Mobile Robotics Technology Challenge
National SkillsUSA

Disaster Response

Middle School Teams

2026-2027

Game Manual Version 1.1

November 3, 2026

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Prefix

Welcome and Thank You

Welcome to the National SkillsUSA Mobile Robotics Technology Challenge, presented by the Robotics Education & Competition Foundation (RECF). The Mobile Robotics Technology Challenge includes activities that simulate situations encountered by robotic programmers and support professionals. Teams are given a task to solve using a mobile robotic system that is built ahead of time and brought to the competition. Teams will have three scored chances to solve the mobile robotic challenge and will also participate in design and programming interviews.

About the RECF

The Robotics Education & Competition Foundation is a registered US 501(c)(3) non-profit organization that exists to spark interest in science, technology, engineering and math by engaging students in hands-on, sustainable, and affordable curriculum-based robotics programs.

Our global mission is to provide every educator with competition, education, and workforce readiness programs to increase student engagement in science, technology, engineering, math, and computer science. We see a future where every student designs and innovates as part of a team, overcomes failure, perseveres, and emerges confident in their ability to meet global challenges.

As a company, we embrace the core values of passion, integrity, and excellence, which we try to embody in everything we do.

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Section 1: The Mobile Robotics Technology Challenge

1.1 About the Mobile Robotics Technology Challenge

The RECF Mobile Robotics Technology Challenge provides a hands-on educational STEM experience focused on robot design, construction, strategy, programming, and problem-solving. The program emphasizes teamwork, critical thinking, communication, documentation, and real-world application of concepts.

The purpose of the Mobile Robotics Technology Challenge is to evaluate each competitor's preparation for employment in the field of robotics, emphasizing teamwork, technical knowledge, and collaborative problem-solving in a workplace environment while recognizing outstanding students for excellence and professionalism.

The Mobile Robotics Technology Challenge is open to teams of two active SkillsUSA members from the same local chapter (school) who are enrolled in programs with robotics, engineering, automation, manufacturing, or electronics as an occupational objective.

1.2 The 2026-2027 RECF Mobile Robotics Technology Challenge

In the 2026-27 Mobile Robotics Technology Challenge, teams utilize mobile robots at a simulated disaster site to coordinate receipt and deployment of supplies. The challenge simulates an organization that receives shipments of water, medical supplies, and fuel at a disaster area and deploys them for use by responders.

Robots navigate a 4’x8’ field to receive and deploy the simulated water, medical supplies, and fuel into designated locations for use by disaster response personnel. Robots can push, lift, rotate, stack, spin, or plow materials, but must follow the rules for each material and match type.

In some matches, team members drive the robot. In others, the robot drives itself based on pre-programmed code written by the students. Not every robot and team will meet the challenge the same way, and there are some ways to score that are easier than others. As long as you follow the rules in this game manual you can meet the challenge however you like!

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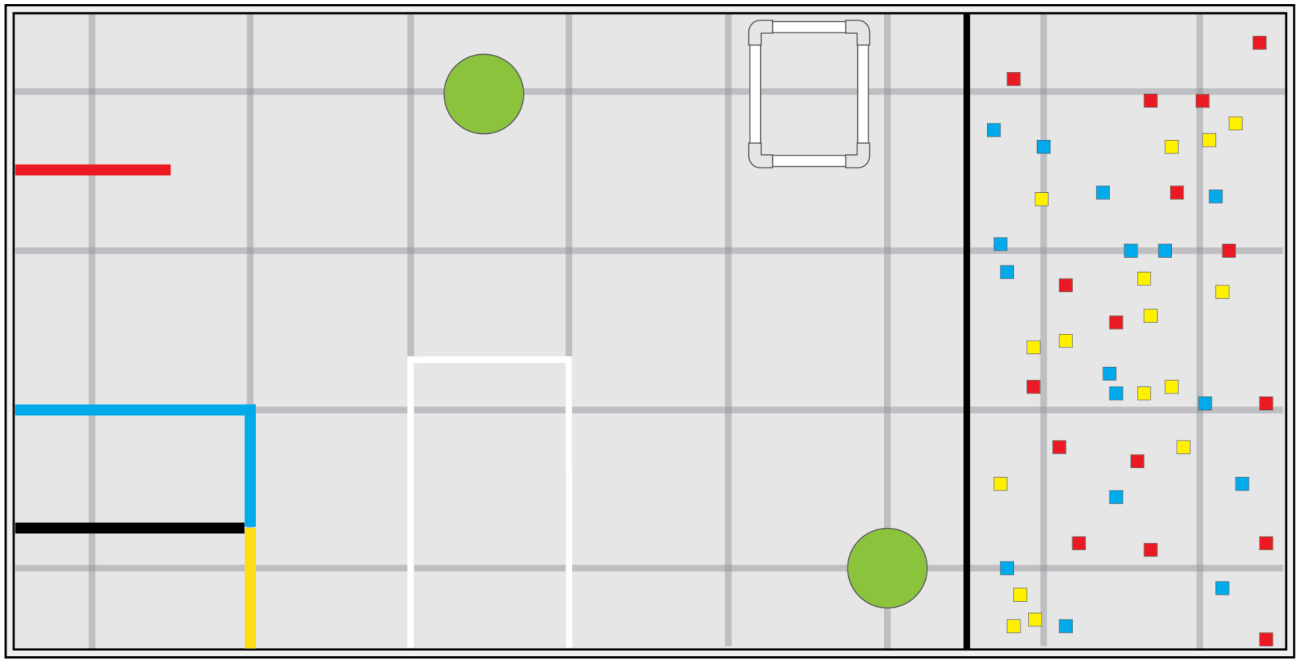

Figure 1.2: Field layout

1.3 Four Mobile Robotics Technology Challenges

- Design & Build a Robot (see section 2) - Using the engineering design process, work with your teammates to design, build, and test a robot to score points in matches
- Driving Match (see section 3) - The two team members work together at the field to score points with a robot responding to input by remote control
- Autonomous Match (see section 4) - The two team members work together at the field to score points with a robot operated entirely by segments of code—no controller!
- Judging (see section 5) - Document and share your use of the engineering design process and programming in an engineering notebook throughout the season, and describe your work to judges during engineering design and programming interviews

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1.4 Definitions

1.4.1 General Definitions

- **Coach / Mentor** - A person who helps students learn concepts used in RECF competitions, and who helps create and organize teams, but who cannot contribute to the students' work used at competitions
- **Engineering Notebook** - A physical or electronic document that records a team's use of the engineering design process, and their work during a competition season
- **Grounded** - Description of a robot that has damaged the field and is no longer allowed to participate in the match; the robot is not allowed to drive, and the controller should be placed on the floor or another nearby position (not on the field)
- **Match** - A period of time during which a team uses their robot to score points within the constraints of the rules in this game manual
    - **Autonomous Match** - A one-minute match with one robot and one drive team, during which the robot operates only by code created by the students
    - **Driving Match** - A one-minute match with one robot and one drive team, during which students operate the robot by remote control
- **Penalty - A point deduction that reduces a team's score for the match (see 1.5)**
- **Robot** - A machine designed and built by students from parts that are legal for use in the RECF Achieve competition
- **Student** - A team member who meets all requirements of the program, is within the age bracket, and who contributes to a team's notebook, robot design, build, code, and/or strategies or serves as a drive team member;

1.4.2 Game-Specific Definitions

- **Cafeteria** - A section of the field (and the 3D projected volume above it) where robots place blue cubes (water); the cafeteria is approximately 8"x17" and is bordered by the field perimeter and the inside edges of the surrounding dividers
- **Charging Zone** - A section of the field (and the 3D projected volume above it) where the robot begins and ends the match; the charging zone consists of the section of the floor defined by white tape lines, including the tape lines (the charging zone is highlighted in orange in figure 1.4.2)
- **Cube** - A foam, six-sided, roughly 1" cubical object that is red, blue, or yellow; each color represents a specific variety of supply at a disaster response site
- **Divider** - A 1" high wall made of wood or plastic and connected to the floor to create a zone or field location; the divider at the generator is 2" high, and all other dividers are 1" high
- **Driver Box** - An area near the field where the drive team must stand during a match (the driver box is highlighted in pink in figure 1.4.2)
- **Fuel Tank** - A mobile structure (and the 3D projected volume above it) built from segments of 1" PVC and PVC connectors; the fuel tank is approximately 8"x11"x1.75" and is where robots place red cubes (fuel)

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- **Generator** - A section of the field (and the 3D projected volume above it) where robots place the fuel tank; the generator is approximately 11”x11” and is bordered by the field perimeter and the inside edge of the adjacent divider
- **Medical Tent** - A section of the field (and the 3D projected volume above it) where robots place yellow cubes (medical supplies); the medical tent is approximately 8”x17” and is bordered by the field perimeter and the inside edges of the surrounding dividers
- **Obstacle** - One of two cylindrical foam objects on the field that represent structural supports the robot must avoid when navigating the field; each obstacle is approximately 12” high and 6” in diameter
- **Receiving Zone** - A section of the field (and the 3D projected volume above it) where yellow, red, and blue cubes are randomly pre-placed for retrieval by robots during the match (the receiving zone is highlighted in green in figure 1.4.2)

Figure 1.4.2 highlights the following defined locations and zones:

- Purple: generator
- Orange: charging zone
- Red: fuel tank
- Yellow: medical tent
- Blue: cafeteria
- Green: receiving zone
- Pink: driver station

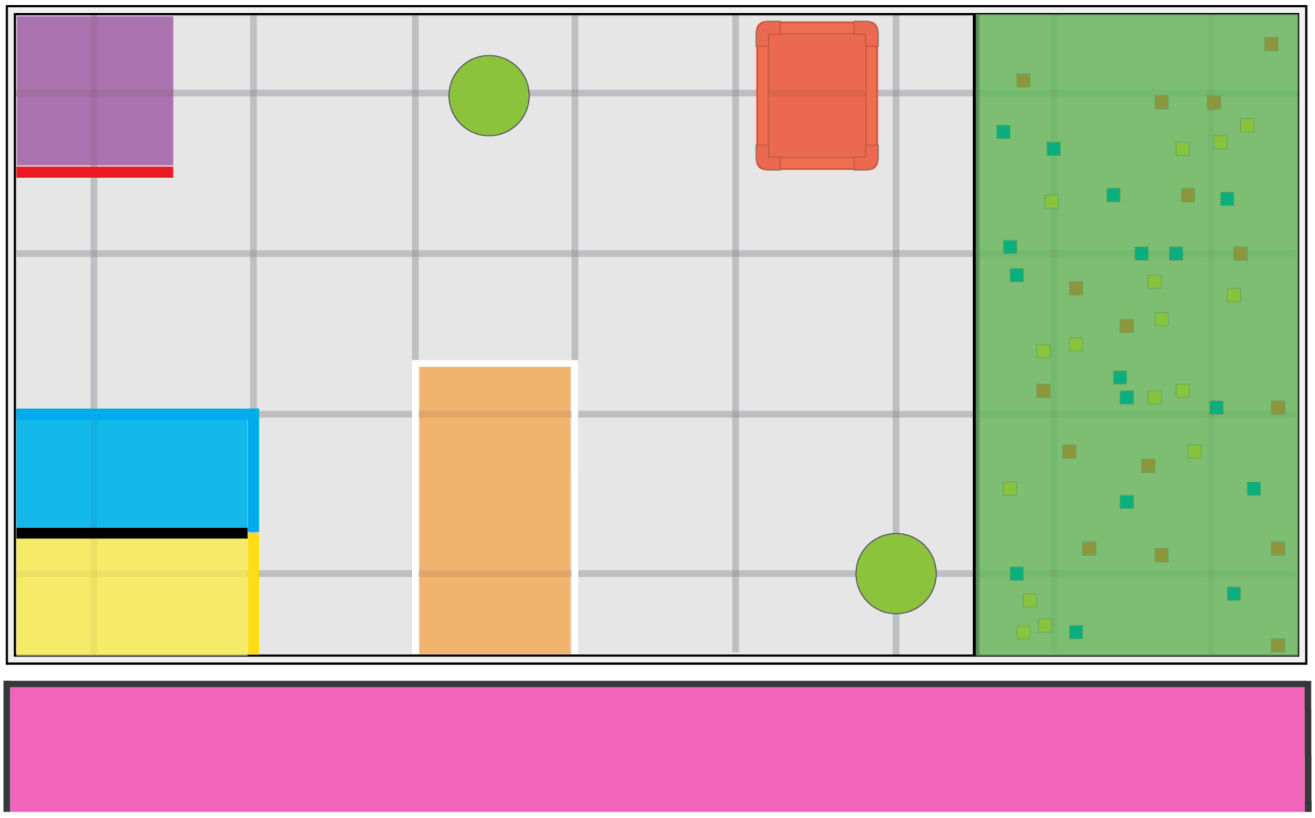

Figure 1.4.2: Highlighted locations and zones

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1.5 Penalties

Penalties are assessed at the end of a match by reducing the team's overall score with either a point or percent deduction, as listed in the scoring table in section 3.1 and summarized below. These deductions are based upon the number of penalties incurred throughout the match.

In addition to the standard point and percentage deductions, a team may be awarded a zero score for the entire match if the head referee determines that a team's actions during a match were egregious or penalties were intentional or strategic.

During the driving phase, referees should focus on helping teams avoid penalties before they happen by calling out actions that may lead to point deductions.

Penalty Category	Deduction
Incorrectly placed supplies	1 point deduction for each incorrectly placed cube
Hitting an obstacle	5% deduction per obstacle (maximum of 10% deduction)
Robot doesn't end the match in the charging zone	10% deduction

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Section 2: Design, Build, and Code a Robot

Robots are primarily created using VEX Robotics® and/or LEGO® electronics and parts. Each robot must pass a brief inspection before it can participate in matches. Robots may change during the competition, but should be reinspected. A robot may not participate in a match if it is in violation of a robot rule.

Each robot must use a single branded system of electronics, but can use any combination of legal VEX® and LEGO® structural parts (see rule 2.2.4 for details).

2.1 Robot design

2.1.1 Teams design their own robots

A team's student members get to decide what their robot looks like, and what it does.

2.1.2 Outside references are okay as starting points

Teams can use someone else's design as a starting point, but should modify it to make it their own. They should be able to explain their design process and original ideas when asked. Outside references should be appropriately credited and described in teams' engineering notebooks.

2.2 Robot build

2.2.1 Basic requirements

- Your robot must be safe, and can't damage the field, people, or other robots
- Your robot must pass an inspection before competing at an event and is subject to reinspection at any time during the event
- The power button must be easy to reach during the match
- Your robot can't have parts or mechanisms that intentionally detach during the match
- Your robot can't be larger than 11" wide by 20" long by 15" tall at the start of the match
- You can only bring one robot to an event
- Your robot can only include legal materials as listed below

2.2.2 Modifying parts

- Electronic components cannot be modified in any way, other than labeling and/or external decorations
- External controller accessories (such as controller scuffs) are allowed, as long as the controller itself remains unmodified.
- Non-electronic parts may be modified

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2.2.3 Required parts

	VEX IQ®	LEGO®
Robot Brain	One VEX IQ® robot brain (1st Gen or 2nd Gen)	• One LEGO® SPIKE™ Hub (large / small) –or– • One LEGO® Mindstorms® EV3 Intelligent Brick
Controller	One VEX IQ® controller	A compatible handheld controller, phone, or tablet connected to the robot or to an appropriate application (e.g., LEGO® Mindstorms® Robot Inventor, LEGO® BOOST, or Pybricks).
Battery	• One VEX IQ® Robot battery (1st Gen or 2nd Gen) –or– • One VEX® Robot AA Battery Holder	• One LEGO® Technic™ Small or Large Hub Battery –or– • One LEGO® Mindstorms® EV3 DC Battery

2.2.4 Optional parts

	VEX IQ®	LEGO®
Motors (up to 6 motors per robot)	• VEX IQ® Smart Motor	• LEGO® Education Double Motor • LEGO® Education Single Motor • LEGO® Technic™ Small Angular Motor • LEGO® Technic™ Medium Angular Motor • LEGO® Technic™ Large Angular Motor • LEGO® Mindstorms® EV3 Large Servo Motor • LEGO® Mindstorms® Medium Servo Motor
Sensors	• VEX IQ® Color Sensor • VEX IQ® Optical Sensor • VEX IQ® Distance Sensor • VEX IQ® Touch Sensor • VEX IQ® Gyro Sensor • VEX IQ® TouchLED • VEX IQ® AI Vision Sensor • VEX IQ® Vision Sensor	• LEGO® Technic™ Distance Sensor • LEGO® Technic™ Color Sensor • LEGO® Technic™ Force Sensor • LEGO® EV3 Color Sensor • LEGO® EV3 Ultrasonic Sensor • LEGO® EV3 Gyro Sensor • LEGO® EV3 Touch Sensor
Pneumatics	VEX IQ® Pneumatics kit.	No compatible pneumatics kit.
Cables	VEX IQ® Smart Cables	LEGO® EV3 cables or attached LEGO® SPIKE™ motor cables.

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Radios	• VEX IQ® 2.4 GHz Radio • VEX IQ® Smart Radio • VEX IQ® 900 MHz Radio	No compatible radio.
	Both VEX IQ® and LEGO®	
Structural Components	Your robot's structure may be comprised of VEX IQ®, VEX GO®, VEX® HEXBUG*, LEGO® Mindstorms®, LEGO® SPIKE™ Prime, and/or LEGO® SPIKE™ Essential parts. * The HEXBUG brand is a registered trademark belonging to Spin Master Corp	

Custom Plastic	• Unlimited custom plastic pieces, which can be a combination of two styles:
	  ○ **Flat cut -** Pieces cut from certain types of non-shattering plastic
	  ○ **3D printed -** Pieces printed from certain types of plastic filament
	• Flat-cut plastic requirements:
	  ○ You may modify your custom flat cut plastic by making holes, cutting sizes and shapes as desired, bending, or otherwise changing the form or appearance of the plastic. You may not chemically weld, melt, or treat flat-cut plastic.
	  ○ You may use any of the following flat-cut plastic types: polycarbonate (Lexan), acetal monopolymer (Delrin), acetal copolymer (Acetron GP), POM (acetal), ABS, PEEK, PET, HDPE, LDPE, nylon (all grades), polypropylene, PTFE, and FEP.
	  ○ Flat-cut plastic that may shatter (ex. plexiglass or acrylic) is not allowed.
	• 3D printed plastic requirements:
	  ○ You may use any of the following filament types: PLA, ABS, TPU, PETG, ASA, nylon, and carbon fiber-filled filaments (e.g., ASA-CF).
	• Custom plastic parts must be designed or customized by student team members, but can be manufactured by an outside entity (e.g., SendCutSend).
	• Please document your use of custom plastic in your engineering notebook.	

Misc.	• Any rubber bands up to 8" long and .25" wide • Tape, only when used for labelling robot wires and electronics • ⅛" VEX V5® metal shafts • Zip ties or cable ties up to 4" long and .12" wide for wire management or attaching custom plastic parts • The team can create and use controller accessories, basic spacers, and adapters and parts made solely to adapt other legal hardware systems to VEX IQ® electronics	

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2.2.5 Disallowed items

- Any kind of lubricant or grease
- Nonspecified electronic components
- Nonspecified structural / mechanical parts
- Anything that compromises the safety of people, other robots, the field, or game pieces

2.3 Robot Code

2.3.1 Students create their own code

A team's student members get to decide what their robot's code looks like, and what it does. Adults may teach coding concepts, but may not tell students what should or should not be included in their code. Teams can pre-write code to practice for a range of scenarios, and fine-tune the code on site.

2.3.2 Coding libraries are okay as starting points

Teams can use coding libraries as a starting point, but should modify the resulting code to make it their own. They should be able to explain how their code works and how it has been modified from the original ideas when asked. Outside references should be appropriately credited and described in teams' engineering notebooks.

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Section 3: Driving Match

In each driving match, the robot receives and delivers shipments of fuel, medical supplies, and water at a simulated disaster site while avoiding obstacles. The robot must end the match back where it started—in the charging zone—to avoid a point deduction.

Teams have 60 seconds to score as many points as possible while operating their robot with a remote controller.

The field setup is shown in figure 3.0.1 below.

Field Setup Guide:

- White lines represent segments of white electrical tape.
- The dividers are secured to the field floor in the locations shown in this section; the divider at the generator is 2” high, and all others are 1” high.
- The two foam cylinders are not secured to the field, and should be positioned as shown in this section.
- The PVC structure should be positioned as shown.
- 16 blue, 16 red, and 16 yellow cubes should be placed randomly in a single layer within the receiving area.

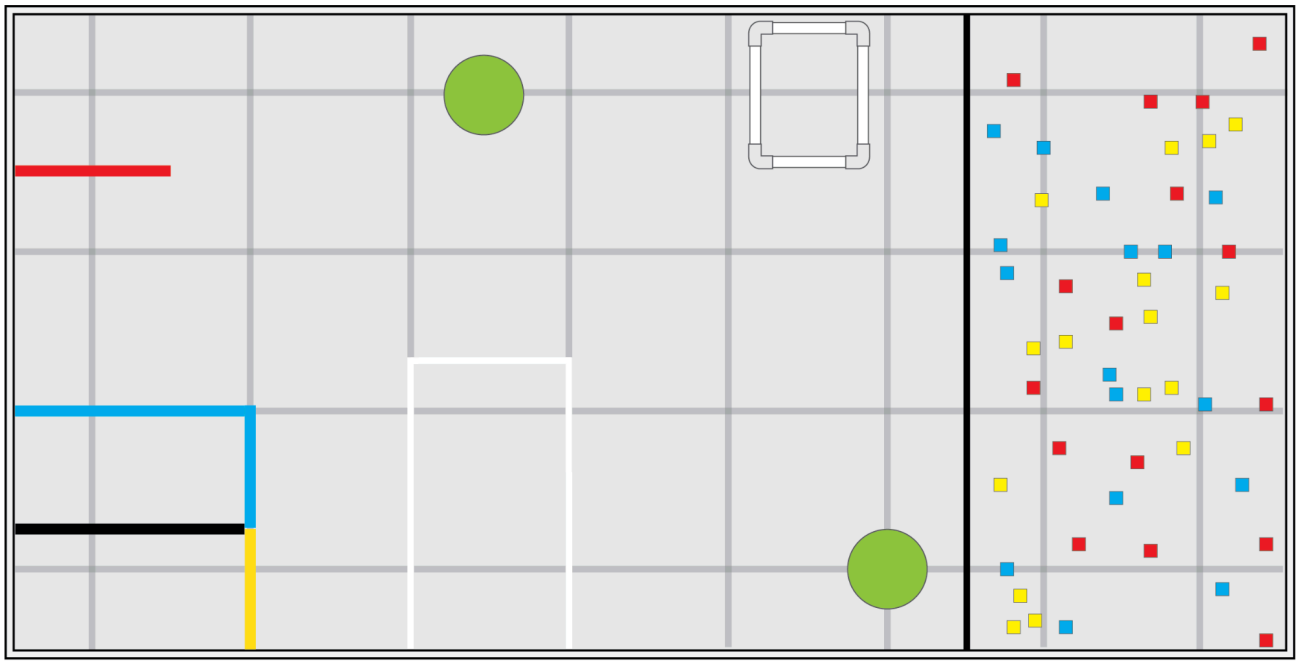

Figure 3.0.1: Field setup

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3.1 Scoring and Scoring Criteria

Driving Phase Scoring or Penalty Category	Points
Fuel placed in the fuel tank	2 points per red cube
Water placed in the cafeteria	1 point per blue cube
Medical supplies placed in the medical tent	1 point per yellow cube
Receiving zone cleared	5 points
Fuel tank placed in the generator	• 15 points if all cubes in the fuel tank are red • 10 points if any cubes in the fuel tank are not red
Penalty: Incorrectly placed supplies	1 point deduction for each incorrectly placed cube
Penalty: Hitting an obstacle	5% deduction per obstacle (maximum of 10% deduction)
Penalty: Robot doesn't end the match in the charging zone	10% deduction

3.1.1 Cube placed in the fuel tank

Each cube that meets all of the following criteria at the end of the match will count as in the fuel tank:

- The cube is at least partially inside the structure bordered by the PVC segments and connectors
- The cube is contacting the floor inside the fuel tank, or another cube that is contacting the floor inside the fuel tank

Each red cube that ends the match in the fuel tank is worth 2 points. Each yellow or blue cube that ends the match in the fuel tank will earn a 1 point penalty.

3.1.2 Cube placed in the cafeteria

Each cube that meets all of the following criteria at the end of the match will count as in the cafeteria:

- The cube is at least partially inside the cafeteria
- The cube is contacting the floor inside the cafeteria, or another cube that is contacting the floor inside the cafeteria

Each blue cube that ends the match in the cafeteria is worth 2 points. Each yellow or red cube that ends the match in the cafeteria will earn a 1 point penalty.

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3.1.3 Medical supplies placed in the medical tent

Each cube that meets all of the following criteria at the end of the match will count as in the medical tent:

- The cube is at least partially inside the medical tent
- The cube is contacting the floor inside the medical tent, or another cube that is contacting the floor inside the medical tent

Each yellow cube that ends the match in the medical tent is worth 2 points. Each red or blue cube that ends the match in the medical tent will earn a 1 point penalty.

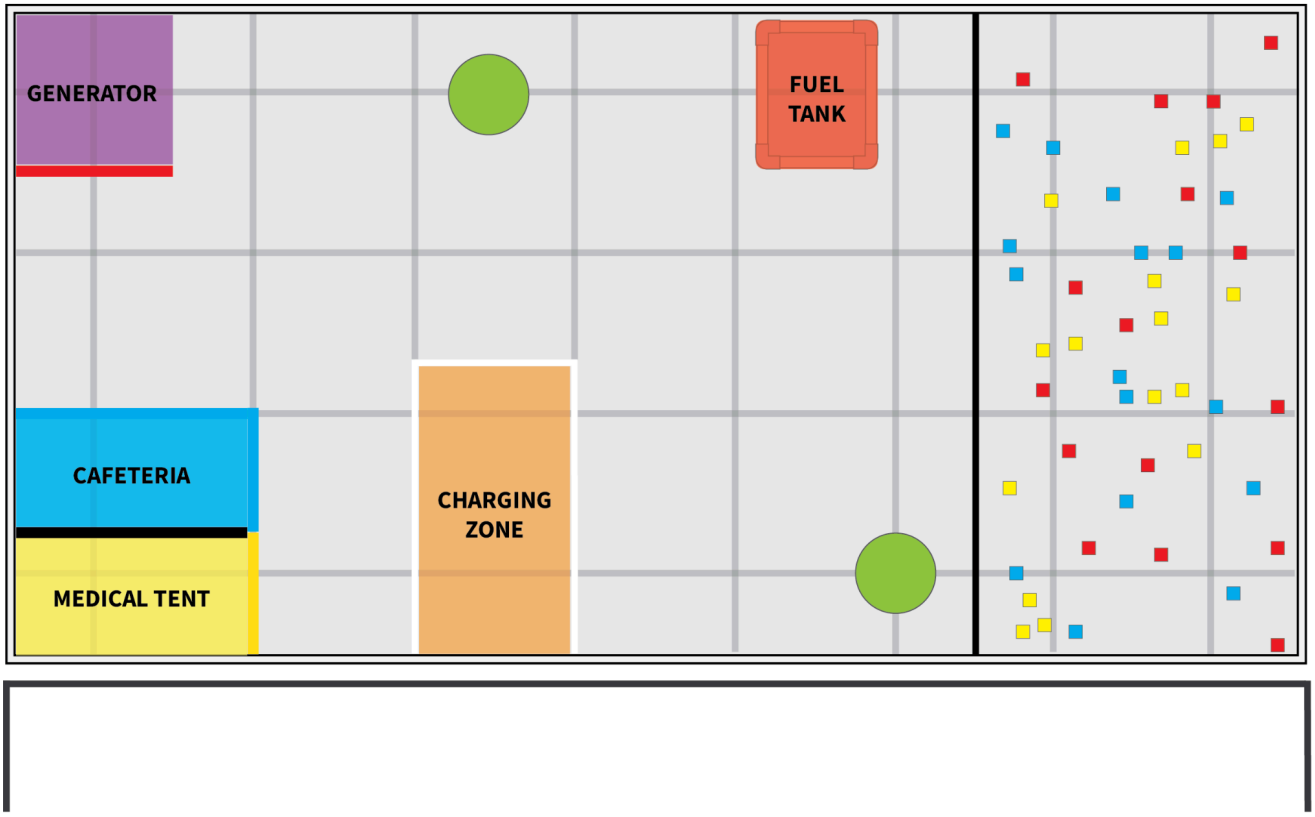

Figure 3.1.3: Field locations and zones

3.1.4 Cleared receiving zone

A team will earn 5 points at the end of the driving phase if no cubes are in contact with the floor inside the zone.

3.1.5 Fuel tank placed in the generator

If the fuel tank meets all of the following criteria at the end of the match, the team will earn 15 points:

- The fuel tank is inside the generator
- The fuel tank is contacting the field perimeter at the back of the generator
- The fuel tank is upright, with the four corner connectors resting on the floor
- The fuel tank includes at least one red cube

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3.1.6 Penalty for incorrectly placed supplies

Each supply placed in the wrong area of the field (e.g., water in fuel tank, medical supply in cafeteria, etc.) will result in a 1-point deduction from the team's score, before other penalties are calculated.

3.1.7 Penalty for contacting obstacles

The team's score will decrease by 5% for each of the two obstacles the robot contacts during the match, with a maximum of a 10% deduction if the robot contacts both obstacles. Contacting the same obstacle multiple times will not increase the deduction unless the referee determines the team is contacting the obstacle intentionally or strategically.

3.1.8 Penalty for ending the phase outside of the charging zone

The team's score will decrease by 10% if the robot ends the phase outside of the charging zone.

A robot counts as being inside the charging zone if the robot is in contact with the white tape that defines the charging zone and/or the floor inside the white tape lines, and is in contact with the section of field perimeter within the charging zone.

3.2 Starting Positions

3.2.1 Driver box

Two team members can come to the field for each match. Both must remain inside of the driver box during the match unless they are interacting with their robot as allowed in 3.4.1. Only the team members can operate the robot during the match.

Team members can't wear headphones or communicate with anyone beyond the field during the match, and spectators can't coach the drive team. Sitting or standing on chairs/stools for support or elevation is only allowed if approved through an accommodation request.

3.2.2 Robot starting position

The robot must meet all of the following criteria at the beginning of the driving phase:

- Within the 11" x 20" x 15" starting size limit
- In contact with the floor inside the charging zone
- Not in contact with the floor outside of the charging zone

3.2.3 Preload cubes

The team may select up to three cubes, in any combination of colors, to begin the match in contact with their robot. The team should remove these cubes from the receiving area before the match and place them in, on, or adjacent to their robot before the match begins. Preloaded cubes do not have to fit within the robot size limits, but cannot cause the robot to be out of size.

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3.3 Match Play

3.3.1 The robot can only operate while the match timer is counting down

The robot can't be in motion before the match timer begins counting down, and has to stop when the timer hits 0. Points scored after the timer reaches 0 will be deducted before the score is submitted.

3.3.2 Cubes that leave the field aren't returned

Any cube that leaves the field during a match (entirely outside of the perimeter) must stay out of the field for the rest of that match. Cubes that are leaving the field cannot be deflected back into the field by humans, or by anything outside of the field.

3.3.3 Don't reach into the field

Before a match, students can only reach into the field to place their robot or to select and place their preloads (3.2.3). Referees can adjust the fuel tank and obstacles if they're more than 1" out of position or in an incorrect orientation.

During a match, students can only reach into the field to reset their robot if it malfunctions (3.4.1).

3.4 What Happens When Things Go Wrong

3.4.1 Robot reset

If the robot breaks or malfunctions during the match, the team can put their controller down, remove their robot from the field, and fix it. If the robot is in contact with any cubes, those cubes are also removed from the field. After repair, the robot must return to the charging zone and a legal starting size before the drive team can resume playing the match.

3.4.2 Field damage

If a robot damages a field, it may be grounded by the referee and the match will end immediately. If the referee decides that damage caused by a student or robot is intentional, the team will earn a zero score for the match. The match will still count as one of the team's match attempts.

3.4.3 Appealing a decision

If the team members disagree with a referee's match ruling or score, they should remain at the field and notify the referee immediately. Team members and referees should be prepared to show specific rules that back up their opinions, and should remember that referees can only make rulings based on the game manual and their own observations and perspectives of the match. Referees and team members may never view video or photos from the match while at the field or during discussions that affect match outcomes or scoring, and students who were not at the field for the match are not allowed to approach the field. The referee will determine when the discussion is over, and will announce their final and binding decision.

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Section 4: Autonomous Match

In autonomous matches, teams have 60 seconds to score as many points as possible using only pre-written code to operate the robot.

Rules from Section 3: Driving Matches apply unless they're specifically changed by a rule in this section.

4.1 Changes From Driving Matches

4.1.1 Team members aren't limited to the driver box

Team members don't have to stay in the driver box during an autonomous match.

4.1.2 The robot can be reset as a strategy

Students can use the robot reset process in rule 3.4.1 as a strategy. For example, the team's code could consist of multiple small segments that are each launched from the starting position after a reset.

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Section 5: Judging

Each team interview lasts a maximum of 10 minutes. Judges use the Team Interview Rubric and Engineering Notebook Rubric. Teams are encouraged to review these rubrics in advance.

5.1 Engineering Notebooks

An engineering notebook is a record-keeping tool that provides students with an opportunity to develop essential skills such as project and time management, brainstorming, and both written and interpersonal communication. Teams are encouraged to document their use of the engineering design process, including details of successes and challenges. All documentation and work related to the engineering notebook must be completed by the students, and they can't use AI-generated content.

All SkillsUSA national competitors must submit their one-page single sided resume online, a digital engineering notebook, a digital CAD drawing(s), and a digital safety risk assessment. The deadline and link for online submissions will be published on updates.skillsusa.org.
Failure to submit any of the required document(s) listed by the established deadline will result in a 10-point penalty.

5.2 Team Interviews

Team interviews are face-to-face conversations between a team of students and two or more volunteer judges. Interviews are opportunities for teams to share their design process, match strategies, learning experiences, and overall approach to the Mobile Robotics Technology Challenge. Each team will receive two interviews of up to 10 minutes each.

Team interviews will be scheduled with the judges following orientation. Teams must request a slot for a judging interview. Teams will need to review the agenda for interviews during orientation. Engineering interviews will not be scheduled on the last day of competition, however teams can finish their programming interviews on the last day of competition. The National Committee will review the process for scheduling interviews during orientation.

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Section 6: Event Personnel, Processes, & Guidelines

6.1 Event Personnel

6.1.1 Head Referee

A head referee is a volunteer who oversees matches using the guidelines in the game manual. Head referees work with team members to prevent and avoid fouls, and communicate fouls and penalties to teams when they occur. Head referees have the final decision on all match and robot rules. Every match must be watched by at least one head referee, and a head referee must be available to assist at robot inspection.

6.2 Event Processes

6.2.1 Team Orientation

Each team must check in when they arrive at the event to locate their team space. Orientation times for each age level will be listed on the official agenda for the competition. During orientation, teams will be provided with an overview of the Mobile Robotics Challenge rules for their age level, as well as the process for scheduling interviews. Teams will be provided with a paper copy of the orientation agenda and allowed time to ask questions of the event staff.

6.2.2 Robot Inspection

Each robot must pass an inspection before it can be used in any type of match at an event. Volunteer inspectors will confirm that robots meet the requirements in the game manual, and will mark passed inspections in the event management software.

6.3 Field Parameters

6.3.1 Field perimeter types

Matches are played on a 4’x8’ field consisting of a floor and a perimeter. Approved field perimeters are the AndyMark FIRST Tech Challenge Perimeter Kit (am0481), the VEX® Portable Competition Field Perimeter (276-8242), and the VEX® Metal Competition Field Perimeter (278-1501).

6.3.2 Game objects

Matches use the foam rollers and foam blocks linked below.

1. Foam roller - two rollers are needed for each field setup
2. 100-piece foam block set - one set is needed for each field setup

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6.3.3 Variances

Although fields and setups should be as identical as possible, teams have to be prepared for some amount of variance. Starting locations for the fuel tank and obstacles may vary up to ±1” (25.4mm) in any direction.

Lighting conditions at fields will vary from event to event. Teams with optical or vision sensors should work with the event partner to calibrate their sensors at the field before matches begin.

6.4 Match Parameters

Each team can attempt up to three driving matches and three autonomous matches. These matches aren’t scheduled, and teams can make these attempts whenever their event schedule permits.

6.5 Field & Game Questions

All field and game play questions should be sent to Sarah Jones, National Technical Committee Chair, at sarah_jones@recf.org.

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