

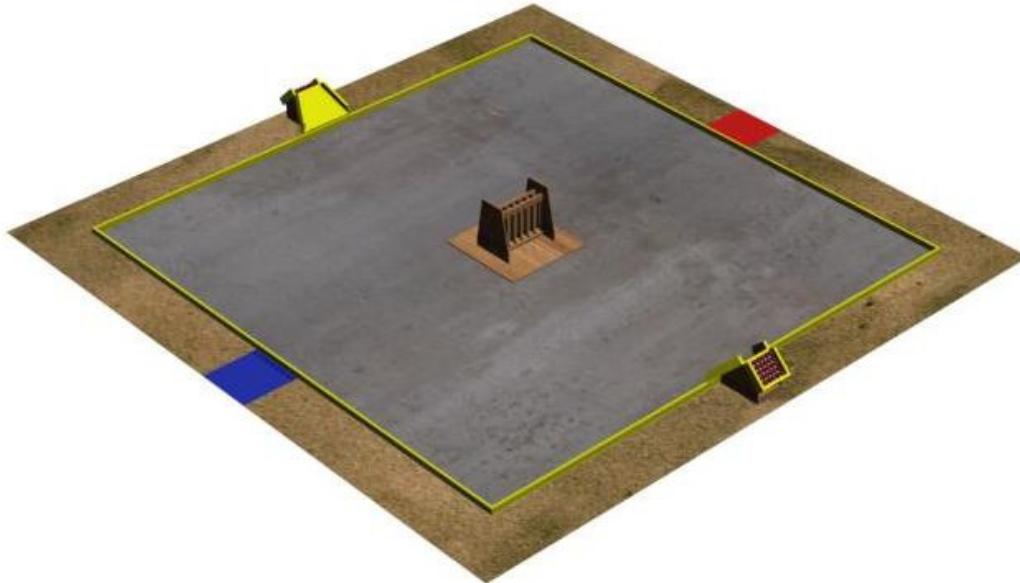


2009 - Provincial Robotics Challenge Scope – Competition 93

Connect

Date: April 22, 2009

Tradex, Abbotsford B.C.



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FURTHER COMMUNICATIONS

Questions for clarification of the rules can be made to the Technical Committee Chair Allan Byres abyres@sd38.bc.ca . Responses to these questions will be posted at <http://www.cambierobotics.com>. Participating Teams are expected to periodically check for updates.



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Level: Secondary School **Duration:** 8 Hours

Purpose of the Challenge:

To create an engineering project to encourage individuals with different skill sets to form co-operative teams to design, fabricate and operate a robot.

Mission Statement:

The intent of the Skills/Compétences Canada National Robotics Challenge is to have teams of students independently Designing / Fabricating / Operating Robots capable of completing the competition tasks in competition with other student-fabricated robots. Teams are not allowed to develop or implement strategies based on interfering with their opponent's ability to complete the competition task set. Teams must avoid the purchase, re-use or adaptation of complete systems that were commercially fabricated to address a task set very similar to the Skills/Compétences Canada National Robotics Challenge. Teams may use the design of commercial mechanisms or systems, which can complete some tasks of the Skills/Compétences Canada National Robotics Challenge, but they must fabricate the mechanisms themselves. It is expected and acceptable that teams will use some newly purchased and recycled parts or components (motors, gears, etc.) to fabricate mechanisms, which will complete the Skills/Compétences Canada National Robotics Challenge tasks. Robots will be inspected for adherence to this statement at the Skills/Compétences Canada National Technological Skills Competition.

Skills and Knowledge Applied:

- Drafting
- Mechanics
- Electronics
- Metalwork
- Woodworking
- Communications

Equipment and Materials

Supplied by the Competitors:

- Robots - Robot accessories (including batteries, battery charger, spare parts)
- Extension cord and power cord
- Various tools required to modify and repair robots onsite
- Safety equipment including mandatory eye protection

Supplied by the Committee:

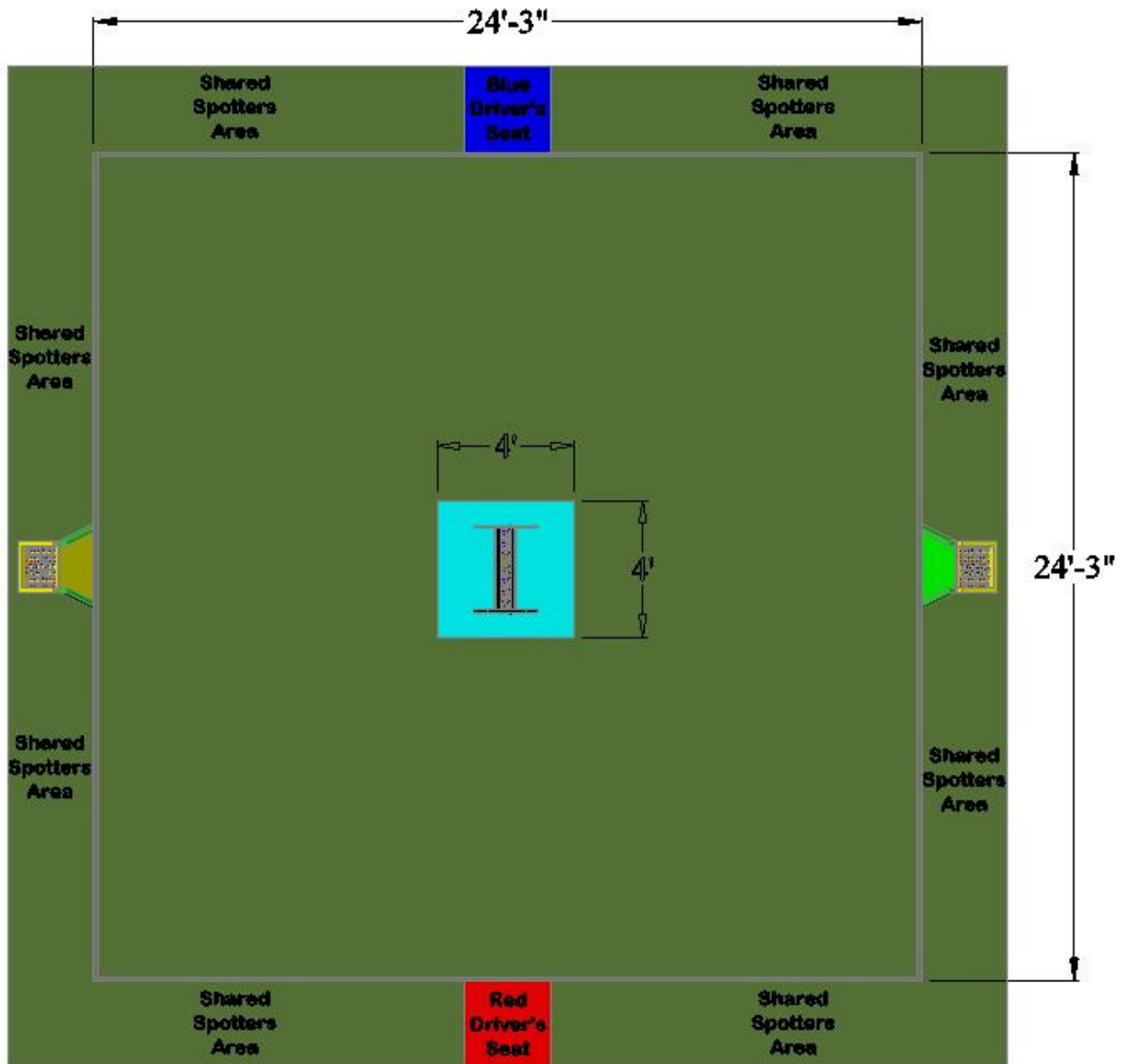
- Playing Field (including game balls, connect rack, timer etc)
- One worktable with access to a 120 V power outlet per team

Judging Criteria: On the court performance of the robot in the set task.

Team Size: Eight Students maximum (provincial competition only, the winning team that is eligible to go to the National competition must only send four team members)

Number of Teams: One team per school unless space allows, teams must contact the Technical chair to see if space allows for more than one team.

THE GAME



OVERVIEW

The competition involves robots traveling through a Shared Open Court Area seeking their Assigned Color Balls that will be randomly distributed on the court at the start of the game. The robots are to take possession of ONE of their Assigned Colored Balls at a time and deliver it into one of the Seven Columns in the Connect Scoring Rack located in the center of the court.

The Competition Balls will be Standard Tennis Balls.



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In Tournament Games, Two Robots will simultaneously attempt to complete the competition task.

Robots must be designed and built by students to the criteria outlined in this document.

A pit area is provided so that students may make repairs and improvements to their robots between games. (Note: Teachers are not permitted in the pit area once the competition has started).

All Robots must remain in the Competition Area at all times throughout the Competition Day.

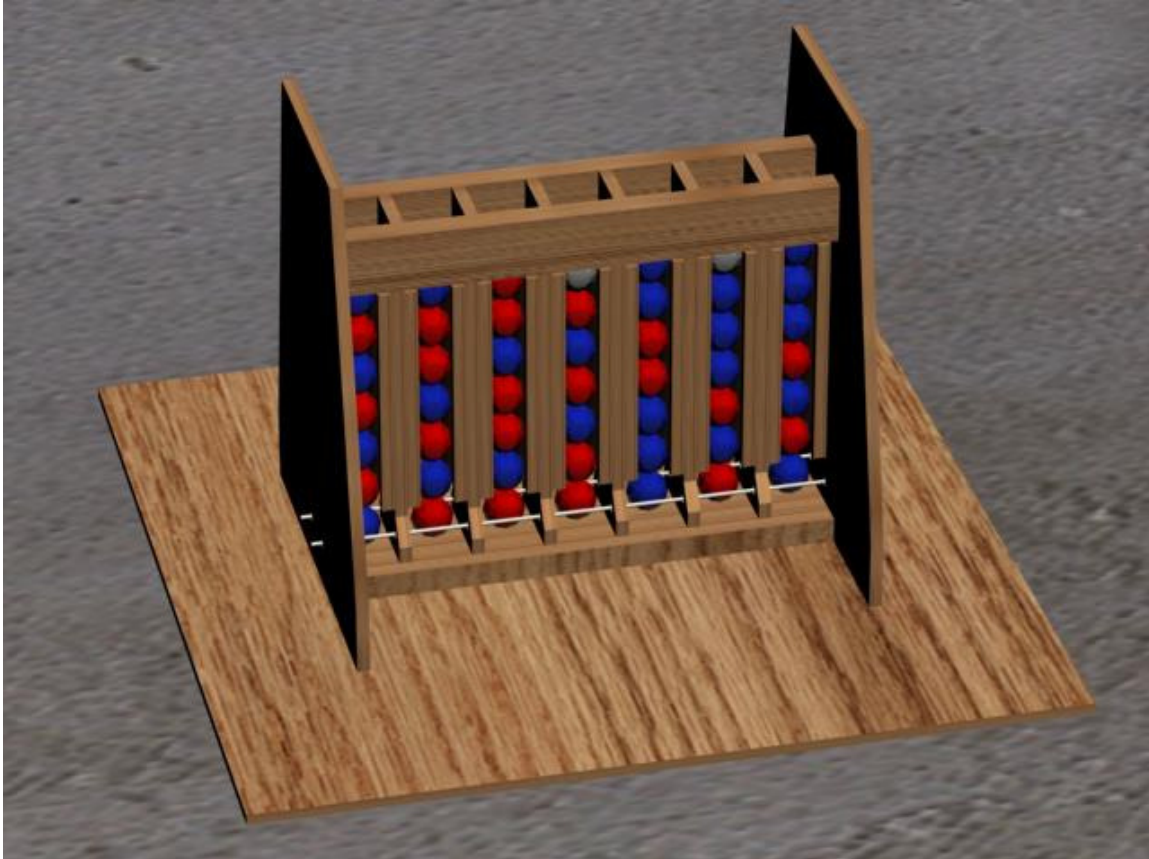
The Pit Area and Competition Court will be available to Teams to work or practice during Lunch Breaks.

Although two robots play on the same court, at the same time they must work to advance their score and not detract from their opponent's score.

Strategies aimed at deliberately interfering with or damaging other robots are not in the spirit of the competition and will not be allowed.

Teams must understand that deliberate Bumping / Ramming of your opponent robot is not allowed. However, when two very mobile robots are sharing an open court space rapidly seeking randomly disbursed target objects **THERE WILL BE ACCIDENTAL ROBOT COLLISIONS**. Teams need to take this into consideration when designing their robot.

SCORING



There are Seven Scoring Columns in the Connect Rack. Robots must deliver their Assigned Colored Balls into the Connect Rack's Scoring Columns.

Only ONE Colored Ball may be delivered into a Connect Rack Scoring Column at a time.

A Maximum of Seven Colored Balls may be placed in a Single Connect Rack Column.

ONE POINT will be awarded for the FIRST Colored Ball delivered by a team into the Connect Rack.

ONE POINT will be awarded when a Robot creates a 'Connect Four' identified as being FOUR Colored Balls connected in a Horizontal, Vertical or Diagonal Straight Line Pattern in the Connect Rack.

The Team with the highest number of Colored Balls in the Connect Rack in each game will be declared the Winner and awarded Two Game Winner Points.

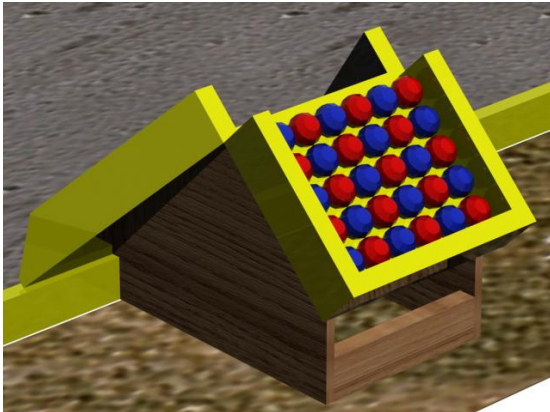
Note: The Maximum Number of Tournament Points awarded in a Single Game is FOUR.
Example: 1 First Ball Point + 1 Connect Four Point + 2 Game Winner Points

Medals will be awarded based on:

- Robot on the court performance in the competition task set as identified through the results of tournament play and playoffs.

RULES AND REGULATIONS

1. Each robot will be assigned a starting position directly in front of their Driver's Assigned Location.
2. Each team will be assigned a Driver's Chair positioned along the courtside directly opposite one of the Connect Rack Solid Ends.
3. The Driver's Chairs will be attached to a Plywood Plate and a Seat Belt will be provided, which Drivers MUST use, to ensure that Drivers remain seated for the entire game.



4. There will be Thirty (Assigned Colored Balls) per robot in each Game.
5. Thirty Colored Balls will be placed in each of the two Ball Launch Mechanism's located at the Mid-point of the Court Perimeter Walls directly opposite the Open Sides of the Connect Rack. (15 Red and 15 Blue in one Launch Mechanism and 15 Blue and 15 Red in the other Launch Mechanism).
6. Robots must deliver their Assigned Colored Balls into the Seven Columns of the Connect Rack located on a 4 by 4 foot by $\frac{3}{4}$ inch wooden Plate positioned at the Center Point of the Court.
7. Robots may be in possession of no more than ONE of their Assigned Colored Balls at a time.
8. ALL 60 Colored Balls will be launched into the court area at the start of every game, including games where a Robot's Opponent has defaulted.
9. Robots may NOT take possession of their Opponent's Assigned Colored Balls but it must be accepted that Robots may accidentally / inadvertently touch, bump or disturb their Opponent's Assigned Colored Balls while they are travelling through the court or are in the act of retrieving their OWN Assigned Colored Balls.



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ROUND ROBIN TOURNAMENT PLAY

1. Teams will play in tournament games.
2. Tournament Standing will be based on the total number of points scored by a team in all of their tournament games combined.
3. Two Robots will play on the court in round robin games.
4. Round robin games will last 4 minutes.
5. The amount of time between games will be determined by the number of participants. This information will be provided to teams at the start of the round robin.
6. Between round robin games, battery changes and repairs to robots may be completed at the team's assigned Pit Area Worktable.
7. During the competition, students must maintain safety at industry standards such as the wearing of safety glasses when performing cutting or stock removal chipping tasks and maintaining a clean pit area workspace.
8. During game play, referees will have ultimate authority over game rulings, and will have full authority over team conduct in the court area.
9. Damaging the court and or the Assigned Colored Balls is illegal. If a robot's design causes damage to the court or the Assigned Colored Balls then it will not be allowed to compete until it can operate without causing damage. Games missed due to this situation will be forfeited.
10. Deliberate strategies aimed at the destruction, collision, damage, overturning, entanglement or active blocking of competitor robots are not in the spirit of the game and are strictly forbidden. Forfeiture of, and removal from the match will result with the first occurrence. Expulsion from the games will occur after the second. Ramming and pushing are not allowed.
11. Games will start on time. Teams are responsible to know when their games are scheduled. Teams arriving late will forfeit the game. They cannot use the remainder of the time in the game.
12. If teams must withdraw from a scheduled game due to mechanical problems then they are asked to inform the Referee as promptly as possible of their decision to Default 'Forfeit the Game'.
13. Competitors cannot enter onto the court surface or make adjustments to their robot during a game.
14. If a robot is mal-functioning and represents a hazard to participants, other robots or itself in the opinion of the Referee, then, the referee may stop the clock, and may authorize the removal of that robot from the court during a game. Disabled robots or parts of robots not generating any safety concerns may be left on the court until the game time expires.
15. Teams will be allowed two competitors in the courtside area. Drivers and spotters may switch roles during a game. The driver is the competitor holding the radio and controlling the robot. The spotter is the competitor providing navigational guidance to the driver through verbal instructions and hand gestures.
16. Drivers must remain in their Assigned Seat throughout the game.
17. Spotters may move freely within the shared spotter's areas.
18. Spotters may **not** enter an opponent team's Drivers area.



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19. At the start of a game, robots must be in their assigned starting positions.
20. Competitors must remain outside the court boundaries.
21. Robots must not leave the competition court at any time during a game.
22. It will be a referee's ruling that decides if an 'End of the Game Assigned Colored Ball Delivery' took place before or after the game-ending buzzer sounded.
23. Assigned Colored Balls landing outside the court boundaries, as a result of Robot Behaviour, **will be returned** to the Competition Court using the nearest Ball Launcher.
24. Robots **may not park** in front of the Connect Rack for the sole purpose of blocking access to it by an opponent.
25. Robots are allowed to drive onto the Connect Rack Base Plate.
26. No part of a Robot can touch / rest on the Connect Rack.

ROUND ROBIN TOURNAMENT STANDING

Round Robin Tournament Standing will be determined by the total number of points scored by a robot in all of their tournament games combined.

- a) A game score of Zero (0) will be awarded for robots that do not show up for (default) a game.
- b) A game score of Zero (0) will be awarded for robots that do not deliver a single ball into the Connect Rack during a game.
- c) Total Round Robin Standing ties will be broken by playing special 4-minute tiebreaker games involving the robots that are tied.

PLAYOFF PLAY



THE COURT

COURT LAYOUT

Please note: Although great pains will be made to keep the court in compliance with the drawings, some inaccuracies in construction may occur. Please make your robot designs allow for a possible ½” tolerance.

The primary court items that have a direct bearing on robot design are:

- 1) The open court surface consists of plywood sheets smooth side up with, OR the Good Side of a ‘Good One Side Plywood Sheet, OR, the smooth facility floor.
- 2) The perimeter court wall is made from 2 by 4 inch planks laying on their narrow edge.
- 3) The Connect Rack is made from ¾ in Plywood plus standard 2 by 4 and 2 by 8 inch planks.
- 4) The Connect Rack is positioned at the Center of a 4 by 4 foot ¾ in Good One Side Plywood Plate.

Detailed court information has been included in the Appendix Section of this scope document.

Note: An AutoCAD drawing of the court is available on www.skillscanada.com.

GAME COLORED BALLS



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The competition Colored Balls will be Standard Tennis Balls.

A Standard Tennis Ball has a diameter between 65.41 mm (2.57520 in) and 68.58 mm (2.700 in) and has 56.7 g (2.000 Oz) to 58.5 g (2.0635 Oz) of weight. Standard Tennis Balls are made in a stitch less manner.

THE ROBOT

RESTRICTIONS

All robots must **pass** a pre-competition inspection for compliance with the safety and design rules before they will be allowed to participate in tournament games.

Note: Robots must remain in compliance with these rules throughout the competition. If teams fall out of compliance with these rules then they will not be permitted to compete and will forfeit all of their scheduled games until they have corrected the problem.

START OF THE GAME ROBOT STATUS

When a robot's main power is turned on prior to the start of a game the robot must be in an overall 'Idle State' and the following conditions must exist:

- The Robot must be stationary in its assigned starting location.
- All systems may be ON.
- All required System Start-up Adjustments must be completed.
- All Electrical / Mechanical Systems and Student Made Electronic Circuits must be under the control of a Kill Switch(es).
- Air System Circuits may be fully charged to 90 PSI and their compressors can be ON.

OVERALL ROBOT SIZE

Robots must not exceed an overall size of 8 cubic feet (13,824 cubic inches) at the start of each game. Robots may expand to a larger size once a game has started.

Overall robot size will be calculated by using the maximum single dimension in each category (length / width / height) of the robot not average dimensions.

This overall size maximum will allow a robot to be any of the following example sizes, or indeed some other variation that does not exceed 13,824 cubic inches:

- (a) an overall dimension of **24 by 24 by 24-inches**, (13,824 cubic inches), or
- (b) an overall dimension of **42 by 18 by 18-inches**, (13,608 cubic inches), or
- (c) an overall dimension of **36 by 21 by 18-inches**, (13,608 cubic inches), or



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(d) an overall dimension of **48 by 24 by 12-inches**, (13,824 cubic inches).

NOTE: The top of your radio antenna may be a maximum of 48” above the court floor. The radio antenna is not considered when defining the overall robot size.

Metric Robot Size Conversion:

24 inch = 60.96 cm

61 cm x 61 cm x 61 cm = 226,981 cubic cm

8 cubic foot = 226 534.773 693 507 cubic cm

OVERALL ROBOT WEIGHT

- No weight restriction is imposed on the robots.
- Robots should be built with robustness in mind. Accidental bumps and scrapes will happen.
- Teams must consider protection of sensitive components and durability of exposed ones when designing all elements of their robots.

ALLOWED PARTS LIST

A quick note about manufactured parts: Although it is impossible to create a comprehensive list of all acceptable parts, a list has been made to provide guidance for teams.

Acceptable components:

- electronic speed controllers
- motors
- gears
- sprockets
- chains
- belts
- pulleys
- tires
- rims
- bearings
- compressed air tanks
- gauges
- tubing connectors
- RC transmitter / receiver
- servo motors
- batteries
- harvested gearboxes from mechanical devices
- PLC unit and interface

Examples

Wheel assembly: tire, tube, hub & bearing.

Power plants, this could involve complete core systems. The intention is to enable power to be delivered to student-created mechanisms.

- A power drill where the complete motor/gear box/clutch/chuck is used.
- An automobile power headrest motor/flexible drive shaft/linear gear assembly are used.
- A photocopier chain drive involving the motor/drive shaft/drive chain sprocket is used.
- A photocopier gearbox to be used to manage a non-photo-copier motor.



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- An electric scooter or wheelchair motor mounted on a student designed and created frame.

It is a team's responsibility to ensure robot compliance to standard.

Note: It is not acceptable to use complete 'out of the box systems' such as a Track Drive System where all components (motors, wheels, track belts, mounting frame, tension wheels etc) were manufactured to work together.

POWER SOURCES / MANAGEMENT

1. The total voltage in any individual circuit **cannot** exceed **24 Volts**.
2. The **maximum continuous** power rating allowed in any circuit is **240 W**. Which will be limited by voltage and fuse selection. Example: $12\text{Volts} \times 20\text{ Amps} = 240\text{ Watts}$
3. Teams are reminded that it is the purpose of a fuse to protect the students themselves and the equipment in their circuits. It is recommended that teams develop circuit diagrams, and calculate the appropriate values for all circuits on their robot.
4. Each current branch path from the battery must include either an **in-line fuse, circuit breaker** or be connected to a dedicated fuse in a rack.
5. Teams must use a wire gauge, which is appropriate to the current values in each circuit.
6. Batteries must be complete sealed commercial battery packs.
7. All **wires** and **batteries** are to be mounted **securely** to the robot taking into consideration that they must be protected from damage due to abrasion when the various robot elements move.
8. Teams are responsible for charging their own batteries and must have a complete set of batteries. It is recommended that a spare set be available.
9. Teams may apply voltages to a motor up to 150% of the motor's marked rating. Note: Teams attempting this must thoroughly test their systems to ensure the motors do not "smoke" under all possible conditions.
10. Robots must be able to be turned off with a single motion. Radio receivers may be in an independent circuit.
11. Teams must submit a wiring diagram of their robot's circuits.
12. Teams may use new or re-cycled motors. See list of allowable parts.
13. There is no restriction on the number of motors used on a single robot.
14. No explosive materials of any kind may be used (ether, gunpowder, acetylene etc.).

NON-ELECTRICAL (BATTERY) ENERGY SOURCES

1. Pressure based energy sources (air or other) may be pre-charged to a maximum of 90-PSI pressure in their reservoirs (cylinders) at the start of each game. This applies to professionally made tanks only.
2. Competitor-made or modified air pressure systems are permitted as long as they do not exceed a maximum pressure of 30 PSI and they include a pressure relief valve set to trigger at 30 PSI.
3. All pressurized tanks on robots must have a pressure gauge to indicate the stored pressure and a form of automatic overpressure safety relief.



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4. The pressure tanks and related gauges / controls must be shielded from damage due to collisions or flying target objects.
5. The stored pressure in the tank must not exceed a maximum of 90 PSI at any time.
6. Tension-based energy sources (elastics, springs or other) may be in either a relaxed at rest state or in a tense / compressed state at the start of each game.
7. Laser devices are prohibited.

RADIOS

1. All teams must use **ground frequencies (75 MHz)** for their RC transmitters or Park Flyer Radio Control units (ones with a limited performance range, 500 feet) which use 2.4GHz Spektrum DSM technology such as those described at http://www.modelflight.com.au/rc_model_radio_control/spektrum_dx6.htm. **Note:** If any signal interference issues arise with WAN's or Phones when using the 2.4 GHz units then it is a team responsibility to resolve not the Robotics Challenge Technical Committee.
2. **Only six channels of a Single RC radio / Single Receiver Set can be used.**
3. Robots may not transmit information or a signal of any type to 'Off the Robot' devices such as computers or video screens etc.
4. All teams must report their radio information to the B.C. Technical Committee in advance of the competition so that potential signal conflicts can be identified and resolved prior to the competition. It is a team responsibility to ensure that their radio does not interfere with an opponent's radio.

PIT AREA

1. Only registered robot competitors are permitted in the pit area.
2. Designated teacher/industry team advisors are permitted in the pit area **only** to inspect the worktable setup of their team prior to the start of the tournament.
3. Designated teacher/industry team advisors are **not** allowed in the pit area during tournament and playoff play.
4. Teachers and industry advisors are not permitted to handle tools or robot parts. Students must affect all repairs and modifications on their robot.
5. Teams will be provided with *Pit Area Workspace* on a standard project table. Depending on the number of teams and availability of space, teams may have to **share** a 60 by 30 inch table.
6. Each pit area table will have access to one electrical outlet. Teams are requested to bring a 25-foot multi-outlet extension cord / power bar as part of their equipment.
7. It is required that teams fabricate a **tabletop stand** for holding their robot in the pit area. This stand should hold the robot securely and be capable of preventing the robot from driving on or off the table in the case of either deliberate motor testing during repairs or due to random, unexpected motor activity.

APPENDIX

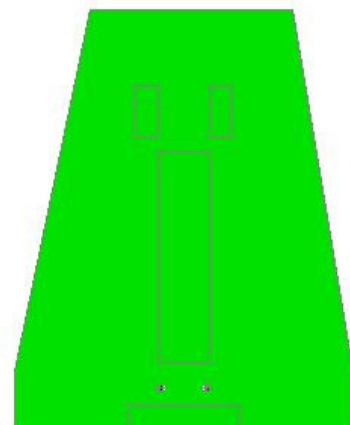
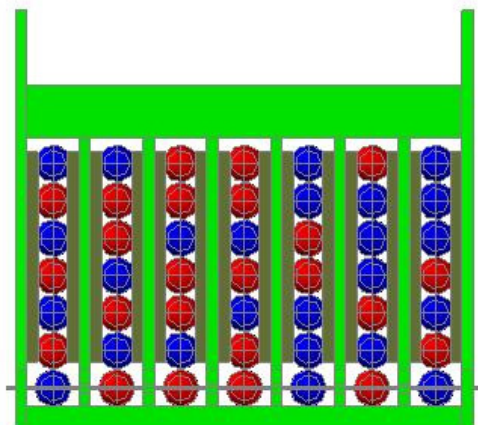
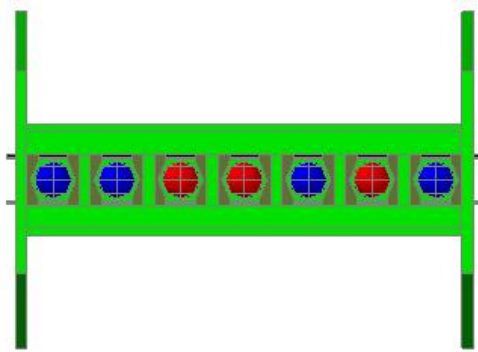
Overall Connect Court Dimensions:

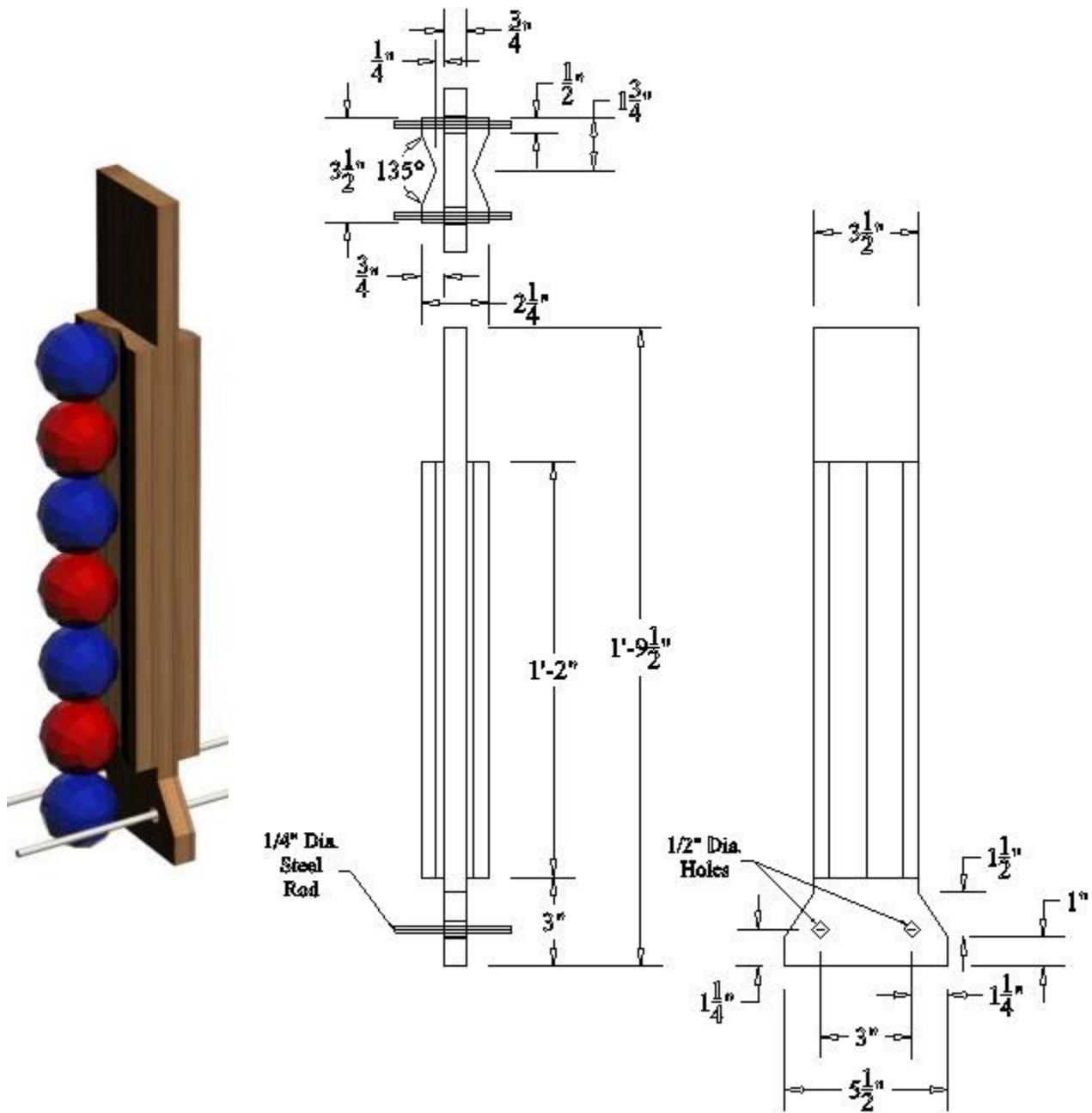
- The Court Playing Surface will be 24 by 24 feet.
- The Perimeter Court Walls will be made using 2 by 4 inch planks.
- This wall will as a result be approximately 3.5 inches tall.
- The Connect Rack Platform will be a 4 by 4 ft by $\frac{3}{4}$ in. Plywood Sheet (Good Side Up).

The Connect Rack Details:

- The Connect Rack will be positioned in the center of the Smooth Open Space Court Surface.
- The Connect Rack will be built using $\frac{3}{4}$ in Plywood, plus 2 by 4 and 2 by 8 in. planks.
- The Connect Rack will have Two $\frac{1}{4}$ in Dia. Steel Rods used to Hold / Release the Tennis Balls.

The Connect Rack:

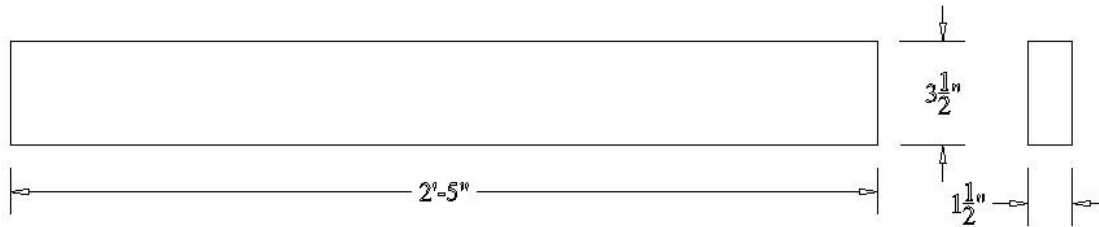




The Connect Rack Columns:

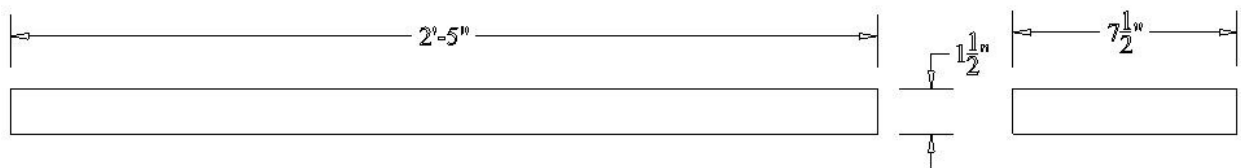
- 1) Will be fabricated from $\frac{3}{4}$ in. Plywood.
- 2) Will have Grooved Face Plates.
- 3) Will be mounted on the 2 by 8 in. Base.
- 4) Will have Holes to support the Steel Rods.

The Connect Rack Top Bars and Base:

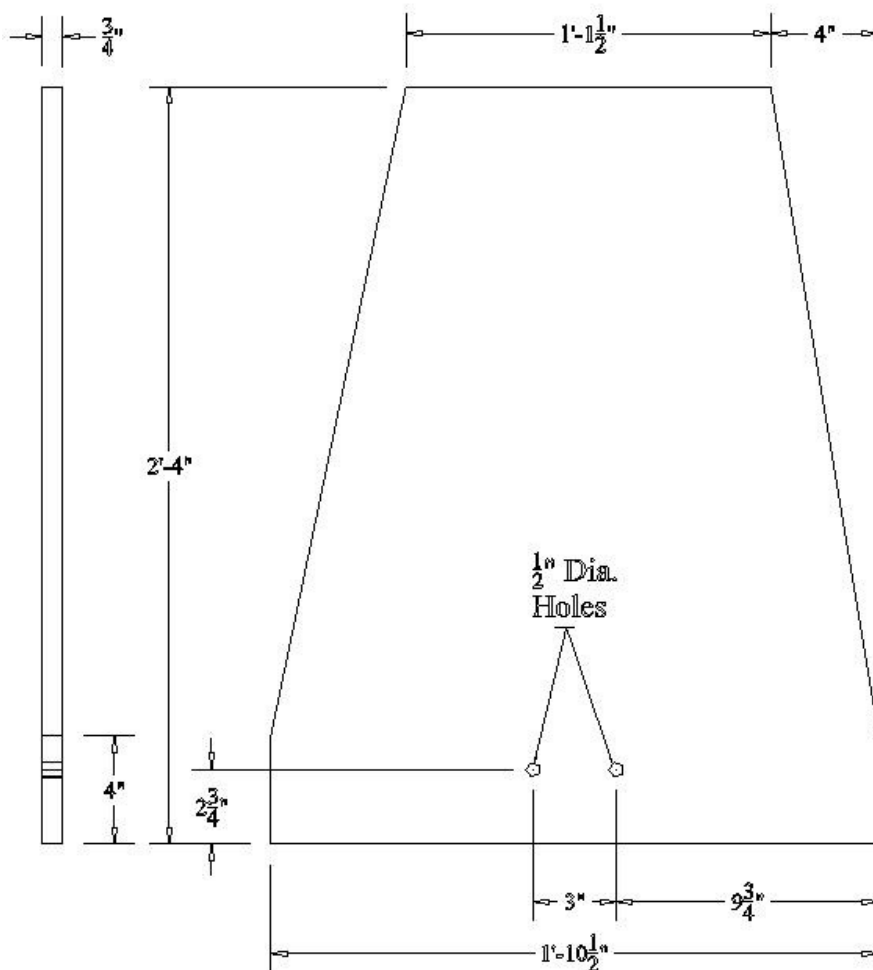


The Top Connect Rack Bars are 2 by 4's.

The Connect Rack Base is a 2 by 8.



The Connect Rack End Plate:



The Ball Launch Mechanisms will support a consistent Ball Launching Process.

<p align="center">BALL LAUNCH MECHANISM CHUTE</p>	<p align="center">LOADED BALL LAUNCH MECHANISM</p>
<p align="center">BALL LAUNCH MECHANISM BASE</p>	<p align="center">BALL LAUNCH MECHANISM BIN</p>



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PRE-INSPECTION FOR COMPLIANCE WITH SAFETY AND DESIGN RULES

- Overall volume $\leq 8 \text{ ft}^3$ (Antenna not counted) (or $13,824 \text{ in}^3$)
- Antenna $< 4 \text{ ft}$ from court floor

- No explosives/combustibles
- No lasers

- All batteries are sealed commercial batteries in good physical condition
- Batteries wired in series should be the same amp hour rating (ex. both 1500 mAh) and batteries in parallel are of same voltage (ex. both 12 volts).
- Batteries securely mounted
- Total voltage in any individual circuit does not exceed 24V
- No circuit exceeds 240W (Voltage x Fuse Current Rating)
- All circuits have a fuse or breaker (breakers must have **DC rating**)
- Appropriately gauged wiring for each circuit
- Wires and connections are in good physical condition
- Wires and connections are not exposed to physical abrasion
- Motors not over-voltaged by more than 50% (a 12V motor can be run at 18V)
- Wiring diagram provided.

- Competitor-made or modified air pressure systems do not exceed a maximum pressure of 30 psi and includes a pressure relief valve set to trigger at 30 psi
- Pressure tanks (cylinders) commercially manufactured if pressure in system exceeds 30 psi
- Pressure indicator
- Pressure in tanks does not exceed 90 psi (6.2 bar)
- Over-pressure safety valve
- Pressure tanks and related gauges and controls are shielded from damage due to collisions

- Robot is able to be turned off with a single motion. Radio receivers may be in an independent circuit.
- Only 6 channels of a single radio control unit are used for communications
- Demonstrate robot functionality with rated fuses

Additional concerns:

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Robot Evaluator Signature

Team Representative Signature