National Tournament Data

- Radio controlled – 22/18/15/28
- Combined – 6/6/5/2
- Tethered – 28/25/29/27
- Infra red – 0/3/0/1

2002, 2003, 2004, and 2005 Robot Ramble National Tournament Top Ten:

- Combined – 2/1/3/1
- Tethered – 5/5/5/5
- Radio Controlled – 3/4/2/4

2002/2003/2004/2005 Robot Ramble National Tournament Data

- Erector – 3/4/3/3
- K'nex – 8/1/2/1
- Lego – 6/5/3/4
- Metal – 4/9/16/14
- Plexiglas – 2/5/1/6
- Robotix – 10/7/1/4
- R/C vehicle – 8/6/9/7
- Wood – 2/3/12/15
- Miscellaneous – 11/5/1/6

COST: RoboCross was designed so robots could be successful with much less sophistication than with Robot Ramble. Students with just a remote control car can have some basic success in RoboCross in getting some points. Students who use some ingenuity can be more successful by achieving more. That may lead to more costly robots, but in my experience running Robot Ramble, only a few teams put much money into the event. Practice is more important than cash.

Range of Robot Ramble cost at the National Tournament for 2004 and 2005:

	<u>2004</u>	<u>2005</u>
under \$100	51%	34%
\$100-\$500	40%	59%
\$500	13%	7%

- Average Robot cost for 2005 was \$124.12
- Average cost of top ten robots in 2004 was \$232.90
- Average cost of top ten robots in 2005 was \$138.75

Finish position of the most expensive robots at the Robot Ramble National Tournament:

2002	\$1,000	7 th Place
2003	\$3,000	21 st Place
2004	\$1,200	21 st Place
2005	\$1,000	25 th Place

- c. At the start of the competition, the robot, with the exception of the wires connecting it to the student control box(es), must fit into a Plexiglas qualifying cube with inside dimensions of 30 cm x 30 cm x 30 cm.
- This size restriction is the same as for Robot Ramble so resources could be shared. Don't build a robot that will barely fit, as you might damage your robot at the beginning of your competition showing the judges it fits in the box. I've seen a few sad cases of disconnected wires or broken wheels as a result of this.
- d. All robot motion must be powered only by electrical, elastic or gravitational energy. These forms of energy may not be converted to other forms such as hydraulics, pneumatics, and fluidics to power the robot.
- This rule is in place due to the somewhat dangerous power sources that were used by some teams in the 2002 Robot Ramble event.
 - Last year we were frequently asked if using suction cups broke this rule as a pneumatic. No, as the source of power was not from the suction cups, but rather from the batteries running the robot.

- e. Each robot circuit must be energized by one or more commercial batteries which do not exceed 9.6 volts. If multiple batteries are used, they may be connected in series or parallel as long as the voltage output does not exceed 9.6 volts. The voltage stated on commercial batteries will be accepted.
- In 2002, one robot competed at the regional, then the state tournament then had batteries in series which resulted in 24 volts. It was disqualified at the National Tournament in 2002 but had competed in both regional and state competitions at 24 volts.
 - Two or possibly three did not qualify at the 2002 Robot Ramble National Tournament.
 - At the 2003 Robot Ramble National Tournament one team was disqualified for too much voltage
 - At the 2004 Robot Ramble National Tournament all teams qualified for voltage.
 - At the 2005 Robot Ramble National Tournament all teams qualified for voltage.
 - Voltage used in 2005 Robot Ramble at the National Tournament: 18 at 9.6V, 7 at 9.0V, 6 at 7.2V, 15 at 6V
- f. Each robot function (such as drive train, arm, etc.) may have its own independent circuit, source of electrical energy, and control mechanism.
- Most robots for Robot Ramble at the National Tournaments had separate circuits for each function (multiple channel control systems). Several had multiple tethered controls.
- g. The robot must have a legible team name on it.
- This type of requirement was a problem for eight Robot Ramble teams at the National Tournament in 2005.
- h. Radio control equipment used for this event must operate on frequencies designated by the Federal Communications Commission (FCC) regulations for surface devices (cars, boats, etc.). The frequency must be marked by the manufacturer on the transmitter. Allowable frequencies are: 75 Mhz band (75.41 through 75.99 Mhz) which contains 30 channels, 27 Mhz band (26.995 through 27.255 Mhz), or 49 Mhz band (49.8302 through 49.890). No other frequencies may be used. Robots using other frequencies will not be allowed to compete.
- References: FCC Regulations, <http://wireless.fcc.gov/prs/radcntrl.html>
 - The frequency must be on the transmitter – a FCC regulation. In 2004 and 2005, one team in each year had no frequency label for Robot Ramble.

3. **PLAYING FIELD:** See diagram of the Playing Field

- a. The playing field for the event shall be constructed on a piece of $\frac{1}{4}$ inch thick Masonite® (tempered hardboard) 4 feet by 4 feet, placed on the floor, smooth side up. Students may not step or stand on the playing field.
- The playing field is drastically different than Robot Ramble. This should eliminate variability of surfaces used as happened with the carpets in Robot Ramble.
- b. The perimeter of the playing field will have a border of commercial 1" x 2" (nominal, $\frac{3}{4}$ " x $1\frac{1}{2}$ " actual) wood, attached to the top surface of the field with the 2" dimension placed vertical.

- c. The playing field will be equally divided into square zones labeled A, B, C, D counterclockwise. Zone D will have a border of commercial 11/16"quarter round molding separating it from the other zones. Rounded side will face Zone A & Zone C.
 - This “bump” separating Zone D from the rest adds an additional challenge beyond just moving objects across a flat surface.
- d. The other interior boundaries will be drawn with a fine tipped marker.
 - Insist on a playing field with ink markings. Taped lines affect the performance of a robot when the tape rolls over and glue suppresses the movement of the robot.
- e. Zone A will contain the starting position for the robot.
- f. Zone B will contain all of the scorable items at the start of the competition.
- g. All materials for the event, including the playing field, qualifying cube, goal (coffee can), Ping-pong balls, tennis ball, D-cell batteries, and Legos will be provided by the event supervisor.
 - Caution there is a new official standard for the size of ping-pong balls.
- h. At the start of the competition, the event supervisor will place the following objects in Zone B: 4 Ping-Pong balls (approx. diameter 38 mm), 4 D-cell batteries, 1 tennis ball, and 4 Lego blocks (standard 4x2 size), as shown in the playing field diagram.
- i. The goal will be an empty, 11.5 oz plastic coffee can with the top removed, bottom intact, and label removed (if paper). The goal will be placed in the outside corner of zone D (see playing field diagram).

4. COMPETITION:

- a. All robots and control systems must be impounded before the start of the competition and will be released after the last team has finished competing. Robots and controls entered by teams that have filed an appeal may be retained by the event supervisor until the appeal process is completed.
 - Robots must be impounded on time! Robots will be ranked behind those impounded on time. To get through this event, the judges need everything to happen on time so delays hurt.
 - In past National Tournaments for Robot Ramble, there was usually one appeal. By keeping the robots until all appeals are resolved, the judges can save the conditions of the robots. In 2006 a robot was allowed to run again based upon an appeal.
- b. Before starting the competition, students will place their robot in the designated starting position in the outside corner of Zone A.

- c. The students will then place the qualifying cube over the robot. If the robot does not fit in the cube, the students will be allowed to compete but their robot will be ranked behind all of the other robots that qualify. After this point, students may not touch their robot until their run is completed.
- If a student forgot to do something to their robot (such as turn it on), they can ask the event judge if they can fix the problem and then repeat this step.
- d. The students will then remove the cube. After the qualifying cube is removed, the robot may self-activate a change in size or shape (not start). Changes may not be activated mechanically or electronically by the students until the competition begins.
- Nothing on the control box(es) should be touched to activate the robot until the next step below.
- e. The competition will start by having the judge verify that the students are ready and then count aloud "1, 2, 3, go". Teams will be allowed three minutes, starting with the word "Go", to complete the task of moving the scorable items into scoring areas.
- Robot Ramble has been a 2-minute event in the past. Although many teams at Nationals could complete the task in that time, it was rare in many regions and state competitions. Adding a minute will allow more teams to complete more of the tasks. It will also make the event take a bit longer to run. If possible, having two playing fields set up can reduce the time required between teams to run.
- f. The competition will stop (and the score will be determined at that point) when any of the following occur:
- i. Three minutes have elapsed from the word "Go".
 - ii. The team says "Stop".
 - iii. Any part of the goal box is "out of bounds".
 - If the goal box is out of bounds at the end of the two minute competition a team will not receive points for scoreable items in the goal box; however the scoreable items will count for items moved to zones C and D.
 - What is considered out of bounds? The original intent was "touching the floor outside the playing field." However, that isn't stated here. It may now mean "past the invisible line perpendicular to the playing field along the outer boundary" as has been used with Robot Ramble. I'll have to check with the "higher ups" to see which interpretation is correct.
 - iv. The team touches the robot.
 - v. The robot is physically moved by the wires connecting it to a control box.
 - One team in 2004 and two teams in 2005 were stopped because they moved the robot with the control wires.
 - vi. A team member steps on the playing field after the team has received a warning.
- g. The robot may move the goal, but the goal must remain inside the playing field in any zone.
- The goal (coffee can) can be tipped on its side.
 - See the comment in rule 4.f.iii above.

- h. If a scorable item is moved by the control wires, it will be out of play and may not be used to attain any points.
 - About a dozen violations occurred in Robot Ramble at Nationals each year.
- i. The students will receive a warning if they step on the playing field. A second step onto the playing field ends the competition and their score will be based on the locations of the scoreable objects at the time the second violation occurred.
 - This was constantly a problem with Robot Ramble. Hopefully the playing field for RoboCross will naturally discourage stepping on it.
- j. Miscellaneous robot parts, or the entire robot, may end up in the goal without penalty.
 - A typical strategy is that the robot will collect items in to a container then drop the container with items into the goal box.
- k. At the end of the competition, all controlers must be set on the floor immediately, and the event supervisor will allow 10 seconds for the robot to "come to rest" with the power off to determine if any parts are touching the ground outside of the playing field.

5. **SCORING:**

- a. At the end of the competition, points will be awarded based on the number and types of items that were moved into scoring areas.
- b. If the robot (parts touching the ground) is completely in:
 - i. Zone B at the end of the competition, the team will receive 3 points.
 - ii. Zone C at the end of the competition, the team will receive 5 points.
 - iii. Zone D or the Goal at the end of the competition, the team will receive 15 points.
 - If the robot is on the line or straddling 2 zones, it will receive the lesser score.
 - At the 2004 National Tournament 5 teams out of 54 competing in Robot Ramble finished the event with the robot out of bounds.
 - At the 2005 National Tournament, 4 robots in Robot Ramble were not in the playing field.
- c. Teams will receive the following points for each item moved into the following areas:

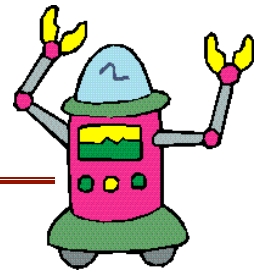
<u>Item</u>	<u>Quantity</u>	<u>Points if in Zone C</u>	<u>Points if in Zone D</u>	<u>Points if in Goal</u>
Ping-Pong Balls	4	1	2	3
Lego blocks	4	2	4	6
Tennis ball	1	3	6	9
D-cell batteries	4	4	8	12

Note: Points may be earned for only one location.

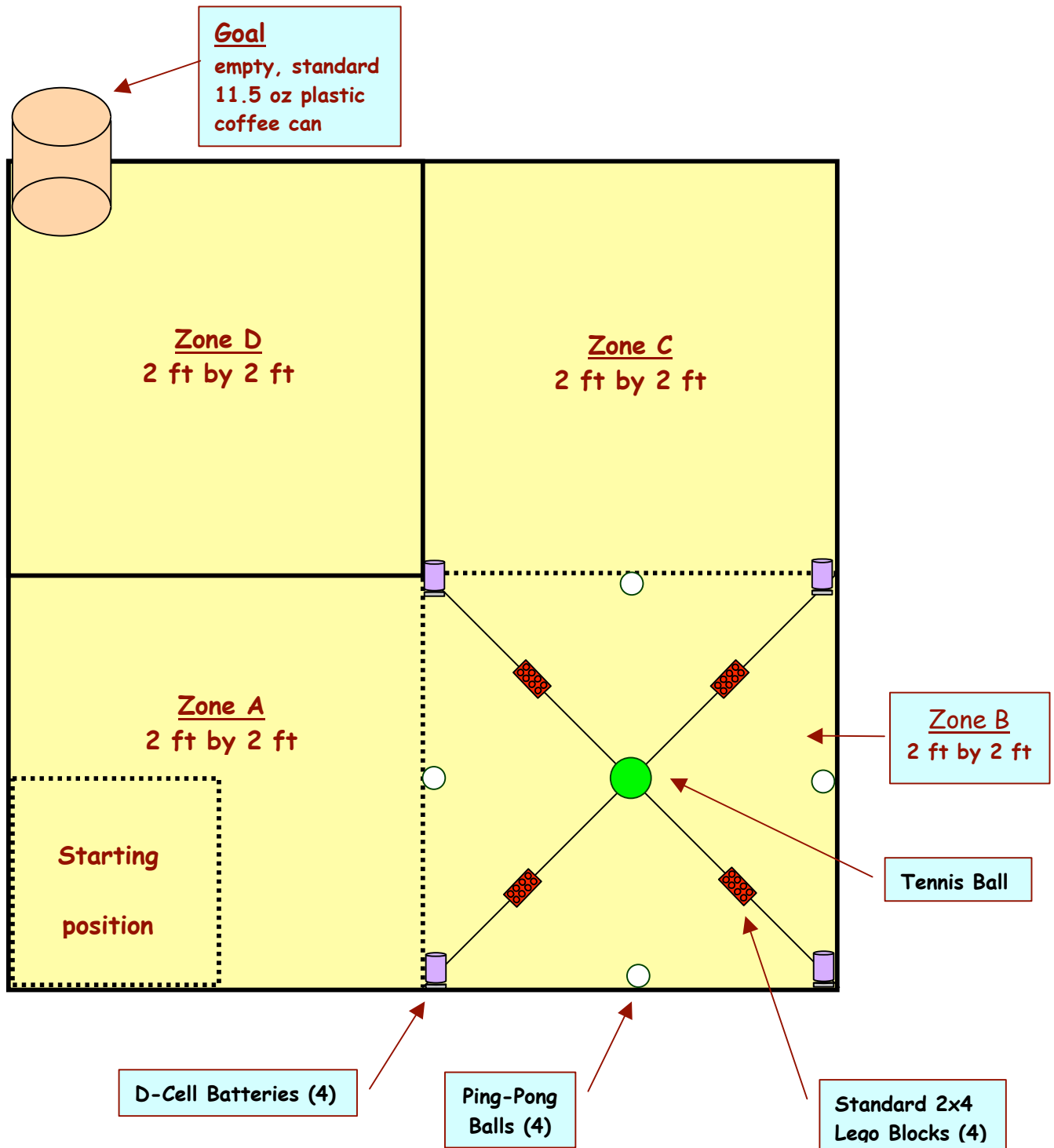
- i. A scorable item that touches the floor outside of the playing field at any time, even if it is under the control of the robot, is out of play and may not be used to attain points.
 - It is okay for the robot to carry items out of the playing field as long as they don't touch the floor.

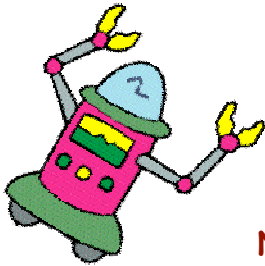
- ii. The robot or any scorable item on the line or straddling 2 zones will receive the lesser score.
- iii. If any part of the goal is out of bounds, the scoreable items within will have no point value.
 - The easiest task for any team is to push all scorable items from Zone B to Zone C which is worth 31 points. Yet in the heat of competition some teams will spend all their time trying to get a battery in the goal can and not get any more points. Practice is the key!
- d. The maximum score is 108.
 - At the National Tournament, perfect scores were attained in Robot Ramble by:
 - 17 Teams in 2002
 - 14 Teams in 2003
 - 11 Teams in 2004
 - 11 Teams in 2005
- e. The team with the most points will be the winner. In the case of a tie, the team that completed the task in the shortest length of time will receive the more favorable score value. If teams still have identical scores, the tie will be broken by massing the robot and batteries. The robot and its batteries with the least mass will receive the more favorable score value (ranking).
 - Scoring Hierarchy:
 1. Points
 2. Time to complete task
 3. Mass of robot
 - At the 2004 Robot Ramble National Tournament, 11 teams had perfect scores and ties had to be broken by time.
 - At the 2003 Robot Ramble National Tournament, 14 teams had perfect scores and ties had to be broken by time. Also the 16th and 17th place teams had identical scores, the same time and the tiebreaker was mass.
 - At the 2005 Robot Ramble National Tournament, 11 teams had perfect scores and ties had to be broken by time. Furthermore, 2 additional ties were broken by mass.
- f. Robots that fail to meet any of the specifications under "Materials" will be allowed to compete but will be ranked behind those that do meet specifications. Robots that violate the FCC regulations will not be allowed to compete and will receive participation point(s) only.
 - At the 2004 Robot Ramble National Tournament, 3 robots did not meet the specifications and were ranked after those that did.
 - At the 2005 Robot Ramble National Tournament, 4 robots did not meet the specifications and were ranked after those that did.
 - If the transmitter does not indicate the frequency (or the label has been removed, or has been tampered with) the robot will not be able to participate
 - At the Robot Ramble National Tournament in 2004 and 2005, two robots did not have frequency tags on the transmitter.

RoboCross 2008 Playing Field

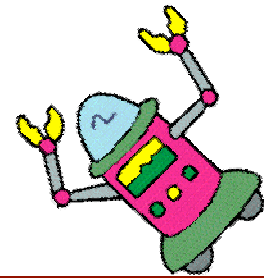


4 ft by 4 ft square playing field





Science Olympiad RoboCross 2008 Event



National Tournament Student Self Check

Before turning in your robot for impoundment, please check the following qualification parameters for your robot. Robots that do not meet these parameters may compete but will be ranked after those robots that do. Additionally, if a R/C robot is operating on a band other than 27, 49, or 75 Mhz it is not in compliance with FCC regulations and may not compete in the RoboCross event.

- No more than one robot may be used by a competing team. (Rule: 1-a)
- Control system must be powered by a battery, which is not to exceed 9.6 volts. (Rule: 1-b)
- Robot must fit into a 30cm x 30cm x 30cm cube prior to the start of competition. (Rule: 1-c)
- Only powered by electric, elastic, or gravitational energy - no hydraulics, pneumatics, or fluidics. (Rule: 1-d)
- Robot is powered by commercial batteries. (Rule: 1-e)
- Voltage output on robot does not exceed 9.6 volts. (Rule: 1-e)
- Robots must have a legible team name. (Rule: 1-g)
- R/C models are in approved frequency range - 75Mhz, 49Mhz, or 27Mhz. (Rule: 1-h)