1. Purpose of the Contest

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

2. Criteria

3. Number of Stations / Allocations

There is a maximum of sixteen (16) spaces available.

Please note: there is no limit to the number of students who can help to build the robot, however, only a team of two (2) students will represent their group the day of the contest and be permitted on the play field. These two students must register online with Skills Canada – Nova Scotia, no later than March 9, 2018. Students can register at www.skillsns.ca

4. Skills & Knowledge to be Tested

- Drafting;
- Mechanics;
- Electronics;
- Metalwork;
- Woodworking;
- Communications.

5. Duration of the Contest (Schedule)

THURSDAY, APRIL 5, 2018

<table>
<thead>
<tr>
<th>Time</th>
<th>Task</th>
</tr>
</thead>
<tbody>
<tr>
<td>5:00 pm – 7:00 pm</td>
<td>Technical inspection. Teams can arrive at any time from 5:00 pm until 7:00 pm for a technical inspection.</td>
</tr>
</tbody>
</table>
This inspection is mandatory and teams must attend an inspection before being permitted to compete.

FRIDAY, APRIL 6, 2018

<table>
<thead>
<tr>
<th>Time</th>
<th>Task</th>
</tr>
</thead>
<tbody>
<tr>
<td>7:00 am</td>
<td>Doors open. Teams are welcome to set up and practice before the heats begin. Any teams that have not had a technical inspection must do so at this time. Please note, time will be extremely limited to make any modifications to the robot.</td>
</tr>
<tr>
<td>9:00 am</td>
<td>Heats start</td>
</tr>
<tr>
<td>12:00 pm</td>
<td>Lunch (provided)</td>
</tr>
<tr>
<td>3:00 pm</td>
<td>Robotics contest ends</td>
</tr>
<tr>
<td>3:30 pm</td>
<td>Medal presentation</td>
</tr>
</tbody>
</table>

6. Prerequisites

**SCNS Prerequisites**

- Attend a public or private secondary institute;
- Be between 13 and 21 years of age on January 1 of the year of the Competition;
- Have been earning junior or senior high school credits any time during the current academic year (September to June);
- Be registered as a competitor with Skills Canada – Nova Scotia;
- Possess a Canadian citizenship or landed immigrant status and be a resident of Nova Scotia. Competitors are responsible for verifying this information if requested;
- Have completed and submitted a signed release form by a parent or guardian, if under the age of 19.

7. Equipment & Clothing

a) What Will Be Supplied

- Playing Field, including Team Home Area;
• One worktable with access to a 120V (min 1000W) power outlet.

b) What Competitors Must Supply

• Robots;
• Easily accessible fuses;
• Easily accessible kill switch/es;
• Robot Accessories including:
  o Batteries;
  o Controller(s);
  o Battery charger;
  o Spare parts.
• Various tools required to modify and repair robots onsite;
• Safety equipment including mandatory eye protection;
• Pre-inspection checklist;
• Wiring diagram;
• Extension cord and power bar;
• Robot stand.

8. Evaluation & Judging Criteria

Outlined in the technical contest description document (below).

9. Additional Information

10. PTC Contact Information

Paul Standing: paul_standing@cbu.ca
Bill Robinson: bill_robinson@cbu.ca
2018 Nova Scotia Skills Competition

MOBILE ROBOTICS

SECONDARY / NIVEAU SECONDAIRE
Pipeline
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1. **Definition of terms referenced in this document**
   a) ‘**Tele-Operated Robot Elements**’ are elements under the direct / active control of competitors during game play using one or two radios/game controllers held by the courtside competitors.

   b) ‘**Mobile Independent Autonomous Mobile Robot Elements**’ are elements that at the start of a game have a competitor pressing their start button or enter on a computer keyboard as the only competitor to Independent Autonomous Mobile Robot Element communication during the entire game.

   c) ‘**Stationary Independent Autonomous Elements**’ are elements that have their power on at the start of games but have no direct contact with a competitor during game play. These units may interact with the team’s tele-operated mobile robot with the actions of the tele-operated mobile robot triggering an active response by the Independent Autonomous Element, which may be managed either by a mechanical based system (e.g. a series of limit switches / no programmed elements) or a pre-programmed system (e.g. managed by an Arduino or other microprocessor) internal to the Independent Autonomous Element.

2. **The Pipeline Teleoperation Game Overview**
   The core game situation requires a robot or robots to build a pair of pipelines to deliver the oil (one-inch ball bearings) through these pipelines to the refinery. In the event of a spill, the robots will be required to clean up the spill by delivering the oil (the bearings) to a ‘Designated Hazardous Waste Containment Site.’
Each team’s ‘Exclusive Use Area’ is approximately 8 ft. x 16 ft.
Each team’s ‘Exclusive Use Area’ has:

- 9 Pipe Cradles 6.00 x 4.50 x 2.00 in.
- 9 Pipes: 12 in. long and 1.5 in. Inside Dia.

The Pipes are stacked in fixed Position Racks.

The Pipe Cradles are in stacks of three (3).

Each team has two (2) Oil Wells with 10 One Inch Dia. Ball Bearings (oil) in each Well.

Each team has two (2) ‘Pipeline Pathways’ defined by the tape lines shown above. A refinery destination for the oil delivery (purple area above). A ‘Hazardous Materials Containment Area’ destination for spilled oil (red area above).
Cradles must be positioned completely between the pipeline pathway tape lines to be awarded a point.

The inside edge of the pipeline pathway tape lines establishes a vertical plane. Cradles breaking this plane will NOT be awarded any points.

Cradles standing on-end or upside down will NOT be awarded points.

If a stack of cradles is correctly positioned between the pipeline pathway tape lines, a point will be awarded for ONLY the bottom cradle.

Pipes must be held above the court floor to be awarded points.

One cradle and two pipe points awarded.
<table>
<thead>
<tr>
<th>One point awarded</th>
<th>Pipe points will be awarded independent of whether or not the pipe is breaking the tape line vertical plane.</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO point awarded when the pipe is touching the court floor.</td>
<td>When a cradle is in a ‘No Point Awarded Position,’ then no point will be awarded for a pipe supported by that cradle.</td>
</tr>
<tr>
<td>Any bearings that are spilled from the oil well must be allowed to touch the ground. They <strong>cannot</strong> be collected directly from the oil well pipe.</td>
<td>Any bearing in the open court can be collected and put in the ‘Hazardous Material Containment Area.’</td>
</tr>
</tbody>
</table>
**Scoring Summary** (scoring will be done at the end of the 4 minute match):

a) **1 Point** for each pipe cradle placed between the tape guidelines.

b) **2 Points** for each pipe successfully placed on a cradle.
   Note: MUST be placed on a scored cradle.

c) **2 points** for each bearing delivered into the refinery.
   Note: bearings MUST be delivered into the refinery through a completed pipeline.

d) **1 point each** for each bearing placed in the ‘Hazardous Material Waste area.’

e) **MINUS 1 point** for any bearing left on the floor.

f) **0 points** for bearings in the possession of the robot (off the floor) at the end of the game.

g) A **bonus point** will be awarded to the team that delivers all of the oil (bearings) through the pipelines into the refinery, first.

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**Teleoperation Pipeline Game Description**

- Games will involve two teams at a time.
- Both competitors are permitted unrestricted movement around the perimeter of their team’s assigned court area.
- Teams can utilize a maximum of two (2) tele-operated robots.
- Teams may also have independent autonomous elements as part of their entry.
- Teams will **NOT** be in possession of a part at the start of a game.
- Each team’s robot **CAN** be in possession of more than one cradle or pipe at any time.

- Teams must build their pipelines using only the provided cradles and pipes.
- Teams cannot use any mechanical devices or tape elements to secure pipes or cradles in place.
- When teams release the oil (bearings) from a well they must ensure that **ALL** elements of their robots are well away from the pipeline to ensure that no element of their robot’s frames / wheels / object management systems are in a position to prevent / hold the pipeline from breaking apart.

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3. **Pit Area and Court Access**

- A pit area is provided so that students may make repairs and improvements to their robots between games. Please note: teachers/coaches are **NOT** permitted in the pit area once the competition has started.
- Teams **MUST** bring their robots into the skill area at orientation.
- The pit area and contest court may be available to teams to work or practice
during the lunch break, if a PTC member is present.

4. **Tournament Play**

   a) The pipeline game tournament is based on an ‘Unseeded Tournament Format.’

   b) The pipeline tournament standing is based on a total score in all games played by each team.

   c) Teams play in an equal number of tournament games.

   d) If time permits, teams participate in an equal number of games against each opponent team.

   e) In the event of a tournament standing tie, a special two (2) minute tie-breaking game is played.

   f) Pipeline playoffs follow a ‘Seeded Tournament Format.’

   g) Pipeline playoffs is a double knockout format.

   h) Tournament and playoff games last four (4) minutes.

   i) The amount of time between games is determined by the number of participants. This information is provided to teams at the start of the tournament. Between tournament games, battery changes and repairs to robots may be completed at the team’s assigned ‘Pit Area Worktable.’

   j) During the competition, protective safety glasses are to be worn while performing material removal tasks (cutting, drilling, etc.).

   l) During game play, referees will have ultimate authority over game rulings, and will have full authority over team conduct in the court area.

   m) Damaging the court area is strictly prohibited. If a robot’s design causes damage to the court elements, it will not be permitted to compete until it can operate without causing damage. Games missed due to this situation will be forfeited. Please 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.

n) Games will start on time. Teams are responsible to know when their games are scheduled. Teams arriving late are not permitted to use the remainder of the time in the game. Competitors cannot enter onto the court surface or make adjustments to their robot during a game.

o) If a robot is malfunctioning 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 shutting off 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.

p) It is a team decision what roles team members will fill. A ‘Driver’ is the competitor holding the robot controller and asserting direct control over a tele-operated robot. The ‘Spotter’ is the competitor providing navigational guidance to the ‘Driver.’

q) Competitors may change roles while a game is in progress.

r) Competitors (‘Driver’ and ‘Spotter’) can move freely in their ‘Assigned Courtside Team Area’ throughout the game.

s) Competitors may not enter an opponent team’s ‘Assigned Courtside Team Area’ at any time during game play.

t) At the start of a game, robots are expected to be in their designated starting positions.

u) Robots arriving AFTER a game has started will be allowed to enter the game and use the time remaining in the 4 minute game.

v) Robots must not leave the contest court at any time during a game.
w) It will be a referee’s ruling that decides if an ‘End of the Game’ piece delivery took place before or after the game-ending buzzer sounded.

x) If a pipe, cradle or bearing falls out of the court, it may not be retrieved and will be out of the limits of play.

y) Robots must build their pipeline using ONLY the provided pipes and cradles.

z) Robots cannot use tape or mechanical devices to hold pipeline elements together.

aa) Robots must be positioned outside the pipeline tape pathway, when the oil (bearings) is released from the well, to ensure no part of a robot (wheels / frame / object management system) is providing support for or holding the pipeline together.

bb) Scoring will take place after the ‘End of the Game’ buzzer.

cc) No aerial (flying) robots are permitted.

5. 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 allow your robot designs to permit for a possible ½-inch tolerance.

The primary court items that have a direct bearing on robot design are the following:
• The open court surface will consist of the ‘good side’ of plywood sheets OR the facility floor OR the smooth side of Masonite sheeting.

Detailed court information has been included in the ‘Appendix' section of this document.

6. The Robot(s)

• All tele-operated robots must pass a pre-competition technical inspection for compliance with the safety and design rules before it will be permitted to participate in tournament games.

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

The mandatory technical inspection will take place on Thursday, April 5th at the NSCC Ivany (Waterfront) Campus from 5:00 pm to 7:00 pm in the Woodside Wing, room 4732-38. If you are unable to attend the technical inspection on April 5th, a limited time slot is also available on Friday, April 6th at 7:00 am. Should you choose the April 6th slot, please be advised that time will be extremely limited to make any modifications to your robot.

7. **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 be met:
   - Robots must be stationary;
   - Robots must be in their designated starting location;
   - If team entries involve multiple robots / mechanisms, then all of them must be placed in the designated starting location and must be positioned to not exceed the permitted total 4 cu ft. volume per team.
   - All systems may be ON;
   - Air system circuits may be fully charged to 100 PSI and their compressors can be ON.

8. **Overall Team Robot Entry Size**
   - Complete team entries must not exceed an overall size of 4 cubic feet (**6,912 cubic inches**) at the start of each game;
   - Team entries may expand to a larger size once a game has started;
   - Overall team entry size is calculated by using the maximum single dimension in each category (length / width / height) of the complete team entry, not average dimensions;
   - This overall size maximum will allow team entries to be any variation / combination of elements that does not exceed **6,912 cubic inches**, using the following formula: volume = length x width x height.

9. **Power Sources / Management**
   - The total voltage in any individual circuit cannot exceed 24 volts;
   - The maximum continuous power rating allowed in any circuit branch is 240 W, which is limited by voltage and fuse selection. A larger main fuse can be used to provide protection for motor controllers. To calculate power in any given circuit, use the following formula: power (watts) = voltage (volts) x current (amps);
Teams are reminded that the purpose of a fuse is to protect the students 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;

- Each current branch path from the battery must include either an in-line fuse, resettable fuse, circuit breaker; or be connected to a dedicated fuse in a rack;
- Batteries must be complete sealed commercial battery packs;
- ALL robots must be able to be turned off with a single motion;
- Robot controller receivers may be in an independent circuit;
- No explosive materials of any kind may be used (ether, gunpowder, acetylene etc.).

10. Non-Electrical (Battery) Energy Sources

- Pressure-based energy sources (air or other) may be pre-charged to a maximum of 100-PSI pressure in their reservoirs (cylinders) at the start of each game;
- Air pressure systems using competitor made or modified air pressure hardware are NOT permitted;
- All pressurized tanks on robots must have a pressure gauge to indicate the stored pressure and a form of automatic overpressure safety relief system;
- The pressure tanks and related gauges / controls must be shielded from damage due to collisions or flying target objects;
- The stored pressure in the tank must not exceed a maximum of 100 PSI at any time;
11. **Recommended Robot Controllers**
- It is recommended (not required) that all teams use 2.4 GHz “non-crystal” control systems on tele-operated Robots;
- Teams are permitted the use of an unlimited amount of channels, but only two separate tele-operated robots. Teams assume full responsibility if any interference is to occur with their respective communication systems that could render the robot(s) useless;
- Tele-operated robots may not transmit audio/visual information to off-the-robot devices. (i.e. having a camera transmit images real time to a computer near the driver, etc.).

12. **Pit Area**
- Competitors MUST wear safety glasses while doing fabrication work involving material removal processes (grinding / cutting);
- Only registered robot are permitted in the contest space;
- 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;
- Designated teacher / industry team advisors are not permitted in the pit area during tournament play;
- Teacher / industry team advisors are not permitted to handle tools or robot parts. Students must affect all repairs and modifications on their robot;
- Teams are provided with a pit area workspace on a standard project table. Depending on the number of teams and availability of space, teams may share a 60 x 30 inch table;
- It is required that teams fabricate a tabletop stand for holding their robot(s) in the pit area. This stand(s) should hold the robot(s) securely and be capable of preventing the robot(s) from driving on or off the table in the case of either deliberate motor testing during repairs or due to random, unexpected motor activity.

13. **Overall Court Description**
- The court playing surface will be a 16’ x 16’ square;
- Individual exclusive use team spaces are 8’ x 16’ rectangles;
- The perimeter court walls are constructed using 2 x 4 inch planks;
  - This wall will be approximately 3.5 inches tall;
- The court surface may vary between melamine, concrete, hardboard, or plywood.
14. Pre-inspection for Compliance with Safety and Design Rules

☐ Mandatory Wiring Diagram provided.
☐ Table Top Robot Stand
☐ Overall volume ≤ 4 ft³ or 6,912 in³
☐ No explosives/c 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 branch exceeds 240W (Voltage x Fuse Current Rating, easily accessible)
☐ All circuits have a fuse or breaker (breakers must have DC rating) and all Fuses / Breakers must be readily accessible.
☐ Mandatory Pressure System Circuit Diagram provided.
☐ No Competitor-made or modified air pressure hardware being used.
☐ Only commercially manufactured Pressure Tanks (cylinders) can be used.
☐ Pressure indicator
☐ Pressure in tanks does not exceed 100 psi
☐ 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 / Logic circuits may be independent of the kill switch.
☐ Control unit to support operator to robot communication are being used.
☐ Demonstration of robot functionality

Additional concerns:

Robot Evaluator Signature

Team Representative Signature
One team’s exclusive use oil wells

Note: The Pull Block is a 1.5 by 1.5 by 1.5 In. Cube

Note: The Center of the Pull Block will be approximately 12 Inches Above the court floor. Teams must be prepared to manage a Plus or Minus One Inch in this value during game play.

Oil well pull block