



PROJECT

#23 – Mobile Robotics

SECONDARY

Gold Mine Operation

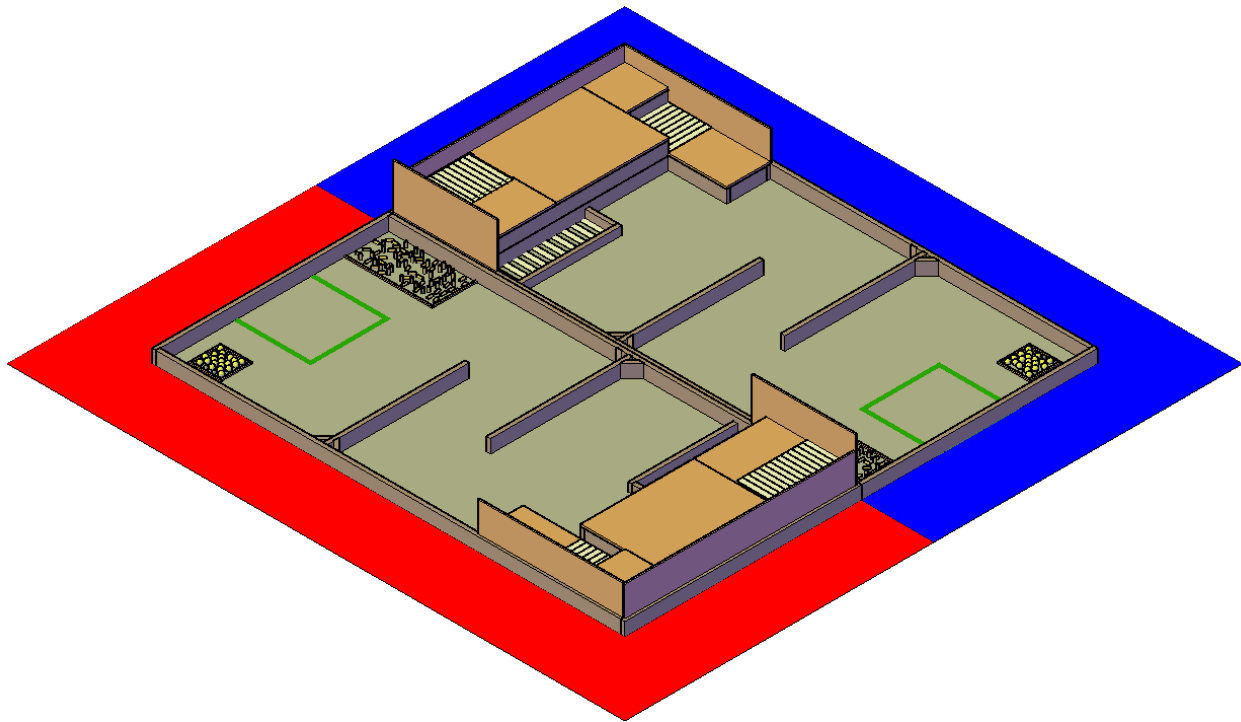


Figure 1: Overall Court

Date: April 26th, 2022

Virtual Competition

CONTEST DESCRIPTION

CONTEST AREA: ROBOTICS

LEVEL: Secondary

COMPETITION SCHEDULE:

Mandatory Orientation and Safety Check: April 25, 2022 – 1:00-2:30pm

Competition Date: April 26th, 2022

Duration: 8 Hours

Mandatory Registration – 7:45AM-8:15AM

Competition- 8:15AM-12:00PM

12:30PM-4:00PM

Lunch 12:00-12:30PM

COMPETITION FORMAT: (VIRTUAL/ IN SCHOOL)

All secondary competitors will be competing with in their school environment and must arrange in advance with a teacher for a safe competition location, according to their school's Covid-19 safety policies. They will need to prepare their competition space with all of the required tools, equipment, materials, and technology (as listed below) that will be needed to complete the competition. Teachers and competitors will need to work together to ensure the competitor is ready for success on their competition day.

Each competitor must have a teacher/supervisor available throughout the day, in case of incident. (Teacher/Supervisor must be present at the competition orientation.)

Competitors and Teachers should be prepared to receive additional information about the competition projects, livestreams, shipping, etc. prior to the competition. Please ensure you are double checking for emails from Skills, including checking junk mail.

WEBEX LIVESTREAMS:

Competition Orientation and Safety Check: The competition will begin with a mandatory virtual orientation and safety check. Competitors will join the assigned link that will be emailed to all registered competitors and registering teachers in advance. This will be the time that competitors are able to check in and ensure sound, cameras, and tech are working appropriately for the competition day. The competition orientation will be followed by a robot safety check. Each team will be required to demonstrate their robot is built to the standards described in the document below. Camera's **MUST** be on and competitors visible on the camera during the orientation.

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Competition Livestream: Competitors must remain on camera through their entire competition. Camera's MUST be on and competitors visible on the camera, as well as mics working. Competitors must consider their camera angle and lighting in advance of the competition. It is the competitor's responsibility to ensure they are prepared for the competition livestream.

PROJECT SUBMISSION LINK:

- <https://form.jotform.com/SkillsAB/2022SCAVC>
- Multiple files can be uploaded at once, each file has a maximum size of 1G. If file sizes are larger than 1G, please follow alternate instructions through the submission link.

ACCEPTED FILE TYPE: pdf, doc, docx, xls, xlsx, csv, txt, rtf, html, zip, mp3, wma, mpg, flv, avi, jpg, jpeg, png, gif. If you would like to submit a different type of file, please place it in a zip folder.

To create a zip file – Select all the files that you would like to submit and right-click your mouse, a menu will open, select Send To, and then click on Compressed (zipped) folder. A zip file will then be created containing your submission documents.

Submissions will be due within 15 minutes of the end of competition time. Please note: Late submissions sent after the date and time specified above will not be accepted.

SAFETY:

The health, safety and welfare of all individuals involved with Skills Canada Alberta are of vital importance. Safety is a condition of participation with Skills Canada Alberta and shall not be sacrificed for the sake of expediency. At the discretion of the judges and technical committees, any competitor can be denied the right to participate should they not have the required proper safety equipment and/or act in an unsafe manner that can cause harm to themselves or others.

Safety Checklist: It is the responsibility of each competitor and teacher to review the Safety Checklist in advance of the competition to ensure all safety requirements are met prior to the competition. During the official competition orientation, the Safety Checklist will be formally reviewed with competitors. The Safety Checklist is posted as a separate document with the Contest Description.

AWARDS CEREMONY INFORMATION: Please join us for a live virtual awards ceremony on May 6th at 6:30PM.

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Court Build: Teams will receive all required pieces and hardware to build their courts. Teams/Schools are responsible to complete the build of the court. Additional information regarding the shipping of the courts will be emailed in March.

Please note: This document is subject to change as competition information is updated. Competitors are responsible for staying up to date with the most recent information. Check the footer for last updated date. Changes will be highlighted in yellow.

COMMITTEE MEMBERS

Sheldon Marquis	John Heslinga	Jim King	Sam Cheng
Kelvin Tan	Erin Whitby		

ADDITIONAL INFORMATION

Skills Canada Alberta Regional and Provincial Rules and Regulations

[Regional and Provincial Rules and Regulations](#)

Lunch

Lunch will NOT be provided.

Virtual Awards Ceremony

The Virtual Awards Ceremony will take place **Friday, May 6th at 6:30PM**. A link will be made available on the website with additional information.

Team Alberta Information

Top eligible medalists will compete virtually in the Skills Canada National Competition (SCNC) May 16-27, 2022. It is recommended that competitors review the SCNC contest description to be familiar with the national contest description and project at <http://www.skillsCanada.com/>.

If a competitor is not able to attend the SCNC, competitors MUST notify Katherine Kupchenko katherinek@skillsalberta.com prior to the start of competition. If a gold medalist is not able to attend the SCNC, the next top-ranking individual will be asked to participate.

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Ethical Conduct

We recognize that participants will be competing individually in their own unique environments. We expect all competitors to compete fairly, respecting and abiding by the established rules in the true spirit of Skills Canada Alberta.

Letter of Participation

Competitors who participate in the 2022 Provincial Skills Canada Competition are eligible for a Letter of Participation that can be downloaded on the Registration Portal after the competition ends.

Questions?

Please contact Whitney Koop whitneyk@skillsalberta.com if you have any questions regarding the Contest Description.

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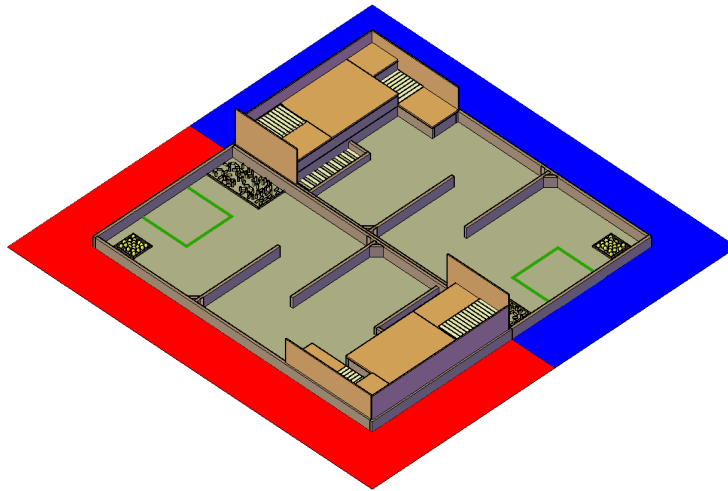
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1. Definition of terms referenced in this document

- 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 input 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 (eg. A series of limit switches / no programmed elements) or a pre- programmed system (eg. Managed by an Arduino or other microprocessor) internal to the Independent Autonomous Element.

2. The Gold Mine Operation Teleoperation Game Overview

- a. The core game situation requires a Robot or Robots to use the components provided in their Exclusive Use Court Space to (a) Mine the paydirt from the mine pits and (b) sort and deliver the tailings and gold into the appropriate zones



3. Detailed Court Areas

3.1: Upper Platform

- a) At one end of the court area, there will be a platform that has a height of 11.75 inches off of the court floor.
- b) This platform has 3 sections:
 - i) One section against the exterior corner of the court, which is 18 inches wide and 18 inches long.
 - ii) A middle section directly against the exterior wall, which is 36 inches wide and 46.5 inches long.
 - iii) A third section 18 inches from the exterior wall, which is 18 inches wide and 30 inches long.
- c) The space between the exterior wall and the third section forms an 11.75 inch deep pit (Deep Mine Pit).
- d) The platform edges are vertical planes extending to the court floor.
- e) The exterior edge of the platform has a 0.5 inch thick, 6 inch tall barrier.
- f) The edge of the platform along the shared wall has a 0.5 inch thick, 12 inch tall barrier (between the platform and the shared wall). This barrier extends 6 inches beyond the edge of the platform.

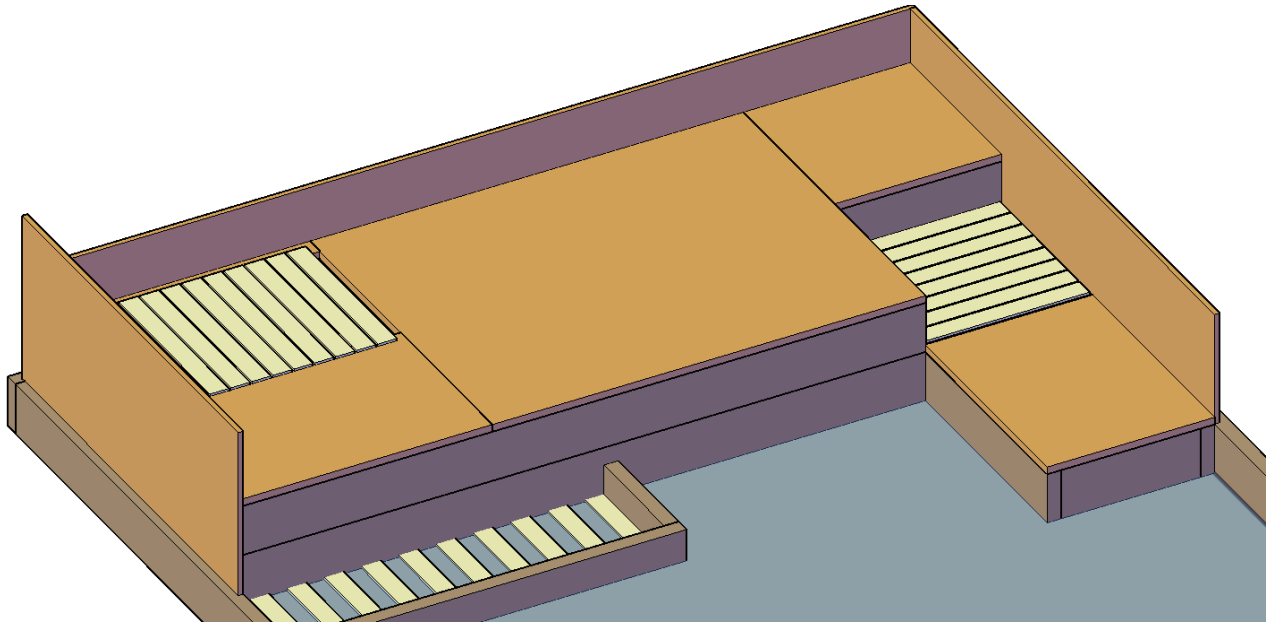


Figure 2: Upper Platform

3.2: Lower Platform

- a) At the same end of the court as the Upper Platform, there is another platform that is 6.25 inches in height.
- b) This platform is located 36 inches from the shorter exterior wall, along the longer exterior wall.
- c) The space between the Upper Platform and Lower Platform forms a 6.25 inch deep pit (Shallow Mine Pit).
- d) The platform edges are vertical planes extending to the court floor.
- e) The exterior edge of the platform has a 0.5 inch thick, 12 inch tall barrier (between the platform and the exterior of the court). This barrier aligns with the edge of the 6 inch platform.

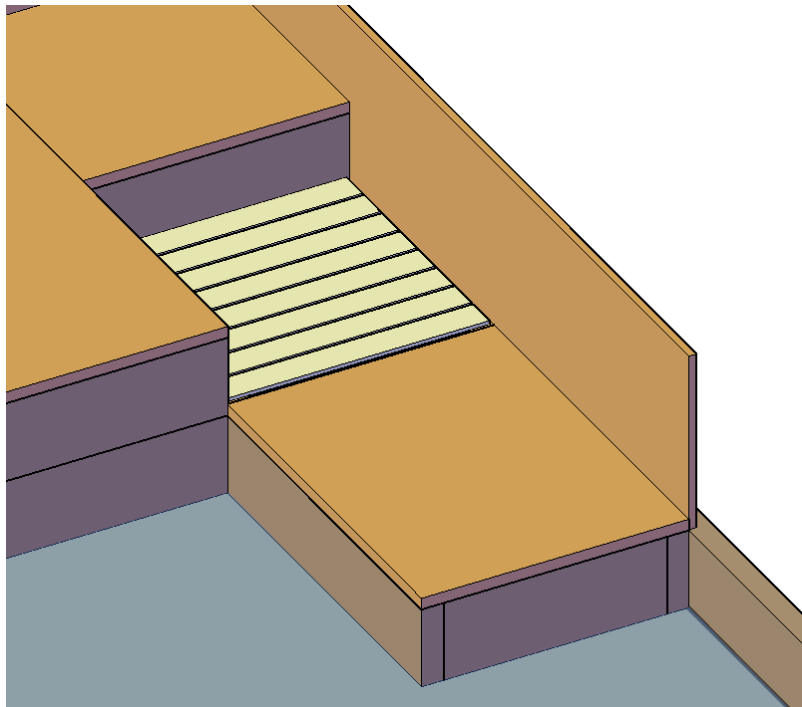


Figure 3: Lower Platform

3.3: Deep Mine Pit

- a) The Upper Platform provides a space along the exterior wall, at the corner of the exterior wall and the shared wall, which is the Deep Mine pit.
- b) This pit extends from the top of the Upper Platform to the court floor, a depth of 11.75 inches.
- c) Along the exterior wall, there is a 2 inch wide ledge, extending from the floor to 11.75 inches above the court floor level (to be level with the top of the Upper Platform).
- d) At the start of the game, this pit will contain 65 pieces of “Paydirt”.
 - i) 45 pieces will be “Tailing” pieces.
 - ii) 15 pieces will be “Low Quality Gold” pieces.
 - iii) 5 pieces will be “High Quality Gold” pieces.
 - iv) Pieces will be randomly placed, as described in Section 3.7 (d).
- e) At the start of the game, this pit will be covered with 13 “Overburden” pieces.
 - i) Overburden pieces are 2 inch wide, 18 inch long strips of $\frac{1}{4}$ inch thick corrugated plastic.
 - ii) They are a solid color, not transparent.
 - iii) They are placed with a 1 inch overhang on each end.
 - iv) They are to be placed with a $\frac{1}{4}$ inch space between them.
- f) The pit dimensions are 11.75 inches deep, 16 inches wide, and 30 inches long.

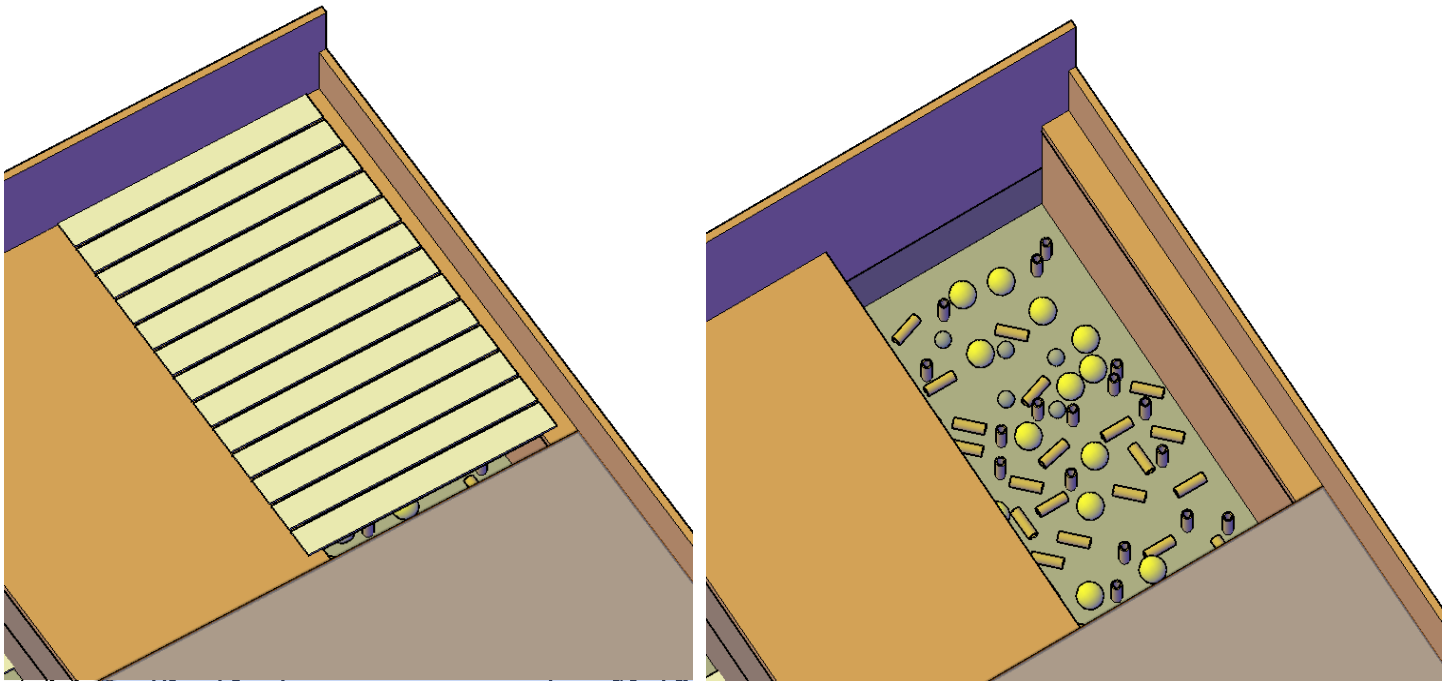


Figure 4: Deep Mine Pit (with and without Overburden)

3.4: Shallow Mine Pit

- a) The space between the Upper Platform and the Lower Platform forms the Shallow Mine Pit.
- b) This pit extends from the top of the platforms to the court floor, to a depth of 6.25 inches.
- c) Along the exterior wall and the opposite side of the pit, there is a 1.5 inch wide ledge, extending from the floor to 6.25 inches above the court level (to be level with the top of the Lower Platform).
- d) At the start of the game, this pit will contain 35 pieces of “Paydirt”.
 - i) 30 pieces will be “Tailing” pieces.
 - ii) 5 pieces will be “Low Quality Gold” pieces.
 - iii) Pieces will be randomly placed, as described in Section 3.7 (d).
- e) At the start of the game, this pit will be covered with 8 “Overburden” pieces.
 - i) Overburden pieces are 2 inch wide, 17.5 inch long strips of ¼ inch thick corrugated plastic.
 - ii) They are a solid color, not transparent.
 - iii) They are placed with a 1.5 inch overhang on each end.

- iv) They are to be placed with a $\frac{1}{4}$ inch space between them.
- f) The pit dimensions are 6.25 inches deep, 15 inches wide, and 18 inches long.

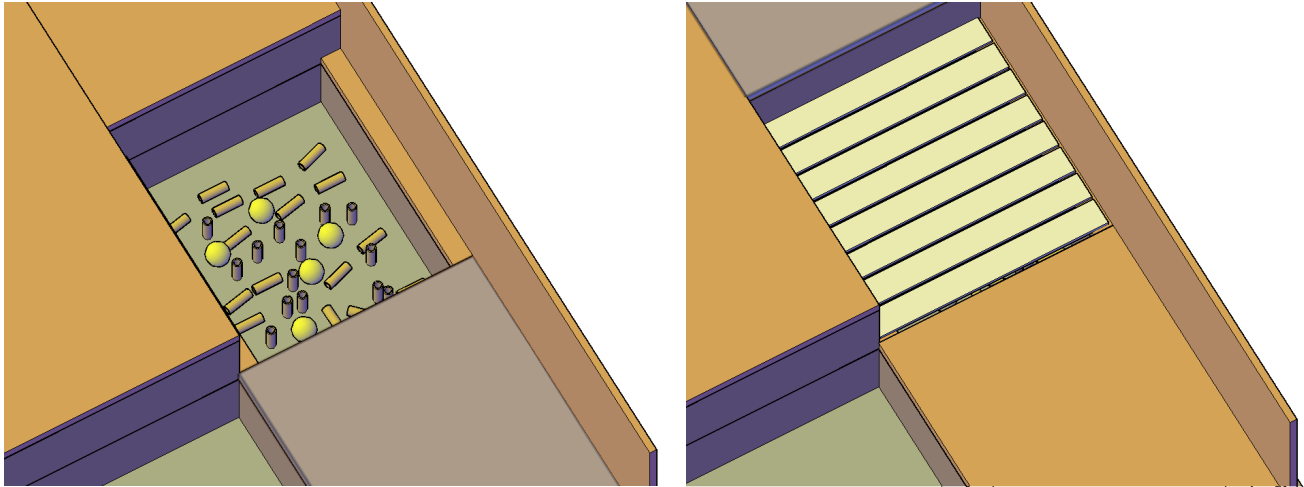


Figure 5: Shallow Mine Pit (with and without Overburden)

3.5: River Area

- a) Along the edge of the Upper Platform, on the court floor, there is a “River Area”.
- b) This area is 12 inches wide, by 42 inches in length. It extends along the platform from the shared wall.
- c) The edges of this area are 2x4s.
- d) The bottom of this area has 12 inch long, 2 inch wide, $\frac{1}{4}$ inch thick corrugated plastic strips placed with 2 inches between them.
- e) Should a game piece fall into the river area, it is still considered in play. Teams are allowed to reach into the river and retrieve the piece, and continue to use that piece.

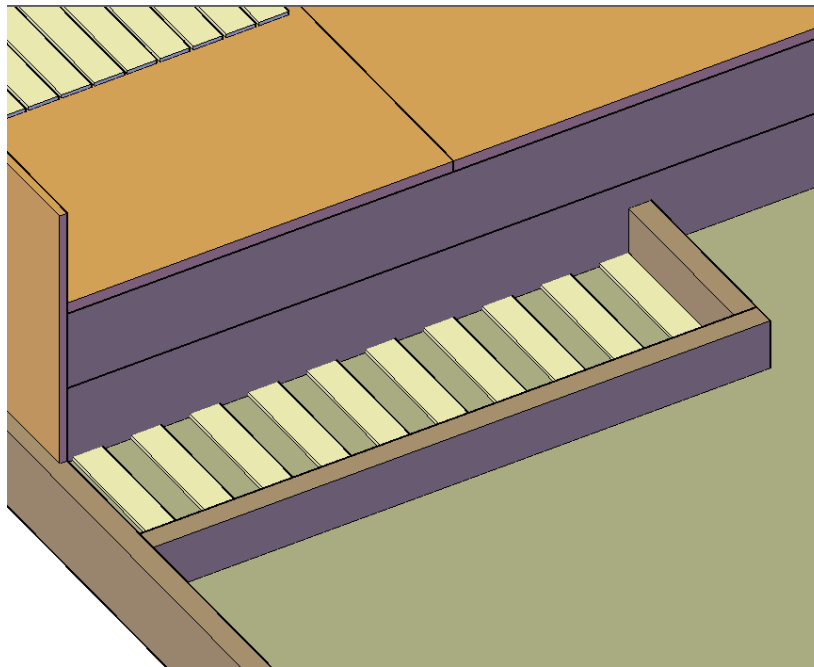


Figure 6: River Area

3.6: Drop Off Zones

- a) The area on the opposite end of the court to the platforms is the sorting area.
- b) Contained in this area are the drop off zones.
 - i) The “Tailing Drop Off Zone” is located in the corner of the exterior wall and the shared wall. It measures 18 inches by 36 inches (internal dimensions).
 - ii) The “Gold Drop Off Zone” is located 6 inches from the corner of the 2 exterior walls. It measures 12 inches by 12 inches (internal dimensions).
 - iii) The drop off zones are lined by 0.5 inch wide, 0.5 inch tall borders.
- c) The “Tailing” pieces are to be placed in the “Tailing Drop Off Zone”.
- d) The “Gold” pieces are to be placed in the “Gold Drop Off Zone”.
- e) The pathway between the “Platforms” and the “Sorting Area” is a winding pathway, with a minimum width of 30 inches

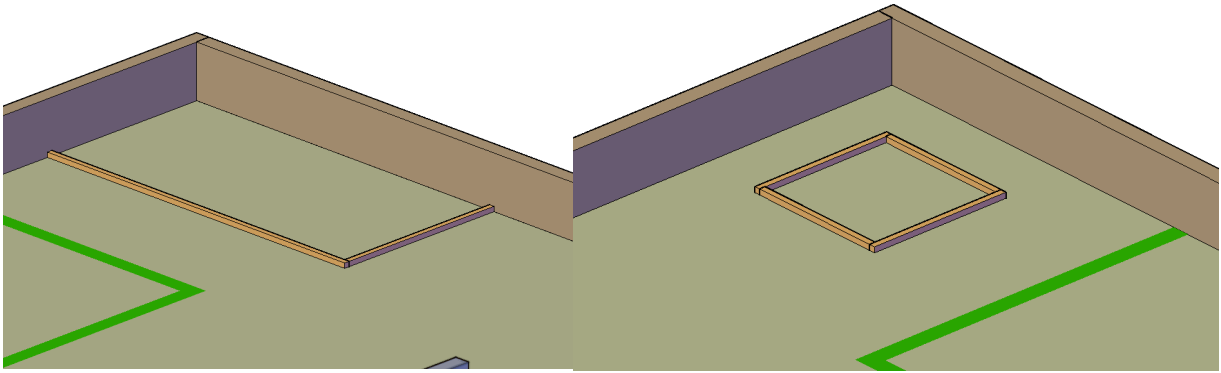


Figure 7: Drop Off Zones (Tailing and Gold)

3.7: Starting Zone

- a) Located in between the drop off zones, the “Starting Zone” measures 30 inches by 30 inches.
- b) It is located along the short exterior wall (opposite the platforms) 32.25 inches from the shared wall and long exterior wall.
- c) At the beginning of the game, a team’s entire robot entry must be within this zone, not breaking the vertical plane formed at the edge of the 30 inch square.

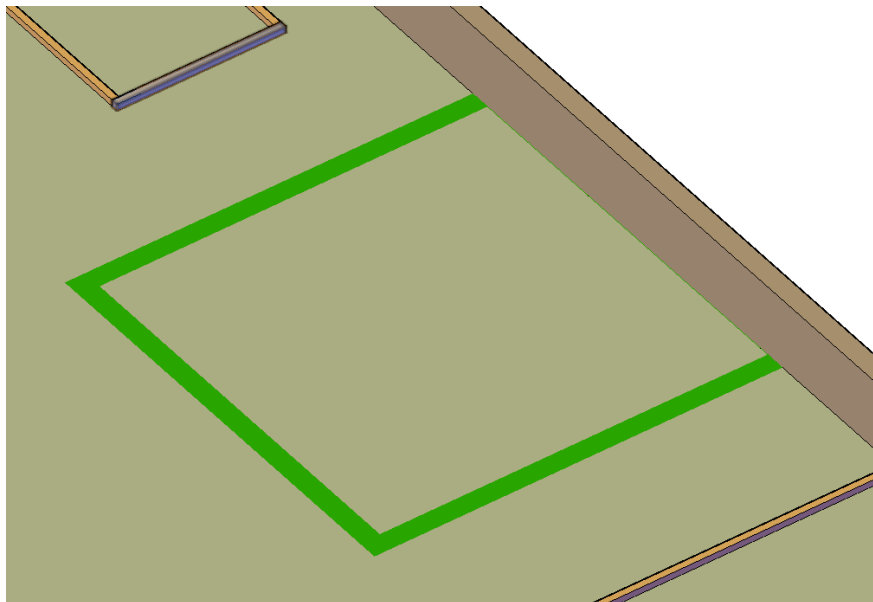


Figure 8: Starting Zone

3.8: Game Pieces

- a) There are 3 types of game pieces which will be used for scoring points.
 - i) "Tailing" pieces are 2 inch long sections of 0.5 inch Copper Type M pipe.
 - ii) "Low Quality Gold" pieces are yellow foam golf balls, measuring 1.68 inches in diameter.
 - iii) "High Quality Gold" pieces are 1 inch diameter steel balls.
- b) The Deep Mine Pit will contain 65 pieces at the beginning of each game. 45 "Tailing" pieces, 15 "Low Quality Gold" pieces, and 5 "High Quality Gold" pieces.
- c) The Shallow Mine Pit will contain 35 pieces at the beginning of each game. 30 "Tailing" pieces, and 5 "Low Quality Gold" pieces.
- d) The pieces for each pit will be randomly placed.
 - i) The pieces for each pit will be placed in a container and mixed.
 - ii) Once mixed, the pieces will be poured from the container into each pit. They will be poured into the pit from the central side of the pit (the side closest to the center of the court).
 - iii) Once the pieces are placed in the pit, the pit will be covered with the "Overburden" pieces.
 - iv) Team members are not allowed to watch the pieces being poured!

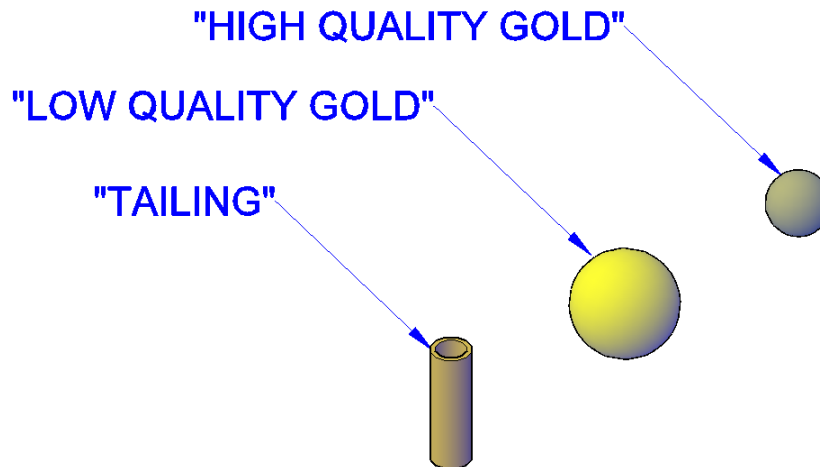


Figure 9: Game Pieces

3.9 Additional Notes

- a) Should any piece fall outside of the competitors playing area, the piece will be considered out of play for that team for the remainder of the match.
 - i) Should these piece(s) fall outside of the court area, it will be considered out of play.

- ii) Should these piece(s) fall into the opponent's space, the opposing team will be allowed to gather and sort the piece(s) for sorting points.
 - iii) Should the "Overburden" pieces fall into the opponent's space, a judge shall remove the piece from the area to prevent any interference it may cause.
- b) At no point is a team permitted to break the vertical plane of the shared middle wall.
- c) At no time are teams allowed to throw any of the game pieces (no throwing, tossing, projecting, etc.) in the interest of fairness and safety.
- i) Throwing would be considered an act of propelling something through the air with a robot generated force by means of:
 - A wheel based shooting mechanism
 - Straight arm throwing mechanism
 - An air pressure shooting mechanism
 - A flicking system where the angle is above the horizontal axis
 - ii) Actions not considered throwing:
 - Dropping of pieces, where the force of movement is gravity, and the movement direction is equal to or below the horizontal axis of the mechanism
 - Bouncing of pieces off robots, as long as the robot is not adding a propulsion force
 - iii) For any other examples not explicitly stated, it is up to the Judges discretion if a Robot is considered to be throwing a piece, with the interest of overall safety in mind. If a robot is deemed unsafe by a Judge, the team utilizing this robot platform will not be allowed to compete in the competition until the Judge decides that the mechanism can be proven safe.
- d) Each Team's Exclusive Use Area is approximately 8 ft. by 16 ft.
- e) Teams have Exclusive Use of a 30 in. wide passageway along three sides of their assigned court area.
- f) Both Team Members can be active in and move throughout this entire team passageway space during game play.
- g) It is a Team Responsibility to define the tasks assigned to each competitor.
- h) If a Team has a Two Robot Entry, then:
- i) Both competitors can be Robot Drivers

- j) Both competitors can also be Spotters for their partner driver. If a Team has a One Robot Entry, then:
 - i) One competitor can be the Robot Driver and one competitor can be a Spotter for their partner driver

Each Team's Area includes:

5.1: Starting Area

- a) Each team's robots will start in the "Starting Square"
- b) The "Starting Square" measures 30 inches by 30 inches.
- c) This is located directly against the exterior wall, in the middle of the short wall, opposite the platforms.
- d) The team's entire entry must begin each match fully within the starting square.
 - i) The entire entry must not break the vertical plane formed by the edge of the starting square.

5.2: Mining Area

- a) Each team will have exclusive access to their mining area, located along the opposite end of the court as the starting area and the "Drop Off Zones".
- b) Each mining area contains 2 platforms and 2 mining pits.
 - i) One platform is 6.25 inches in height (Lower Platform).
 - ii) One platform is 11.75 inches in height (Upper Platform).
 - iii) One pit is 6.25 inches in depth (Shallow Mine Pit).
 - iv) One pit is 11.75 inches in depth (Deep Mine Pit).
- c) The Lower Platform is 18 inches by 24 inches.
- d) The Upper Platform has 3 distinct areas:
 - i) One section which is against the exterior corner of the court, which is 18 inches wide and 18 inches long.
 - ii) A middle section, which is directly against the exterior wall, which is 36 inches wide and 46.5 inches long.
 - iii) A third section that is 18 inches from the exterior wall, which is 18 inches wide and 30 inches long.
- e) The edges of each platform extend vertically down to the court floor.
- f) The exterior edges of the platforms have a vertical barrier extending up from the top of the platforms, as described above (See Sections 3.1 and 3.2)

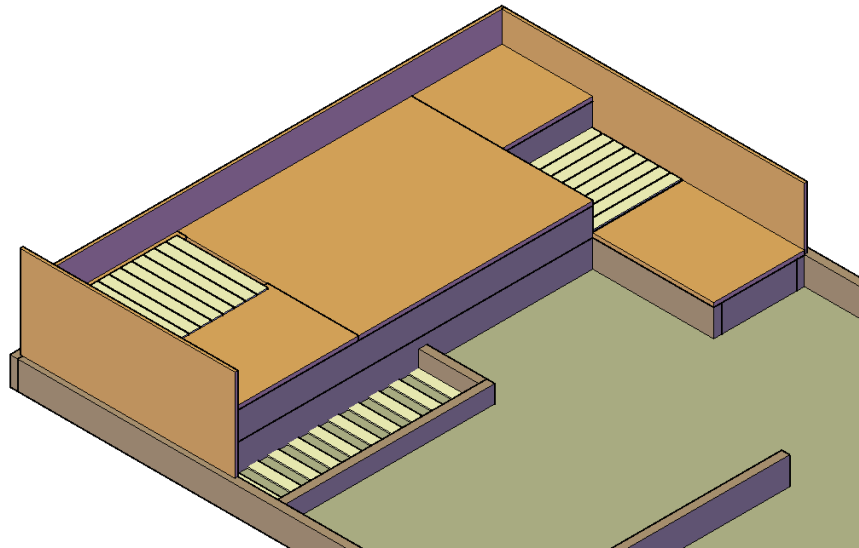


Figure 10: Mining Area

5.3: Sorting and Delivery Area

- a) The area on the opposite end of the court to the platforms is the sorting area.
- b) Contained in this area are the drop off zones.
- c) The “Tailing” pieces are to be placed in the “Tailing Drop Off Zone”.
- d) The “Gold” pieces are to be placed in the “Gold Drop Off Zone”.
- e) The pathway between the “Platforms” and the “Sorting Area” is a winding pathway, with a minimum width of 30 inches

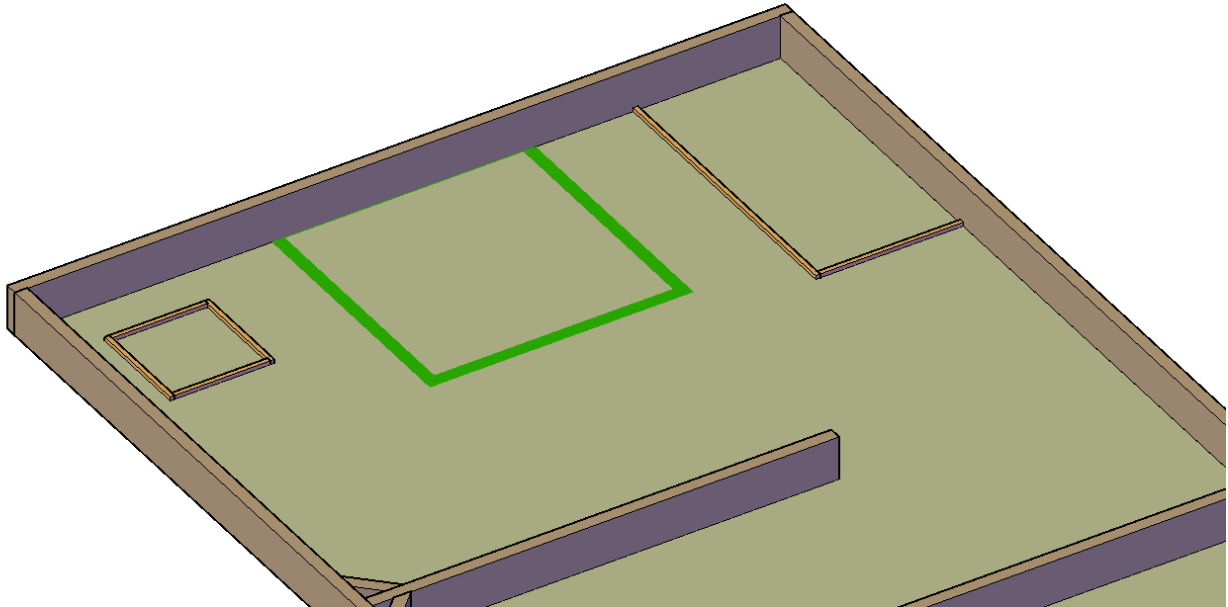


Figure 11: Sorting and Mining Area

6. Gold Mine Operation Game Description

- a. Rounds will involve One Team at a time.
- b. Both Competitors are allowed unrestricted movement around the perimeter of their Team's Assigned Court Area.
- c. Teams can utilize a Maximum of TWO Tele-operated Robots.
- d. Teams may also use ONE Independent Autonomous Element as part of their entry (which must fit into the overall size limitation at the beginning of the game).
- e. Teams may also use an Unlimited Number of Independent Elements as part of their entry (which must fit into the overall size limitation at the beginning of the game).
 - These Independent Elements cannot be Independently Electronically controlled (cannot be Autonomous)
 - These must be easily cleaned up at the end of the match
- f. Teleoperated Robots may NOT be in possession of any Tailing or Gold components at the Start of a game.
- g. **On the day of competition, competitors will be allotted two attempts.** Each attempt will be 4 minutes each, and the teams final score during each attempt will count towards their final score.

- h. For each 4 minute attempt, each team will have a total of 10 minutes (4 minute round, 6 minutes of padding) to prep once their team name is called to ensure each team has adequate time for each attempt.
- i. **At** the end of competition day, if a tie arises between individual teams, their qualifier results will be used to decide outcomes from ties.
- j. **Note:** Competitors will participate in BOTH the Mining Operation Game and the Autonomous Robot Tasks during the Competition Day.

7. Scoring Summary

Scoring will be done at the end of each 4 min. match:

7.1: Mining Points

- a) Teams will earn points for successfully removing pieces from each pit.
- b) 1 point will be awarded for each successfully mined “Tailing” piece.
- c) 2 points will be awarded for each successfully mined “Gold” piece.
- d) A successfully mined piece will be defined as a piece that has been fully removed from the pits.
 - i) Any piece that is removed from a pit and then returns to either pit will not be considered a successfully mined piece.
 - ii) Any piece that remains on a robot that remains inside the pit will not be considered a successfully mined piece.
- e) Mining points will be tallied at the end of the 4 minute match.
 - i) Mining points will be determined by counting the remaining pieces within each pit, and subtracting that number from the starting total amount.
 - ii) *For example, if 35 “Tailing” pieces remain in the 12 inch pit at the end of the match:*
$$45 - 35 = 10 \text{ successfully mined “Tailing” pieces}$$
- f) Maximum available Mining pieces and points:
 - i) From the Deep Mine Pit:
45 “Tailing” pieces - 45 mining points
20 “Gold” pieces - 40 mining points
 - ii) From the Shallow Mine Pit:
30 “Tailing” pieces - 30 mining points

5 “Gold” pieces - 10 mining points

- g) Note: If any piece is mined from one pit and returns to either of the pits, that piece will not be awarded any mining points, as it will not be considered successfully mined.

7.2: Sorting Points

- a) Teams will earn points for successfully sorting the mined pieces and placing them into the proper sorting area.
- b) Pieces must be deposited into the designated area.
 - i) Robots must release the pieces for them to be considered successfully deposited. Any piece remaining on a robot will not be considered successfully deposited.
 - ii) Pieces must be freely standing within the delivery area to be successfully deposited. This means pieces contained within a bag or container are not considered successfully delivered.
 - iii) Pieces must be within the sorting area and not touching the floor outside of the area to be considered successfully deposited. Pieces balanced on the barrier of the sorting area would count as deposited as long as it does not touch the court floor outside of the sorting zone.
- c) 1 point will be awarded for each successfully sorted and deposited “Tailing” piece into the “Tailing Drop-off Zone”.
- d) 2 points will be awarded for each successfully sorted and deposited “Low Quality Gold” pieces into the “Gold Drop-off Zone”.
- e) 4 points will be awarded for each successfully sorted and deposited “High Quality Gold” pieces into the “Gold Drop-off Zone”.
- f) Any pieces not deposited into the correct drop-off zone will not be awarded “Sorting Points”.
 - i) Should a gold piece be placed in the “Tailing Drop-off Zone”, it will be awarded no “Sorting Points”
 - ii) Should a tailing piece be placed in the “Gold Drop-off Zone”, it will be awarded no “Sorting Points”

7.3: Autonomous Points

- a) Teams will earn points based on an electronic assignment submission solving a problem, as outlined in the autonomous competition section.

8. Marking Sheet

2022 Skills Canada Robotic - Vancouver											
Mining Operation Scoring Sheet											
Match number:	Mining Points		Number of Pieces Mined	Points per piece	Mining Score	Sorting Points	Number of Pieces	Points per piece	Sorting Score		
6 Inch Mine	Tailing Pieces			x 1pt		Tailing Pieces		x 1pt			
	Gold Pieces			x 2pt							
12 Inch Mine	Tailing Pieces			x 1pt		Low Quality Gold		x 2pt			
	Gold Pieces			x 2pt							
Total Mining Points:									Total Sorting Points:		
										Total Score:	
Team Name:						Competitor Signature:					

9. Pit Area and Court Access

A pit area is expected to be available so that students may make repairs and improvements to their robots between games. This is to be monitored by the designated proctor for safety and to ensure students are the only ones working on their robots.

10. Game Play

- a. Teams will compete during 2 full 4 minute game runs.
- b. At the end of each run, teams are to fill out their own score sheet, and show all of the score based components on the live video feed for the judges watching to corroborate with their own records. The presiding judges will read out the total points at the end of each round and will tally the points at the end of the total 10 minutes round.
- c. Gold Mine Operation Tournament Standing will be based on the total number of points scored in all games played by each team.
- d. 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 competition day.
- e. Between games, battery changes and repairs to robots may be completed at the team's assigned Pit Area Worktable.
- f. During the competition, protective safety glasses are expected to be worn while performing material removal tasks (cutting, drilling, etc.).
- g. During game play, the judges will have ultimate authority over game rulings and will have full authority over team conduct in the court area.
- h. Damaging the court area is prohibited. If a robot's design causes damage to the court elements*, 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 involves BREAKING court components. Robots bumping into court components and causing them to shift position without breaking any court element will NOT be viewed as 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.
 - i. *Note: The corrugated plastic overburden pieces are not considered parts of the court when considering damages.
- i. Competitors cannot enter onto the court surface or adjust their robot once

- the game has started. Doing so will result in the match being suspended at the time which they enter.
- j. If a robot is mal-functioning and represents a hazard to participants, other robots or itself in the opinion of the proctor/PTC designate, then, the proctor/PTC designate may stop the clock, and may authorize the 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.
 - k. It is a Team Decision what roles team members will fill. Drivers are the competitors holding the robot controller(s) and asserting direct control over a Tele-operated robot.
 - l. The Spotter would be the competitor providing navigational guidance to the driver.
 - m. Competitors may change roles while a game is in progress.
 - n. Competitors (Driver/s and/or Spotters) can move freely in their Assigned Courtside Team Area throughout the game.
 - o. Competitors may not enter an opponent team's Assigned Courtside Team Area at any time during game play.
 - p. At the start of a game, robots are expected to be in their Designated Starting Position.
 - q. Robots arriving AFTER a game has started will be allowed to enter the game and use the Time remaining in the 4 min. game.
 - r. Robots must not leave the contest court at any time during a game.
 - s. It will be a PTC's ruling that decides if an 'End of the Game Component Placement' took place before or after the game-ending buzzer sounded. This ruling will happen after video submission and review by the PTC.
 - t. If a Gold or Tailing piece falls out of the court, it may not be retrieved and will be considered out of the game for the remainder of the game time.
 - u. Scoring will take place after the End of the Game Buzzer
 - v. No aerial (flying) robots are allowed.

11. Court Layout

- a. Please note: Although great pains will be made to keep the court in compliance with the drawings, some inaccuracies in construction may occur when schools build their courts. **Please make your robot designs allowing for a possible ½ inch tolerance.**

- i. The open court surface will consist of the good side of Plywood Sheets **OR** the facility floor **OR** the smooth side of Masonite Sheeting.
- ii. Detailed court information has been included in the Appendix Section of this document.

12. The Robot(s) Restrictions

- a. All tele-operated 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.
- b. **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 their scheduled games until they have corrected the problem.

13. Start of the Game Robot Status

- a. 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:
 - i. Robots must be stationary.
- b. Robots must be in their designated Starting Location.
- c. If Team Entries involve multiple Robots / Mechanisms, then all of them must fit within starting location and must be positioned to not exceed the allowed total 5 cu ft. volume per Team.
- d. All systems may be ON.
- e. Air System Circuits may be fully charged to 100 PSI and their compressors can be ON.

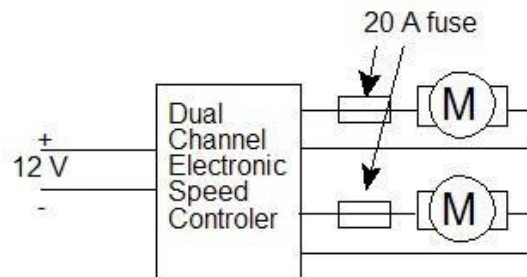
14. Overall Team Robot Entry Size

- a. Complete Team Entries must fit within the 30 by 30 inch starting area at the start of each game, as defined by the vertical plane of the starting area.
- b. Complete Team Entries must not exceed an overall size of 5 cubic feet (8,640 cubic inches) when measuring the total length, width, and height of the robot in its starting position.
- c. Team Entries may expand to a larger size once a game has started.

15. 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 will be 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)

Acceptable Circuit Protection: (ESC is NOT protected by fuse)



Recommended Circuit Protection: (ESC IS protected by fuse)

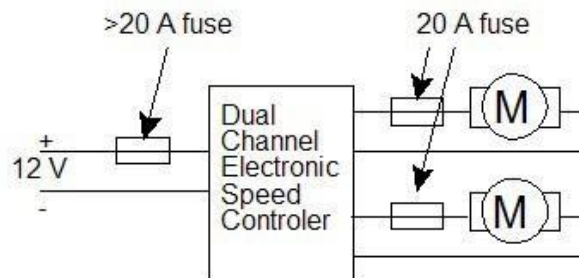


Figure 12: Circuit Protection

- 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.
- 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.

- i. Devices with a known, dedicated internal fuse (based on manufacturer's documentation) are considered to have this requirement met, assuming the fuse rating is appropriate.
- e. Batteries must be complete sealed commercial battery packs.
 - i. Competitors must have the Material Safety Data Sheets for their batteries.
- f. ALL Robots must be able to be turned off with a single motion.
- g. Robot Controller receivers may be in an independent circuit.
- h. No explosive materials of any kind may be used (ether, gunpowder, acetylene etc.)

16. Non-Electrical (Battery) Energy Sources

- a. 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.
- b. Air pressure systems using Competitor-made or modified air pressure hardware are NOT permitted.
- c. All pressurized tanks on robots must have a pressure gauge to indicate the stored pressure and a form of automatic overpressure safety relief system.
- d. The pressure tanks and related gauges / controls must be shielded from damage due to collisions or flying target objects.
- e. The stored pressure in the tank must not exceed a maximum of 100 PSI at any time.
- f. 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.
- g. Laser devices are prohibited.

17. Recommended Robot Controllers

- a. It is recommended (not required) that all teams use 2.4 GHz "non-crystal"

control systems on Tele-operated Robots.

- b. Teams are allowed the use of an unlimited number 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.
- c. Tele-operated Robots may not transmit audio/visual information to off the robot devices. (Ex: Having a camera transmit images real time to a computer near the driver, etc.)



18. Pit Area

- a. Competitors **MUST** wear safety glasses when doing fabrication work involving material removal processes (grinding / cutting).
- b. Only registered competitors are permitted in the contest space.
- c. 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.
- d. Designated teacher/industry team advisors are not allowed in the pit area during tournament play.
- e. Teachers and industry advisors are not permitted to handle tools or robot parts. Students must affect all repairs and modifications on their robot.
- f. Teams will be provided with a 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.
- g. It is required that teams fabricate a tabletop stand for holding their robot(s) in the pit area. This stand or these stands 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.

19. Overall Court Description:

- a. The Court Playing Surface will be a 16' by 16' square.
- b. Individual Exclusive Use Team Spaces are 8' by 16' rectangles.
- c. The Perimeter Court Walls will be made using 2 by 6-inch planks.
- d. This wall will as a result will be approximately 5.5 inches tall.
- e. The court surface may vary between melamine, concrete, hardboard, or plywood.

20. Pre-inspection for Compliance with Safety and Design Rules

- ☐ Mandatory Wiring Diagram provided.
- ☐ Tabletop Robot Stand
- ☐ Overall volume $\leq 5 \text{ ft}^3$ or $8,640 \text{ in}^3$
- ☐ 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
- ☐ Material Safety Data Sheets available for all batteries.
- ☐ 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 can 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:

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Robot Evaluator Signature

Team Representative Signature

21. Autonomous Competition

- a. The day before the competition, registered competitor teams will be given a problem that a virtual robot must be able to solve. The team must demonstrate how they will solve the autonomous section using traditional online methods i.e. through diagrams, written responses, etc. to convey to the judges that the team understands what needs to be solved, and outlines their ideas as to how they would solve the problem.
- b. Once the competitors have received the autonomous competition, the competitors are free to try and solve the problem up until they must submit at 5:00pm on the day of the competition.
- c. To solve the autonomous competition, competitors must submit a flow chart outlining the programming they would enact in order to solve the problem.
- d. Projects will be assessed based on completeness, organization, and usage of standard flow chart blocks.
- e. Each “Do” statement in the flow chart must be the simple control of a robot’s device. I.e. turn on right wheel, stop right wheel motor, etc. The goal of this is to create larger, more complex subroutine from simple, easy to interpret commands.
- f. The judge should be able to clearly follow each robot’s decision and should be able to clearly understand the solution to the problem.
- g. The autonomous competition submission must be uploaded by 5:00pm on the day of competition in order to be counted. Upload details will be given on the day before the competition.

Store Check-out Process

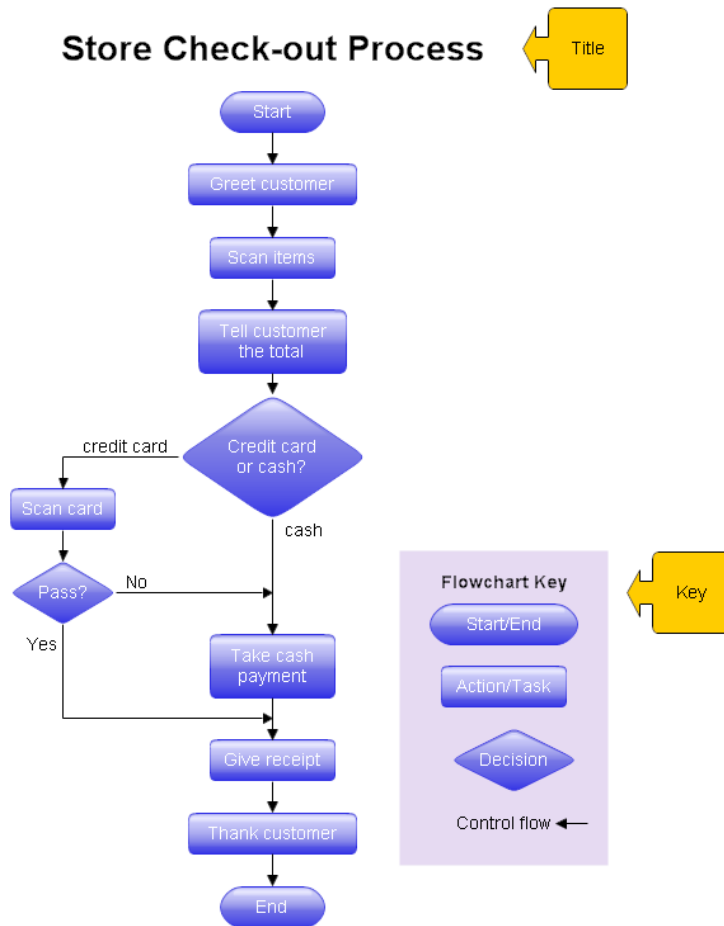


Figure 13: Example Flow Diagram

Assumed Sensors Available to the Robot

You are limited to using the following imaginary types of devices and sensors on your virtual robot:

Type of Device	Qty.	Description
Ultrasonic Distance Sensor	3	Tells you how far away objects are from the robot
Simple Momentary Switch Button	1	A robot mounted push button that can be activated by the robot touching something or human activated outside of the maze.
Heading Sensor	1	Can provide information on the orientation of the robot in the room. Can read 0 to 360 degrees. Assume the heading sensor works like a compass.
Robot Microcontroller	1	Can store memory of locations and sensor data and can be programmed in any programming language.
Claw and/or capturing device	1	Any device used to pick up the single object that needs to be delivered to the end block.

Electrical Devices

Type of Device	Qty.	Description
Motor Controller	1	Used to receive input signals, and control power output to up to 4 motors
Low RPM and/or stepper motors	4	Means of locomotion for the robot platform
12V Battery	1	Energy source for robot
Fuses/breakers and/or fuse blocks	As required	Safety devices to protect robot from overloading

Disconnect Switch	As required	Safety disconnection for entire robot platform
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Assumed Project Limitations:

- 1.The robot can only travel in 2 dimensions - X and Y. The robot must always be in contact with the floor.
- 2.The robotic platform has unlimited battery range and can travel an infinite amount of distance to achieve it's task



Appendix A: Court Area Dimensions and Details