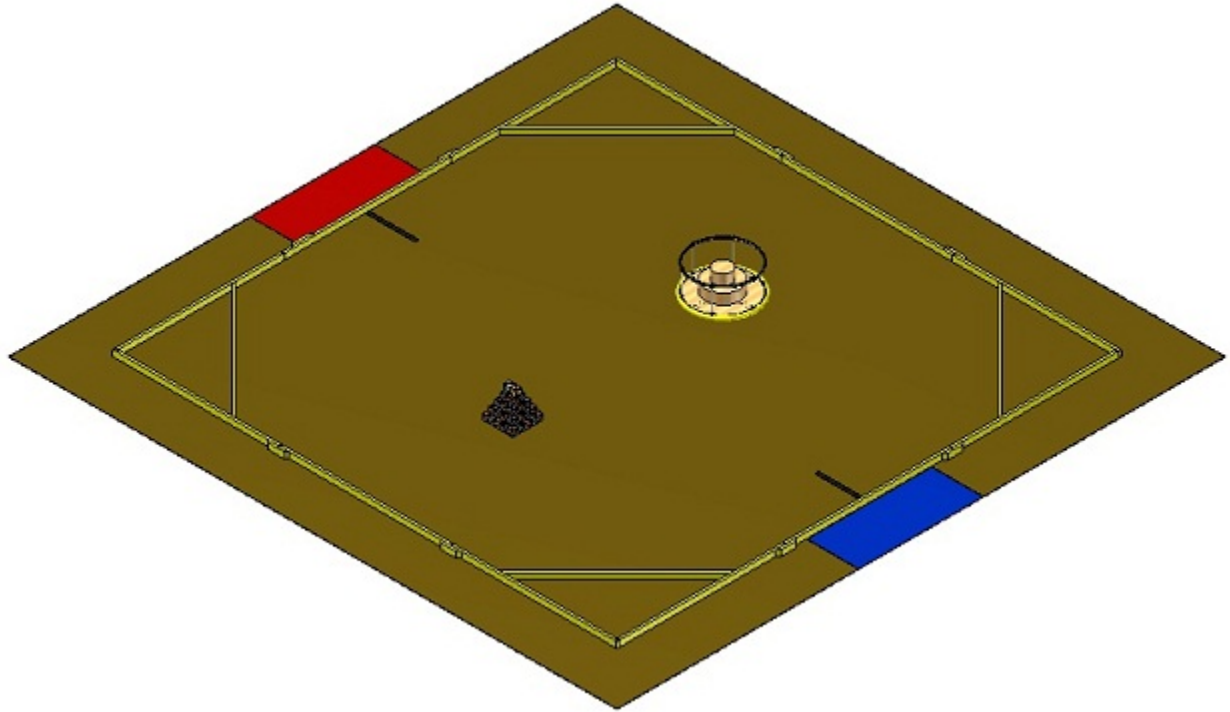


# Panning for Gold



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**FURTHER COMMUNICATIONS**

Questions for clarification of the rules can be made to the Technical Committee Chair

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2012 – British Columbia Robotics Challenge Scope – Competition 93

**TABLE OF CONTENTS**

<b>Scope Details</b>	Page 3
<b>The Game</b>	
Planview Court Image	Page 4
The Pan and Nuggets	Page 5
Expected Pan Behavior	Page 6
Panning for Gold Specific Robot Design Considerations	Page 6 - 7
Scoring	Page 7
Court Side Scoring Form	Page 8
Tournament Standing	Page 8
Game Overview	Page 8 - 9
Rules and Regulations	Page 9 - 10
Tournament Play	Page 10 - 12
Playoff Play	Page 12
Seven Team Playoff Pattern	Page 13
<b>The Court</b>	
Court Layout	Page 14
<b>The Robot</b>	
Robot Restrictions	Page 14
Start of the Game Robot Status	Page 14
Overall Robot Size	Page 15
Overall Weight	Page 15
Allowed Parts List	Page 15 - 16
Power Sources / Management	Page 16
Non-Electrical (Battery) Energy Sources	Page 17
Radios	Page 17
Pit Area	Page 17
<b>Appendix</b>	
Court Area Details	Page 18
The Pan Details	Page 19
Pre-Inspection for Compliance with Safety and Design Rules Form	Page 20



*2012 – British Columbia Robotics Challenge Scope – Competition 93*

**Level:** Secondary School      **Duration:** 5 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. 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)
- Various tools required to modify and repair robots onsite
- Safety equipment including mandatory eye protection
- Extension cord and power cord

**Supplied by the Committee:**

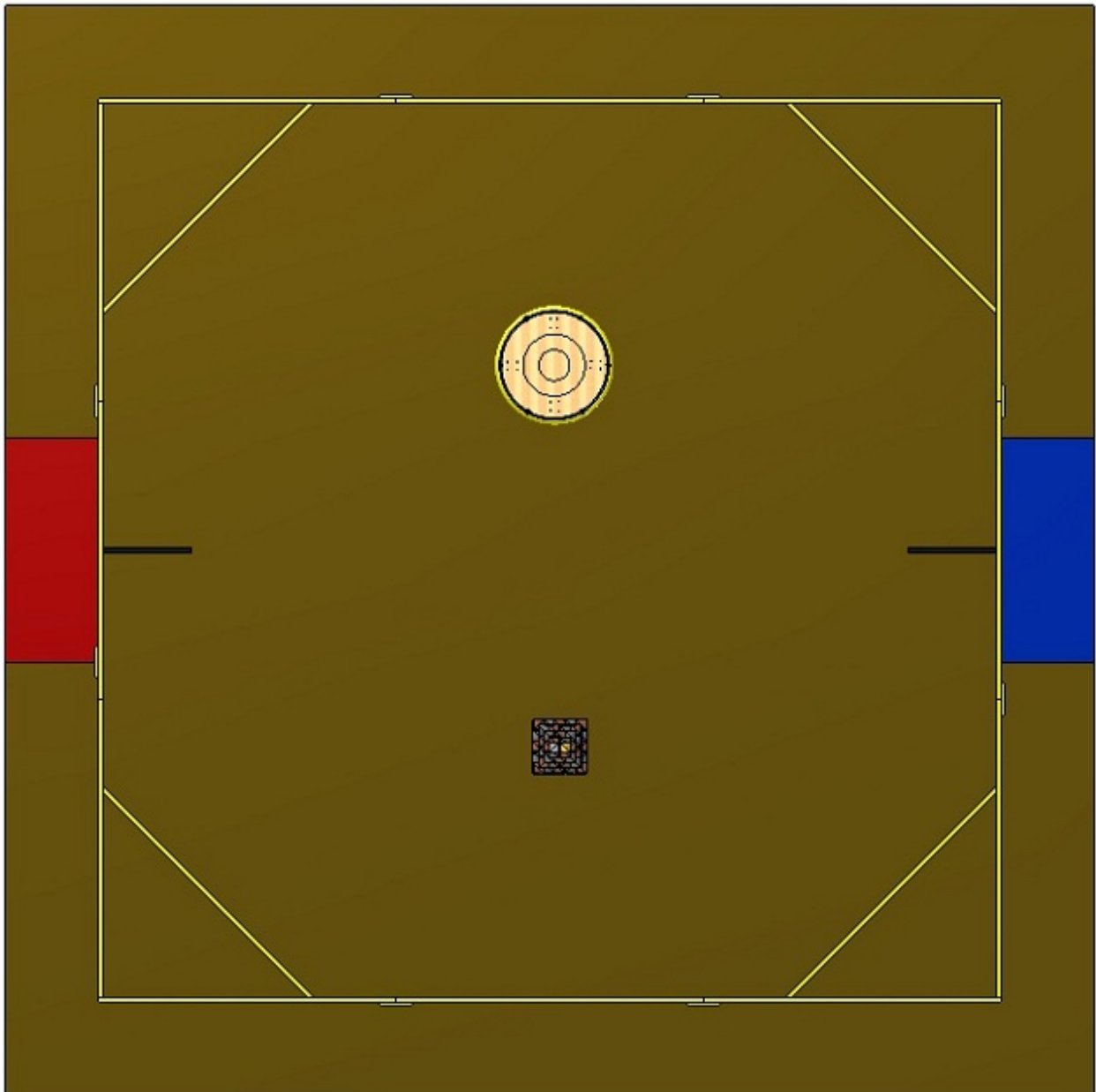
- Playing Field including Team Home Area
- One worktable with access to a 120 V power outlet (minimum 100W) per team

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

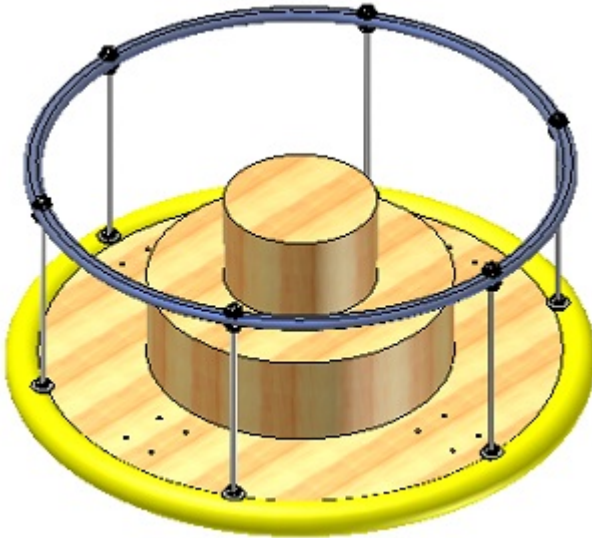
**Team Size:** Four Students maximum

**Number of Teams:** Maximum of 3 per school

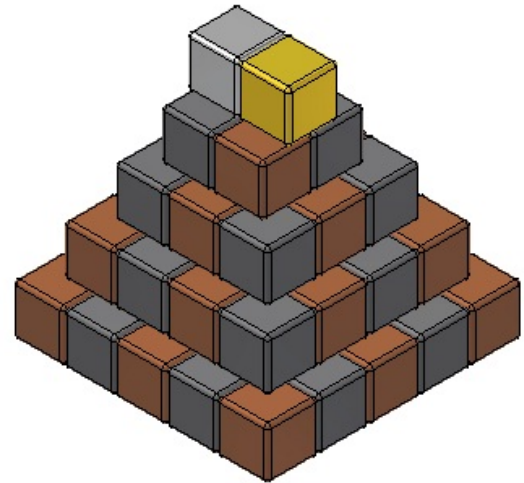
## THE GAME



The basic game concept is gathering your Assigned Colour Nuggets and delivering these Nuggets into a Shared Resource: 'The Pan'.



The Pan

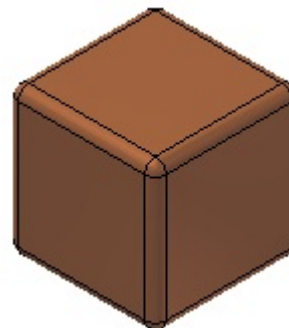


The Nugget Pyramid

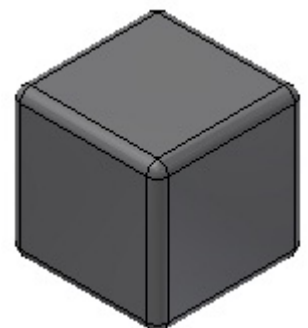
Nugget details:

- Each Nugget is a Solid Wooden Block 3.5 by 3.5 by 3.5 Inches
- Each Nugget has Rounded Edges (0.25 In. Fillet Radius)
- There are 56 Nuggets in play
- Teams are assigned 27 Copper or Nickel Nuggets
- Teams are assigned either 1 Silver or 1 Gold Nugget
- The Start of the Game Nugget Pyramid is composed as follows:

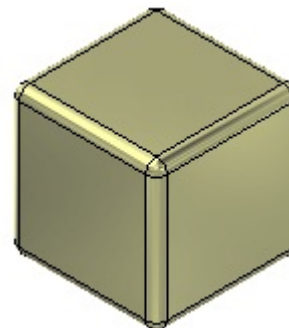
Layer 1: 13 Nickel and 12 Copper Nuggets  
 Layer 2: 8 Nickel and 8 Copper Nuggets  
 Layer 3: 4 Nickel and 5 Copper Nuggets  
 Layer 4: 2 Nickel and 2 Copper Nuggets  
 Layer 5: One Gold and One Silver Nugget



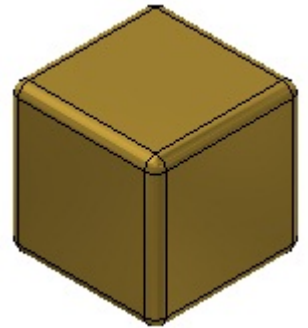
Copper Nugget



Silver Nugget

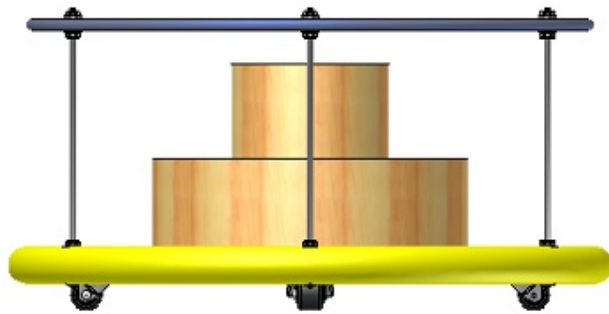


Nickel Nugget

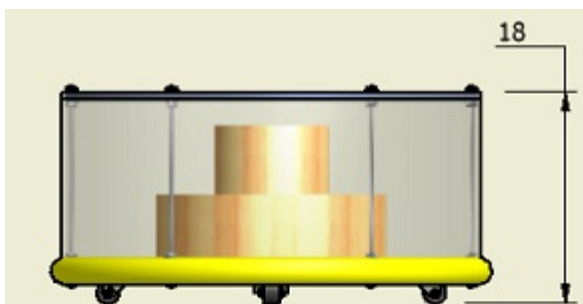


Gold Nugget

Expected ‘Pan Behavior’ in games includes:

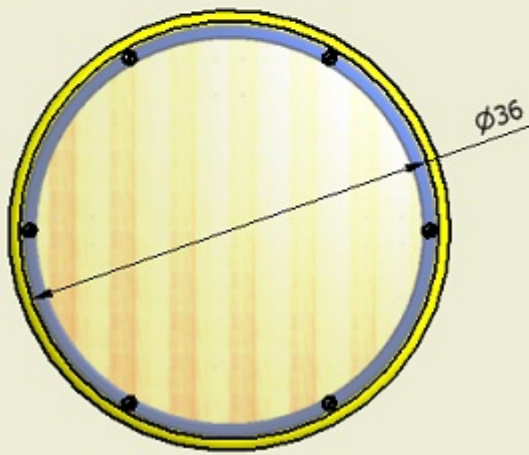


The Pan



The Pan is Shielded by a Perimeter Vertical Plane (Dia. 36 Inches) and a Horizontal Over the Pan Top Ring Plane (18 Inches Above the Court Floor).

No Part of a Robot is allowed to Break Either of these Planes at anytime.



- The Pan has four casters and will move during game play.
- **The Pan WILL Hit: Nuggets, the Court Perimeter Walls AND Robots during game play.**
- Robots are allowed to Hit (Bump into) the Pan to move it. The expected relationship in this situation is similar the relationship between a Cue Ball and a Cue in Pool.
- Robots are NOT Allowed to Touch the Pan’s Upper Ring or the Posts supporting the Upper Ring.
- Robots are allowed to Push the Pan to move it. Push is defined as maintaining Robot Bumper / Side of the Robot / Back of the Robot contact with the Pan’s Bumper Ring while the Robot is moving.
- **Robots are NOT ALLOWED to Grasp or Hold Onto the Pan with any type of mechanical system at anytime during game play.**



2012 – British Columbia Robotics Challenge Scope – Competition 93

### **Panning Game Specific Robot Design Considerations**

- Robot designs MUST take into consideration that Robots WILL BE HIT by the Pan from random directions.
- If Robot Drive Systems / Nugget Collection or Delivery Systems / Frames BREAK as the result of contact by the Pan this will be considered to be ‘Part of Game Play’.
- Robots are NOT allowed to Ram or Push Opponent Robots directly. However, if Two Robots are voluntarily choosing to push ‘The Pan’ from opposite sides at the same time it will be allowed.
- Teams must understand that if two Robots choose to push the Pan from opposite sides at the same time there is a possibility the Pan will ‘Unexpectedly Pop Out’ and the Robots will collide.

### **Robot Nugget Management System Restrictions**

- Robots may NOT be in possession of more than ONE Nugget in their combined Nugget Collection / Delivery System at anytime during game play.
- Teams may deliver Nuggets by:
  - Reaching Out Over the Pan and Dropping a Nugget into the Pan,
  - Tossing / Flipping / Throwing / Pushing a Nugget into the Pan from beyond the Pan Bumper
  - The MAXIMUM Distance a Nugget Delivery Systems is allowed to Project / Deliver a Nugget is 24 inches measured from the leading edge of the robot.
- **Nugget Delivery System Performance will be tested during the Robot Inspection Process and Robots not complying with the Maximum 24 inch Delivery Restriction will NOT be allowed participate in games until they have modified their Delivery System to be in compliance with the 24 inch Delivery restriction.**

### **Scoring**

- **Nuggets must be ‘On / In the Pan at the end of the game to be awarded points.**
- Copper and Nickel Nuggets ON the Pan Floor / Bumper have a value of One Point each.
- Copper and Nickel Nuggets ON the Pan’s First Tier have a value of Two Points each.
- Copper and Nickel Nuggets ON the Pan’s Second Tier have a value of Three Points each.
- Silver and Gold Nuggets have a value of 3 Times the value of their position on the Pan:  
Examples: 3 Points on the Pan Floor / Bumper, 6 Points on the First Tier and 9 Points on the Second Tier.
- ON a Tier is defined as: Nuggets hanging over the edge of a Tier count as ‘ON the Tier’ as long



2012 – British Columbia Robotics Challenge Scope – Competition 93  
 as they are NOT touching anything off the tier.

- Nuggets hanging over the edge of a tier and TOUCHING a Nugget on a lower level will be assigned the Point Value of the Lower Level.

2012 Edmonton Robotics Score Sheet				Special Nuggets Placement Value 3 Times their Location Value		
Game # Team Name	Nuggets on Pan Floor / Bumper Value One Point Each	Nuggets on Tier One Value 2 Points Each	Nuggets on Tier Two Value 3 Points Each	Special Nugget is on Pan Floor / Bumper	Special Nugget is on Tier One	Special Nugget is on Tier Two
<b>Team Signature:</b>						
Game # Team Name	Nuggets on Pan Floor / Bumper Value One Point Each	Nuggets on Tier One Value 2 Points Each	Nuggets on Tier Two Value 3 Points Each	Special Nugget is on Pan Floor / Bumper	Special Nugget is on Tier One	Special Nugget is on Tier Two
<b>Team Signature:</b>						

### Tournament Standing

A Team’s Tournament Standing will be determined by the total number of Points scored in ALL of a Team’s Tournament Games Combined.

Tie Games are allowed during Tournament Game Play.

Tournament Standing Ties will be broken by the playing of Direct Head to Head Tie Breaker Game(s).

### Game Overview

- Games will involve Two Robots at a time.
- All Teams will participate in an equal number of Games.
- Robots share a smooth open court area.
- Robots will attempt to Collect and Deliver Nuggets into the Pan.
- Robots must stop all operation when the time ends.

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.



2012 – British Columbia Robotics Challenge Scope – Competition 93

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

Strategies aimed at deliberately damaging other robots is 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 **THERE WILL BE ACCIDENTAL ROBOT COLLISIONS**. Teams need to take this into consideration when designing their robot.

**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 Team will be assigned a Start of the Game Position.
2. Each team will be assigned a Driver's Area along courtside directly behind their Start of the Game Position.
3. Drivers and Spotters **MUST** wear Safety Glasses during Game Play.
4. A Robot may be in possession of a Maximum of 1 Nugget at a time.
5. Robots **ARE NOT ALLOWED** to take possession of an Opponent's Nugget. Possession of an Opponent's Nugget means it is in either your Nugget collection or Nugget Delivery Mechanism. IF a Robot accidentally takes possession of an Opponent's Nugget then this Robot must return the Opponent's Nugget to the Open Court Surface **BEFORE** they will be allowed to deliver any of their own Nuggets into the Pan.

Note: If an Opponent's Nugget lands on a robot or becomes stuck under a robot then the robot will **NOT** be considered to be in possession of this Nugget in either of these situations.

Note: Teams may **NOT** attempt to retrieve their Nuggets from on or under an Opponent robot.

Note: If an Opponent's Nugget lands on a Robot then this Nugget must be left where it is independent of whether or not it is in a position where it is interfering with the Robot's operation.



*2012 – British Columbia Robotics Challenge Scope – Competition 93*

Note: Teams should shield critical components such as their Emergency Switch from being hit or interfered with by random Nuggets.

6. Robots ARE Allowed to Push ALL Nuggets around on the Open Court Floor including the Opponent's Nuggets.

Note: This includes deliberately moving / pushing Nuggets around for the purpose of 'Burying an Opponent's Special Nugget'.

Note: If an Opponent has initiated its' Nugget Collection System to Pick up a Nugget then a Robot CANNOT Interfere by moving / pushing Nuggets to cause the specific Nugget the Opponent is in the act of collecting / Picking Up to move.

7. If a Missed Delivery results in a Nugget remaining on the Open Court Floor then a Robot may retrieve this Nugget and attempt to deliver it into the Pan again.
8. If a Missed Delivery results in a Nugget exiting the Court Area or landing inside the Corner Framed Areas then this Nugget will be deemed Out of Play and NOT returned to the Court.
9. Robots may Push or Bump the Pan.
10. Robots may NOT Grasp / Pull Pan.
11. Teams may NOT install a camera, mirror or other image generating device on their robot for the purpose of projecting an image visible to either the Spotter or Driver.

### **TOURNAMENT PLAY**

1. Teams will play in tournament games.
2. Teams will participate in an equal number of games against each opponent Team.
3. The Tournament will be structured to provide all teams with an equal number of 2 Robot game experiences. Example: In 2010 each Team had 21 Game Experiences during Tournament Play.
4. Tournament 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 tournament.
6. Between tournament 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.



*2012 – British Columbia Robotics Challenge Scope – Competition 93*

9. Damaging the court and or the Pan / Nuggets is illegal. If a robot's design causes damage to the court / Pan or Nuggets then it will not be allowed to compete until it can operate without causing damage. Games missed due to this situation will be forfeited.

NOTE: Damage is considered to be BREAKING court components. Robots bumping into court components and causing them to shift position without breaking any court element will NOT be considered to be damaging the court. It is expected that all court components will be fixed firmly in place so that the court is a Neutral Factor in the competition.

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. Ramming and pushing of Opponent Robots is not allowed.

Note: A warning will be given for the first offense. **Only ONE Warning will be given for the entire Tournament.** Forfeiture of, and removal from the game will result with the Second occurrence. Expulsion from the competition will occur after the third.

NOTE: **Teams MUST expect there WILL BE ACCIDENTAL COLLISIONS during game play.**

10. Games will start on time. Teams are responsible to know when their games are scheduled. Teams arriving late will be allowed to use the remainder of the time in the game.
11. 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'.
12. Competitors cannot enter onto the court surface or make adjustments to their robot during a game.
13. 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 shutting off of the robot during a game. Disabled robots or parts of robots not generating any safety concerns will be left on the court until the game time expires.
14. 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.
15. Drivers must remain in their Assigned Area throughout the game.
16. Spotters may move freely within the shared spotter's areas.
17. Spotters may **not** enter an opponent team's Drivers area.
18. At the start of a game, robots are expected to be in their assigned starting positions. Robots arriving **AFTER** the game has started will be allowed to enter the game and use the Time remaining in the 4 min. game.
19. Competitors must remain outside the court boundaries.
20. Robots must not leave the competition court at any time during a game.



*2012 – British Columbia Robotics Challenge Scope – Competition 93*

21. It will be a referee's ruling that decides if an 'End of the Game Shot' took place before or after the game-ending buzzer sounded.
22. Nuggets landing outside the court boundaries, as a result of Robot Behavior, **will not be returned** to the Competition Court.
23. Deliberate ramming of an opponent robot will **not** be allowed.

**PLAYOFF PLAY**

1. Two Robots will play on the court in playoff games.
2. Playoff games will be Standard Game Length (4-minutes).
3. Playoff games cannot end in a tie. If a tie score exists in a Playoff Game then additional 4 minute periods will be played (as many as needed) until one of these extra periods ends with one team ahead. Note: Teams will be allowed to return to their Pit Area Table to make repairs, change batteries between the extra periods of a playoff game. If 'Overtime Periods' are required the time between these periods will be set at 4 min.
4. The Playoffs will be structured on a Double Knock-Out Format. Teams will need to lose TWO Playoff Games to be eliminated.
5. Initial Playoff Game Pairings will be based on the Final Tournament Standings.



2012 – British Columbia Robotics Challenge Scope – Competition 93

## **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 inch tolerance.

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

- 1) The open court surface consists of masonite sheets smooth side up with duct taped seams, 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 Center Net Structure is made from 2 by 4 inch planks.

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

## **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:

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



2012 – British Columbia Robotics Challenge Scope – Competition 93

### **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
- (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.

### **SUGGESTED 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 | • chains  | • bearings             |
| • motors                       | • belts   | • compressed air tanks |
| • gears                        | • pulleys | • gauges               |
| • sprockets                    | • tires   | • tubing connectors    |
|                                | • rims    |                        |



2012 – British Columbia Robotics Challenge Scope – Competition 93

- RC transmitter / receiver
- servo motors
- batteries
- harvested gearboxes from mechanical devices
- PLC unit and interface
- Microprocessor

### 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.
- 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 standards.

### 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. Teams must develop circuit diagrams, and calculate the appropriate values for all circuits on their robot. Teams must submit a wiring diagram of their robot's circuits.
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. Robots must be able to be turned off with a single motion. Radio receivers may be in an independent circuit.
10. Teams may use new or re-cycled motors. See list of suggested parts.
11. There is no restriction on the number of motors used on a single robot.
12. No explosive materials of any kind may be used (ether, gunpowder, acetylene etc.).



2012 – British Columbia Robotics Challenge Scope – Competition 93

### NON-ELECTRICAL (BATTERY) ENERGY SOURCES

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.

1. Air pressure systems using Competitor-made or modified air pressure hardware are NOT permitted.
2. All pressurized tanks on robots must have a pressure gauge to indicate the stored pressure and a form of automatic overpressure safety relief.
3. The pressure tanks and related gauges / controls must be shielded from damage due to collisions or flying target objects.
4. The stored pressure in the tank must not exceed a maximum of 90 PSI at any time.
5. 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.
6. Laser devices are prohibited.

### RADIOS

1. All teams are encouraged to use 2.4 GHz “non crystal” radios, but please contact Randy for acceptance of your radio and receiver.
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.

### PIT AREA

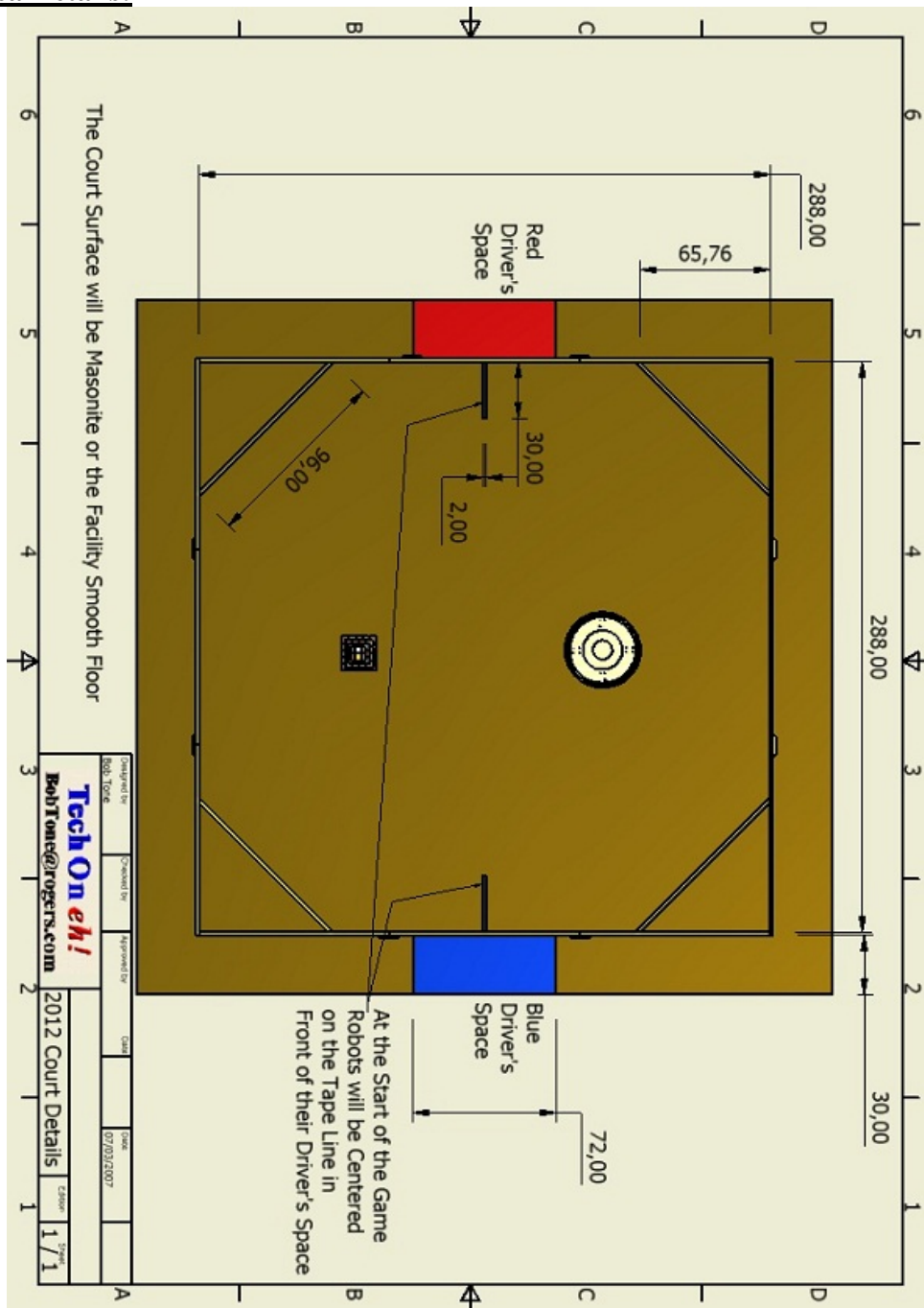
1. Only registered robot competitors are permitted in the pit area.
2. Designated teacher/industry team advisors are permitted in the pit area **only** to inspect the worktable setup of their team prior to the start of the tournament.
3. Designated teacher/industry team advisors are **not** allowed in 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**

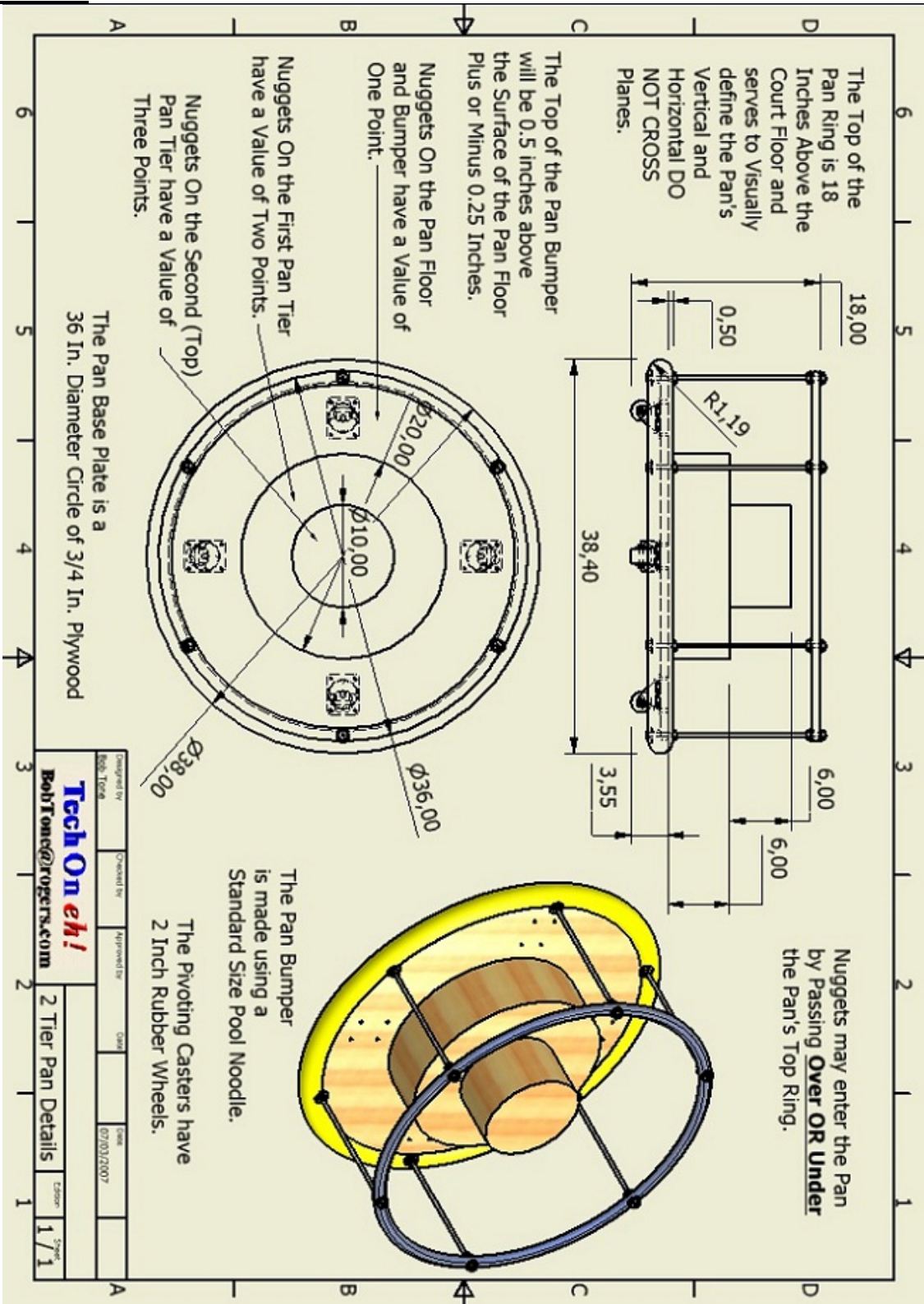
**Overall Court Dimensions:**

- 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.

**Court Area Details:**



**Pan Details:**





2012 – British Columbia Robotics Challenge Scope – Competition 93

**PRE-INSPECTION FOR COMPLIANCE WITH SAFETY AND DESIGN RULES**

- 24 Inch Maximum Nugget Delivery System Performance Criteria Met
- Mandatory Wiring Diagram provided.
- Mandatory Pressure System Circuit Diagram provided.
- Table Top Robot Stand
- 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)
- No Competitor-made or modified air pressure hardware being used.
- 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