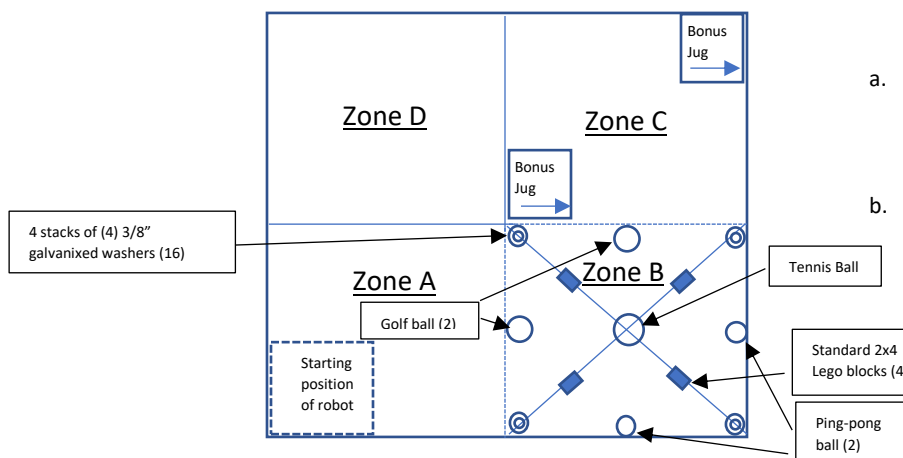


## ROBO-CROSS Division B

1. **DESCRIPTION:** Teams design and build a robot capable of performing certain tasks on a prescribed field.  
A TEAM OF UP TO: 2                      IMPOUND: No                      APPROXIMATE TIME: 15-20 minutes
2. **CONSTRUCTION PARAMETERS:**
  - a. Each team may enter only one robot that must be built prior to competition.
  - b. The robot may be controlled remotely by radio, infrared, or hard-wired control boxes. The robot and controllers are defined as “the device”.
  - c. A commercial kit must have at least one functional modification, defined as a modification such that the lack of it will result in the robot not working or working differently.
  - d. The robot in the ready to run position must fit entirely inside an imaginary 28.0 cm cube.
  - e. The robot may drop passive components but must not separate into two or more active components.
  - f. All robot motion must be powered by only by electrical, elastic, or gravitational energy. These forms of energy must not be converted to other forms such as hydraulics or pneumatics to power the robot.
  - g. Only commercial batteries may be used to energize each of the electrical circuits in the robot and its controller(s). Multiple batteries may be connected in series or parallel as long as the expected voltage output across any points does not exceed 14.4 volts as calculated using their labeled voltage. Teams must be able to show the event supervisor the labeled voltage at check-in. All power sources must be contained either in the robot or as part of the controller(s).
  - h. Competitors must go to [http://www.soinc.org/robo-cross\\_b](http://www.soinc.org/robo-cross_b), to check legal and permitted frequencies for the radio controlled equipment for surface devices.
  - i. Students must be able to answer questions regarding the design, construction, and operation of the device per the building policy found on [www.soinc.org](http://www.soinc.org).
3. **TECHNICAL DOCUMENTATION:** In addition to the device, teams must develop and submit at check-in (or as announced by the director) the following three technical documents – see samples at [www.soinc.org](http://www.soinc.org).
  - a. Illustration (any form, photo, drawings, etc.) of the basic structure of the device with labels that must show:
    - i. All motors, numbered for reference in 3.b.i
    - ii. All energy sources
    - iii. Controls used to interact with the robot
  - b. Operating description:
    - i. Robot reaction to each control input
    - ii. Tentative/proposed plan of movement (i.e., which objects in the competition area will be moved and how the robot plans to move each object)
  - c. Written or typed Practice Log:
    - i. Record at least 10 runs
    - ii. Record at least 3 parameters. The parameters recorded must include score and time. Any additional data recorded will qualify as the third parameter.
4. **PLAYING FIELD:** See diagram of the playing field



- a. The playing field must be a smooth, rigid, 4'x4' nominal outer dimension surface. Acceptable surfaces include, but are not limited to: hardboard, plywood, tile, hard foam board, etc.
- b. The perimeter of the playing field will have a border of commercial 1"x2" (nominal, 3/4"x1 1/2" actual) wood, attached to the top surface of the field with 2" dimension placed vertically. Try to find wood that does not have a milled radius on the edges. Out of bounds is defined by the area that is outside the outer perimeter of the border walls, touching the floor. Anything that extends beyond the walls but does not touch the floor will not be considered out of bounds.
- c. The playing field will be equally divided into square zones labeled counterclockwise as A, B, C, D. Zone D will have a border of commercial 5/8" to 11/16" quarter round molding attached on the inside of Zone D's borders. The rounded side must face Zone D with the greater height

placed vertically. Zones extend vertically from the playing surface.

- d. The outer interior boundaries must be designated by a line made with a fine tipped marker.
  - e. Zone A must contain a marked 28.0 cm square in the outside corner as the robot starting position.
  - f. Zone B will contain all of the objects listed in 4.h.
  - g. Playing field may be designated to fold or separate along the zone boundaries. When in use they must not separate, and must not have more than 3 mm gaps or steps. One layer of tape, up to two inches wide may be used to secure these seams.
  - h. At the start of the competition, the Event Supervisor must place the following objects in Zone B: 2 ping-pong balls (approx. diameter 38mm), 2 golf balls, 16 washers (3/8" I.D., 7/8" O.D.) 1 tennis ball, and 4 Lego bricks (standard 2 stud x 4 stud size), as shown in the playing field diagram. To prevent premature movement of ping-pong balls, the Event Supervisor may put on the playing field a small dimple or paper reinforcement rings.
  - i. The two bonus jugs must be the bottom of any plastic gallon jug (round/square, etc.) cut off to a height of 14.5 cm to 15.5 cm. One must be placed in the inside corner of Zone C and the other in the far outside of Zone C, both with the opening facing away from Zone D. The jugs may be different.
  - j. The Event Supervisor will supply the playing field, 2 bonus jugs, and objects in 4.h.
5. **THE COMPETITION:**
- a. At check-in, the Event Supervisor inspects and measures the device, selects 6 items from the technical documentation, and has the competitors point them out on their device.
  - b. Before starting the competition, competitors must place their robot in the designated starting position in the outside corner of Zone A. The robot must be in ready to run configuration.
  - c. The event supervisor will place all scoring items and bonus jugs on the playing field. Competitors should verify the position of all items prior to the start of each run.
  - d. The competition must start by having the Event Supervisor verify that the timers and competitors are ready. The Event Supervisor will 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 objects into scoring areas.
  - e. Each team will be allowed to perform two runs. The higher of the two scores will be recorded as the team score.
  - f. The robot may move the bonus jugs (which must remain inside the playing field in any zone).
  - g. If an object is moved by the control wires, it must be out of play and must not be used to attain any points.
  - h. Miscellaneous robot parts may end up in or on the bonus jugs without penalty.
  - i. The run must stop (and the time recorded to the precision of the instruments) when any of the following occurs (none of these actions will move a team to a lower tier):
    - i. Three minutes have elapsed from the word "go"
    - ii. The team says "science"
    - iii. Any part of the robot or bonus jugs is out-of-bounds AND touches the floor outside the playing field.
    - iv. The team touches the robot, the bonus jugs, or the scorable objects.
    - v. The robot is physically moved by the wires connecting it to a control box
    - vi. A team member steps on the playing field.
  - j. The robot must stop within 2 seconds of the run completion.
  - k. Any object moved/moving after the time has stopped must be scored where it was prior to that time.
  - l. Teams who wish to file an appeal must leave their documentation and device with the Event Supervisor.
6. **SCORING:** At the end of the competition, points will be awarded based on the number and types of objects that are in the specified scoring areas and run time. High score wins.
- a. If at the end of the competition the robot (parts touching the playing field and not touching the top of the perimeter walls) is completely in:
    - i. Zone A – teams will receive 0 points
    - ii. Zone B – teams will receive 2 points
    - iii. Zone C – teams will receive 5 points
    - iv. Zone D – teams will receive 15 points
    - v. Robot parts (including dropped pieces) touching the ground in multiple zones receive the lesser zone score.
  - b. Objects are scored by the zone they are in or over. Teams must receive the following points for each object moved into the following areas:

<u>Object</u>	<u>Quantity</u>	<u>Points if in Zone C</u>	<u>Points if in Zone D</u>
Washers	16	1	2
Lego blocks	4	2	4
Ping-ping balls	2	3	6
Golf balls	2	3	6
Tennis ball	1	4	8

- i. Each object must earn points for only a single zone.
  - ii. Any object on the line or straddling 2 zones will receive the lower score.
  - iii. A 2x bonus will apply to any object in or fully supported by the bonus jug while on its side.
  - iv. A 3x bonus will apply to any object in or fully supported by the bonus jug if the opening is facing up.
  - v. A 2x bonus will apply to any object if at least one object of that type is in or fully supported by each bonus jug. No single object can be considered in both bonus jugs.
  - vi. Any object that touches out of bounds or is in a jug which touches out of bounds, even if it is under the control of the robot, is out of play and may not be used to attain points.
- c. If a team has scored at least 100 points by moving objects, it must also receive 0.5 points for each second between the stop time and the maximum 180 second time.
  - d. The score must be reduced by 3 points for each incorrect identification from technical documentation in 5.a.
  - e. Teams with incomplete technical documentation will have 5% deducted from their score for each technical documentation category (3a, 3b, and 3c), with a 15% max deduction. Teams with no technical documentation will have 20% deducted from their score.
  - f.  $\text{Score} = \text{Robot Score} + \text{Object Score} - \text{Deductions} + (180 - \text{Run Time})/2$
  - g. Tie breaker: Lowest mass of device
  - h. Tier 1: Devices that meet all requirements are ranked by highest score
  - i. Tier 2: Devices with competition violations are ranked by highest score
  - j. Tier 3: Devices with construction and/or competition violations are ranked by highest score.
  - k. Participation points only: Devices that violate the frequency rules or are unable to compete.
  - l. No Show points only: Devices that have no capability by design to score points by moving objects.