Mobile Robotics Technology Challenge
National SkillsUSA

Disaster Readiness

Secondary & Post-Secondary 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 in a simulated supply warehouse for a disaster relief support organization to receive, store, and ship supplies. The challenge simulates an organization that receives donations of water, medical supplies, and fuel from individuals and businesses, and stores those donations within the warehouse until materials are ready to be shipped to disaster areas.

Robots navigate a 6’x12’ field to collect and sort the simulated water, medical supplies, and fuel into designated storage areas, then autonomously ship supplies when relief is needed for a disaster. Robots can push, lift, rotate, stack, spin, or plow materials, but must follow the rules for each material and phase of the match.

In some parts of a match, 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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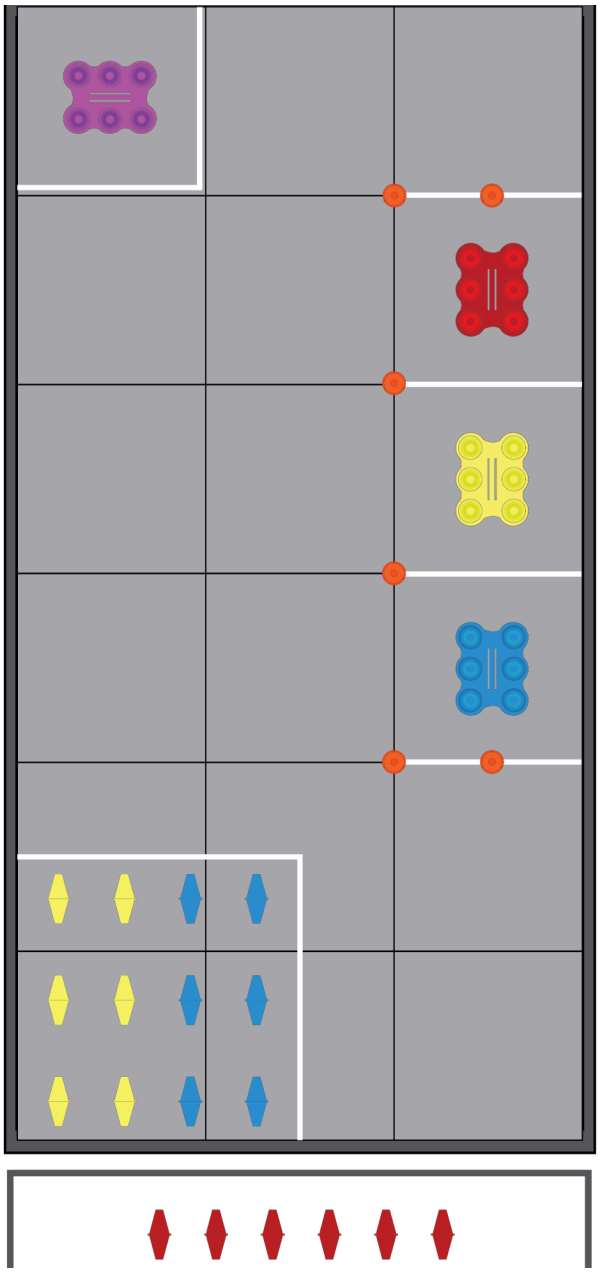

Figure 1.2: Field layout

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 Phase (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 Phase (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 two-phase period of time during which a team uses their robot to score points within the constraints of the rules in this game manual; each match begins with a required driving phase, which is followed by an optional autonomous phase
    - **Autonomous Phase** - A one-minute period with one robot and one drive team, during which the robot operates only by code created by the students
    - **Driving Phase** - A one-minute period 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 a match phase (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

- **Charging Zone** - A section of the field where the robot begins and ends the match; the charging zone consists of the center field tile on the end opposite the driver box (the charging zone is highlighted in orange in figure 1.4.2)
- **Cone** - A plastic, two-segment object that is roughly 6" tall and 3.3" wide, and which represents a donated material; each cone is described by its color (red = fuel, yellow = supplies, and blue = water)
- **Container** - A 6-segmented plastic object in the shipping zone or a storage zone, where robots place cones during a segment of the match; each container is approximately 12" long, 9.25" wide, and 3.5" high to the top of the convex indentations (not including the handle)
    - **Shipping Container** - A purple container located in the shipping zone, where robots place cones for shipping during the autonomous segment of the match
    - **Storage Container** - One of three containers (red, yellow, or blue) located in the storage zones, where robots place matching cones for storage during the driving phase of a match
- **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)

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- **Loading Zone** - A section of the field where teams can add red cones during the driver controlled segment of the match; the loading zone consists of the corner field tile adjacent to the driver box and opposite the receiving zone (the loading zone is highlighted in dark gray in figure 1.4.2)
- **Nested** - A description for a connection between a cone and a container, in which a convex cone fits securely inside of an opening on a container
- **Obstacle** - One of six orange plastic obstacles on the field that represent structural supports the robot must avoid when navigating the field; obstacles are placed on the tape lines surrounding the storage zones as shown on figure 1.2; each obstacle is approximately 3” high and 3.3” wide
- **Receiving Zone** - A section of the field where yellow and blue cones are pre-placed for retrieval by robots during the driving phase of a match (the receiving zone is highlighted in green in figure 1.4.2)
- **Shipping Zone** - A section of the field that contains the shipping container used during the autonomous phase of a match; the shipping zone is adjacent to the robot starting position and opposite the driver box, and is bordered by the inside of the field perimeter and the inside edges of the surrounding white tape lines (the shipping zone is highlighted in purple in figure 1.4.2)
- **Storage Zone** - One of three sections of the field where robots place cones into storage containers during the driving phase based on the cones’ colors; each storage zone is bordered by the field perimeter and the inside edges of the surrounding white tape lines
    - **Fuel Storage** - The storage zone closest to the robot starting position and farthest away from the driver box; robots place red cones into the storage container in this zone during the driving phase of a match (the fuel storage zone is highlighted in red in figure 1.4.2)
    - **Supply Storage** - The center storage zone; robots place yellow cones into the storage container in this zone during the driving phase of a match (the supply storage zone is highlighted in yellow in figure 1.4.2)
    - **Water Storage** - The storage zone closest to the driver box and the loader; robots place blue cones into the storage container in this zone during the driving phase of a match (the water storage zone is highlighted in blue in figure 1.4.2)

Figure 1.4.2 highlights the following defined locations and zones:

- Purple: shipping zone
- Orange: charging zone
- Red: fuel storage zone
- Yellow: supply storage zone
- Blue: water storage zone
- Green: receiving zone
- Dark gray: loading zone
- Pink: driver station

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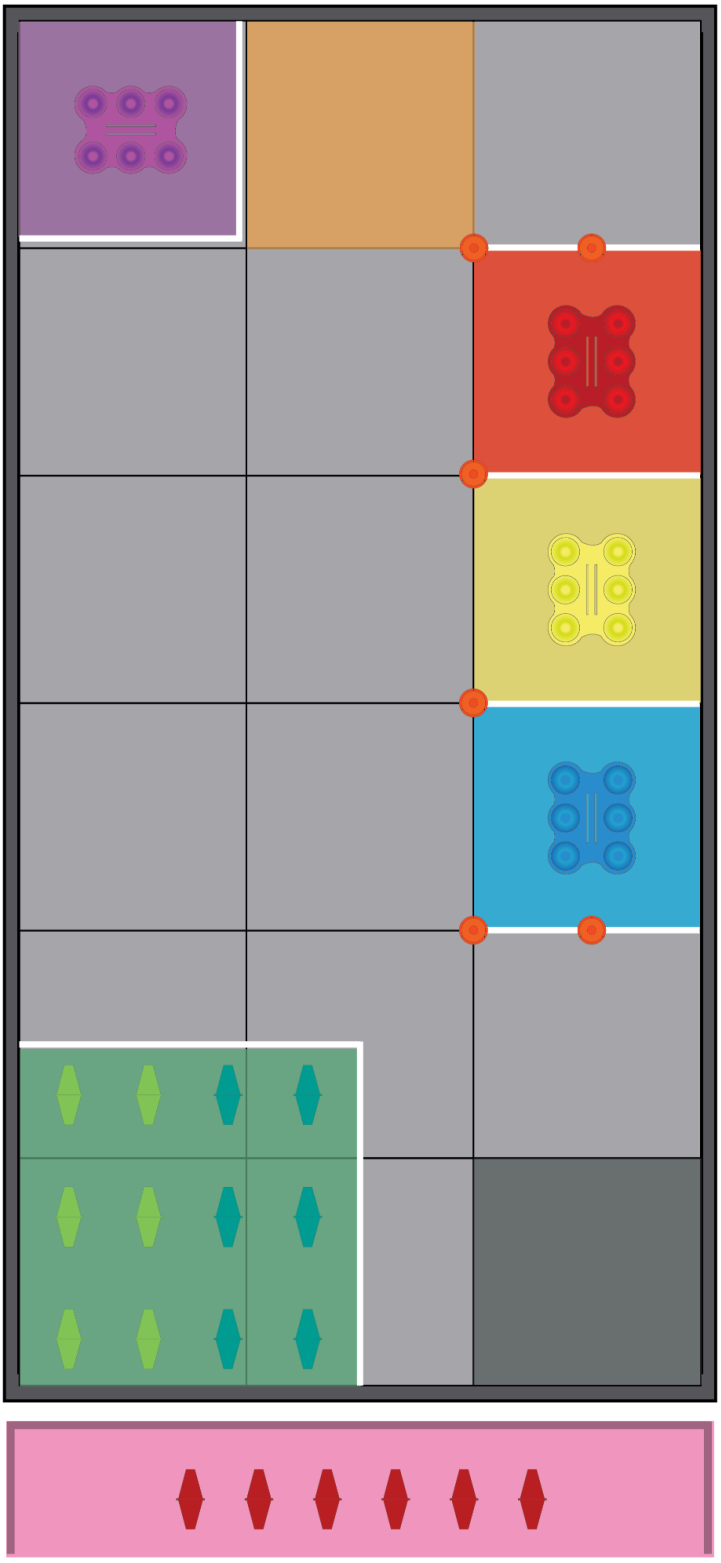

Figure 1.4.2: Highlighted locations and zones

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1.5 Penalties

Penalties are assessed at the end of a match by reducing the team's overall score with a percent deduction, as listed in the scoring tables in sections 3.1 and 4.1 and summarized below. These deductions are based upon the number of penalties incurred throughout the match phase.

In addition to the standard 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.

Match Phase	Penalty Category	Deduction
Driving Phase	Hitting an obstacle	5% deduction per obstacle (maximum of 30% deduction) applied to driving phase score
Driving Phase	Entering the shipping zone	5% deduction per violation (maximum of 20% deduction) applied to driving phase score
Driving Phase	Robot doesn't end the phase in the charging zone	10% deduction applied to driving phase score
Autonomous Phase	Hitting an obstacle	5% deduction per obstacle (maximum of 30% deduction) applied to autonomous phase score
Autonomous Phase	Entering the receiving zone	5% deduction per violation (maximum of 20% deduction) applied to autonomous phase score
Autonomous Phase	Robot doesn't end the phase in the charging zone	10% deduction applied to autonomous phase score

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Section 2: Design, Build, and Code a Robot

Robots are primarily created using VEX V5® electronics and non-electronic parts from any combination of three robot brands: VEX V5®, Robits® by AndyMark, and Pitsco Education TETRIX® MAX. 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 the VEX V5® system of electronics, but can use any combination of legal VEX V5®, Robits® by AndyMark, and Pitsco Education TETRIX® MAX 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
- Your robot should be able to be quickly and safely powered down, either by having easy access to the power button or to easily unplug the battery
- Your robot can't have parts or mechanisms that intentionally detach during the match
- Your robot can't be larger than 18" wide by 18" long by 18" 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
- Non-electronic parts may be modified

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2.2.3 Required parts

	Required Parts
Robot Brain	VEX V5® Robot Brain
Controller	VEX V5® Controller* **Teams may use up to two controllers for a single robot.*
Radio	VEX V5® Robot Radio
Battery	VEX V5® Robot Battery Li-Ion 1100mAh

2.2.4 Optional parts

	Electrical / Pneumatic optional parts
Motors up to a total of 99W	• VEX V5® Smart Motor 11W • VEX V5® Smart Motor 5.5W
Sensors	• VEX V5® AI Vision Sensor • VEX V5® Bumper Switch & Bumper Switch v2 & Bumper Switch 6N • VEX V5® Distance Sensor • VEX V5® GPS Sensor • VEX V5® Inertial Sensor • VEX V5® Line Tracker • VEX V5® Limit Switch • VEX V5® Light Sensor • VEX V5® Optical Sensor • VEX V5® Rotation Sensor • VEX V5® Vision Sensor • VEX V5® Potentiometer & Potentiometer v2
Cables	• VEX V5® Smart Cable • VEX V5® Power Cable • VEX V5® 2-Wire, 3-Wire and 4-Wire Extension Cable • VEX V5® 2-Wire and Serial Y-Cable
Pneumatics	Commercially manufactured pneumatic components including cylinders, actuators, valves, gauges, storage tanks, regulators, manifolds, and tubing • All components must be rated for 100 psi or higher • Pneumatic devices may only be charged to a maximum of 100 psi • Compressors or other forms of onboard charging are not permitted • Pneumatic components may not be modified from their original state, other than cutting tubing or wiring to length; assembling components using pre-existing threads, brackets, or fittings; or applying minor cosmetic labels.

This is not a comprehensive list of legal electronic VEX V5® components. Any robot part within the VEX V5® system is legal for this challenge.

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	Mechanical / Structural optional components
VEX V5® / VEX IQ®	All VEX V5® structural and mechanical parts are considered legal, including: ● VEX V5® metal C-channel, U-channel, plates, angles, rails, tracks, gussets, brackets, and shafts ● VEX V5® wheels and tires ● VEX V5® hardware and fasteners, such as screws, nuts, bolts, washers, bearings, shaft couplers, standoffs, shaft inserts, VersaHex adapters and spacers ● VEX V5® plastic and metal gears, sprockets, pinions, gear inserts, rack gears, bevel gears, worm gears, worm wheels, mounting brackets, lead screw nuts and segments, cam followers, and joints ● VEX V5 chain and treads, tank tread links, conveyor belt inserts, and conveyor belt base links ● VEX V5® plastic shaft bearings, shaft collars, bearing flats, hex nut retainers, shaft bushings, and standoff retainers ● VEX V5 ® Flywheel weight and Intake Roller ● VEX V5® Claw kits ● VEX IQ® Chain & sprockets ● VEX IQ® gears ● VEX EXP® structure, mechanical, and motion products *This is not a comprehensive list of legal VEX V5® components. Any robot part within the VEX V5® system is legal for this challenge.*
Robits® by AndyMark	All Robits® by AndyMark structural and mechanical parts are considered legal, including: ● Robits® tubes, beams, gussets, carriers, channel, plates, aluminum slides, bushings, brackets, and standoffs ● Robits® wheels and tires ● Robits® hardware, fasteners, spacers, screws, nuts, bearings, and springs ● Robits® gears, hex shafts, shaft adaptors, and belts ● Robits® chain sections, links, breakers, and tensioners ● Robits® pulleys, pulley mounts, pulley bearings, pulley extensions, and slide pulley holders ● Robits® turntable gears and assemblies *This is not a comprehensive list of legal Robits® by AndyMark components. Any non-electronic structure, motion, or hardware part from the Robits® by AndyMark system is legal for this challenge. Please consider compatibility with VEX V5® system electronic components (such as motors) if utilizing Robits® by AndyMark components.*
Pitsco TETRIX® MAX	All Pitsco Education TETRIX® MAX structure and mechanical parts are considered legal, including: ● TETRIX® MAX channels, bars, angles, plates, brackets, flats, and rails ● TETRIX® MAX tubes, tube reinforcers, tubing couplers, tube clamps, tubing corner blocks, and tubing anchor blocks ● TETRIX® MAX wheels and tires ● TETRIX® MAX hardware, fasteners, screws, and nuts ● TETRIX® MAX gears and sprockets

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	• TETRIX® MAX axles, hubs, spacers, stand-offs, bushings, shafts, shaft couplers and axle set collars • TETRIX® MAX tank tread chain links, tank tread rubber inserts, tank tread conveyor paddles, and chain breakers • TETRIX® MAX gripper kit *This is not a comprehensive list of legal Pitsco Education TETRIX® MAX components. Any non-electronic structure, motion, or hardware part from the Pitsco Education TETRIX® MAX system is legal for this challenge. Please consider compatibility with VEX V5® system electronic components (such as motors) if utilizing TETRIX® MAX components.*
Any source	• Commercially-available fastening hardware (when used for fastening), including screws, nuts, spacers, washers, and standoffs • Commercially-available flex/compliant wheels, rollers, or stars made from silicone rubber or TPU • Commercially-available magnets

Important notes

1. Some product kits from Robits® by AndyMark and Pitsco Education TETRIX® MAX include prohibited electronic parts, including motors, servos, controllers, cables, batteries, sensors, etc. Please take this into account when making purchasing decisions for your robot build.
2. If you are utilizing a pre-designed robot system kit, such as a chassis, lift kit, launcher expansion kit, claw kit, etc. you must appropriately document and credit that part of your robot AND modify it to make it your own in some capacity.
3. Please note that not every part will be compatible with other parts when combining robotics systems.

	Custom plastic and decorations

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.

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Misc.	• Any rubber bands up to 8” long and .25” wide • Hot glue to secure cable connections • Plastic zip ties up to 12” long and 0.25” wide • Non-aerosol-based lubricants or grease, when used sparingly; lubricants or grease may not be used on any components that will come into contact with any part of the field, game objects, or other robots • Anti-static compound, when used sparingly in a way that will not leave residue on any part of the field, game objects, or other robots • An unlimited amount of cord or string that is non-elastic and no thicker than ¼” (6.35mm) • Commercially-available products designed for bundling or wrapping cables and/or pneumatic tubing, used only for the purpose of cable/tubing protection, organization, or management (e.g., electrical tape, cable carrier, or cable track) • Commercially-available anti-slip drawer liner, in pieces no larger than 12”x15” • One micro-SD card installed in the VEX V5® Robot Brain • Tape used to secure connections between cables, prevent leaks on pneumatic fittings, and label wires/motors/sensors • The team can create and use controller accessories, basic spacers, and adapters and parts made solely to adapt other legal hardware systems to VEX V5® electronics; these parts do not have to be designed or modified by student team members

2.2.5 Disallowed items

- Any electronic components from a system other than VEX V5®, including motors, servos, controllers, cables, sensors, batteries, and radios. Electronic components from Robits® by AndyMark and Pitsco Education TETRIX® MAX are prohibited.
- Any structural / mechanical parts from a system other than Robits® by AndyMark, Pitsco Education TETRIX®, or VEX V5® unless listed in rule 2.2.4.
- 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 Phase

In the driving phase of a match, the robot receives, sorts, and stores donations of fuel, supplies, and water in a simulated warehouse while avoiding obstacles and off-limits areas. A team's actions in this phase of the match directly impact the autonomous phase; cones are not reset or moved between the end of the driving phase and the start of the autonomous phase. 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 shipping zone contains the purple container, which is not secured to the field.
- Orange obstacles are single pieces that sit flat on the floor in positions on the tape lines around the storage zones.
- The red container is located in the storage zone farthest from the driver box.
- The yellow container is located in the center storage zone.
- The blue container is located in the storage zone closest to the driver box.
- Yellow, blue, and red cones are constructed of 2 pieces connected with three trimmed zip ties.
- 6 yellow and 6 blue cones should be placed randomly within the tape lines of the receiving area.
- 6 red cones should be placed within the driver box prior to the match.
- GPS strips are not required
- See section 6 for more information

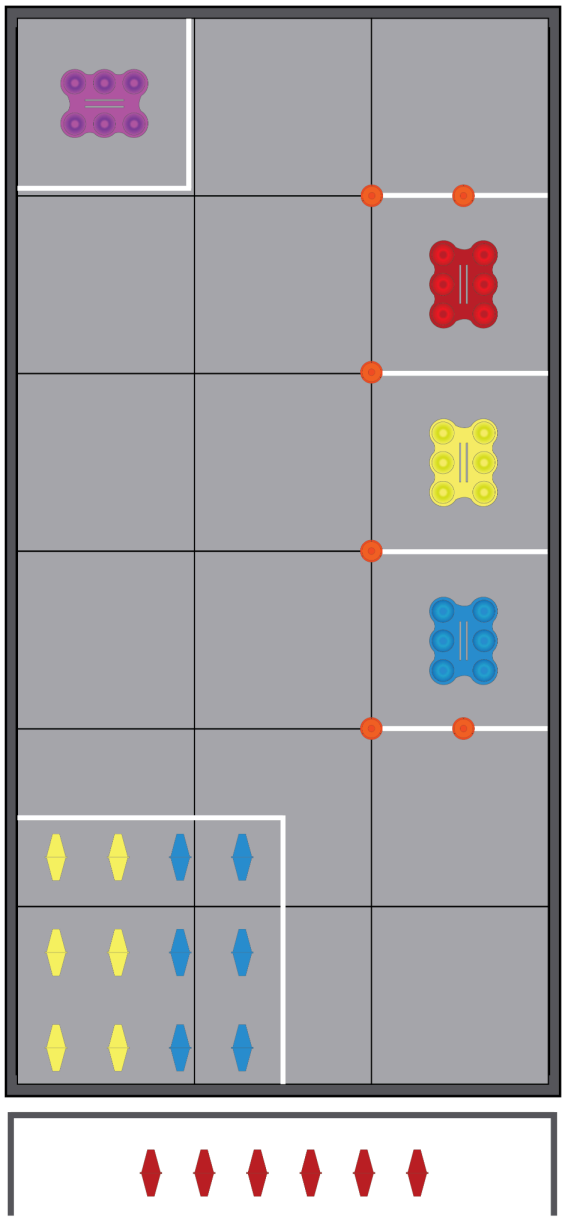

Figure 3.0.1: Field setup

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Object	Quantity & Location
Containers	Total = 4 Located in the shipping & storage zones
Red Cone	Total = 6 Located in the driver box to be introduced during the match
Blue Cone	Total = 6 Randomly placed in the receiving zone before the match
Yellow Cone	Total = 6 Randomly placed in the receiving zone before the match
Orange Obstacle	Total = 6 Placed in specific locations on the tape lines around the storage zones

3.1 Driving Phase Scoring and Scoring Criteria

Driving Phase Scoring or Penalty Category	Points
Blue cone nested in the storage container in the water storage zone	2 points per cone
Red cone nested in the storage container in the fuel storage zone	2 points per cone
Yellow cone nested in the storage container in the supply storage zone	2 points per cone
All blue and yellow cones cleared from the receiving zone	5 points
All red cones nested in the storage container in the fuel storage zone	15 point bonus
Penalty: Hitting an obstacle	5% deduction per obstacle (maximum of 30% deduction)
Penalty: Entering the shipping zone	5% deduction per violation (maximum of 20% deduction)
Penalty: Robot doesn't end the phase in the charging zone	10% deduction

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3.1.1 Nested cone placed in matching storage

Each cone that meets all of the following criteria will earn 2 points for ending the driving phase of a match inside its matching storage zone:

- The cone is nested into the storage container
- The cone and storage container are upright, with the container resting flat on the floor
- The color of the cone matches the storage container and storage zone (see figure 3.1.1):
    - Red = fuel storage zone
    - Yellow = supply storage zone
    - Blue = water storage zone
- The base of the storage container is in contact with or at least partially within the tape lines that define the storage zone

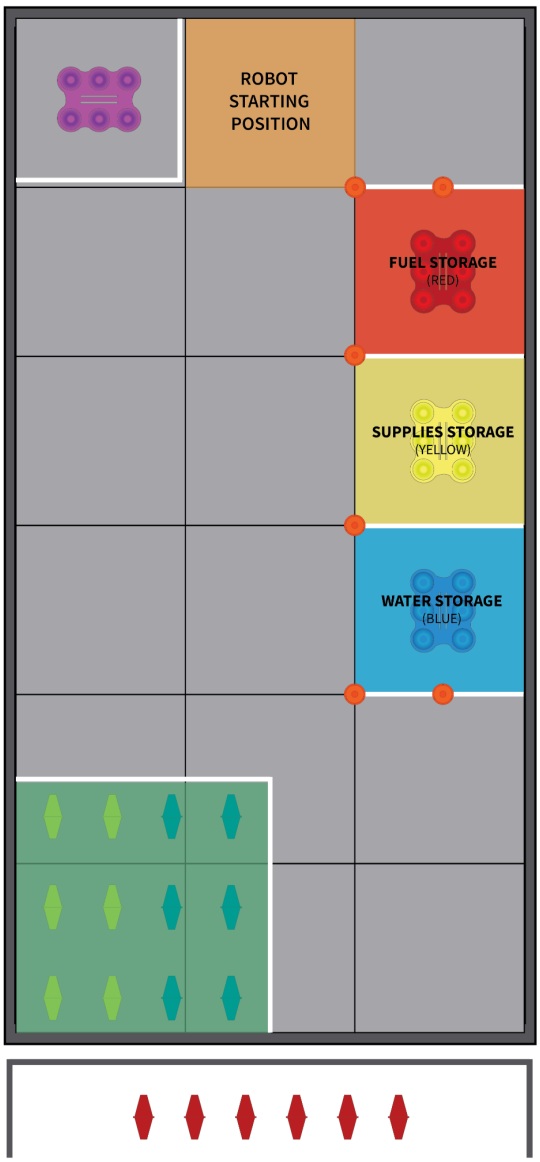

Figure 3.1.1: Storage zones

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3.1.2 Cleared receiving zone

A team will earn 5 points at the end of the driving phase if no blue and yellow cones remain within the tape lines that define the receiving zone.

3.1.3 All red cones placed in storage

If all red cones are introduced to the match and meet the storage criteria in rule 3.1.1 at the end of the driving phase, the team will receive 15 points.

3.1.4 Penalty for contacting obstacles

The team's score for the driving phase will decrease by 5% for each of the six obstacles the robot contacts during the driving phase, with a maximum of a 30% deduction if the robot contacts all six 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.

3.1.5 Penalty for entering the shipping zone

The team's score for the driving phase will decrease by 5% for each time the robot contacts the shipping container or the floor inside the shipping zone, up to a maximum decrease of 20% / four contacts.

3.1.6 Penalty for ending the phase outside of the charging zone

The team's score for the driving phase 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 foam tile that defines the charging zone and in contact with the section of field perimeter within the charging zone.

3.2 Driving Phase 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.

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3.2.2 Robot starting position

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

- Within the 18” x 18” x 18” starting size limit
- In contact with the floor inside the charging zone
- Not in contact with any other tiles of the floor
- Not in contact with any obstacles
- Not in contact with the shipping container

3.2.3 Eye protection

Every team member has to wear some form of eye protection. Eyeglasses meet the requirement, but we recommend safety glasses with non-shattering lenses and side shields.

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 Cones that leave the field aren’t returned

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

3.3.3 Team-loaded objects

Either team member can move red cones from the supply in the driver box into the loading zone during the driving phase (not before!). Cones must be placed into the field one at a time by hand, and can be placed on the field tile or into a robot that is on that field tile.

3.3.4 Don’t reach into the field

Before a match, students can only reach into the field to place their robot. Referees can adjust objects 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 introduce cones (3.3.3) or reset their robot if it malfunctions (3.4.1).

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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 cones, those cones 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 three 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 Phase

In the autonomous phase of a match, the robot collects and moves specific donations from storage into shipping containers while avoiding obstacles and off-limits areas. Just as in the driving phase, the robot must end the match in the charging zone to avoid a point deduction.

Teams have 60 seconds to score as many points as possible while their robot executes pre-written code. The autonomous phase may only be attempted following the driving phase, and all cones begin the autonomous phase in their positions from the end of the driving phase.

4.1 Autonomous Phase Scoring and Scoring Criteria

Autonomous Phase Scoring or Penalty Category	Points
Correct cone nested in the shipping container in the shipping zone	6 points per cone (maximum of six per shipment = up to 72 total)
Completed shipment removed from the field	15 point bonus per shipment (up to 30 total)
Penalty: Hitting an obstacle	5% deduction per obstacle (maximum of 30% deduction)
Penalty: Entering the receiving zone	5% deduction per violation (maximum of 20% deduction)
Penalty: Robot doesn't end the phase in the charging zone	10% deduction

4.1.1 Some tasks are scored in real time

The referee will actively track and record most tasks during the autonomous phase. It is recommended that the referee verbally confirm that a shipment is complete and ready to be removed from the field.

4.1.2 The autonomous phase consists of two shipments

During orientation on the first day of competition, the NLSC Technical Committee Chair will randomly determine which items must be included in each of the two shipments in the autonomous phase. Each shipment will consist of six (6) cones in any color combination.

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4.1.3 Correct cone nested on the shipping container

A cone will earn 6 points as part of a shipment in the autonomous phase if it meets all of the following criteria:

- The cone color matches the requirements of the current shipment (4.1.2)
- The cone is nested into the shipping container inside the shipping zone
- The cone and shipping container are upright, with the container resting flat on the floor
- The base of the shipping container is in contact with or at least partially within the tape lines that define the storage zone

4.1.4 Completed shipment removed from field

The robot must retrieve the needed supplies to fulfill each shipment. Once a shipment is completed and confirmed by the referee, a team member must remove those items from the field in order to finish the shipment and earn the bonus for completing that shipment.

4.1.5 Penalty for contacting obstacles

The team's score for the autonomous phase will decrease by 5% for each of the six obstacles the robot contacts during the autonomous phase, with a maximum of a 30% deduction if the robot contacts all six 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.

4.1.6 Penalty for entering the receiving zone

The team's score for the autonomous phase will decrease by 5% for each time the robot contacts the floor inside the receiving zone, up to a maximum decrease of 20% / four contacts.

4.1.7 Penalty for ending the phase outside of the charging zone

The team's score for the autonomous phase 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 foam tile that defines the charging zone and in contact with the section of field perimeter within the charging zone.

4.2 Autonomous Phase Starting Positions

4.2.1 Team members

Two team members can come to the field for each match, but are not required to remain in the driver box during the autonomous phase. Team members cannot use the controller to operate the robot during the autonomous phase, and the robot must operate solely by team-created code.

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.

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4.2.2 Robot starting position

Team members can remove the robot from the field after the driving phase as needed, and/or adjust the robot's position before the start of the autonomous phase. The robot must meet all of the following criteria at the beginning of the autonomous phase:

- Within the 18" x 18" x 18" starting size limit
- In contact with the floor inside the charging zone
- Not in contact with any other tiles of the floor
- Not in contact with any obstacles
- Not in contact with the shipping container

4.2.3 Field and game objects

If the shipping container and/or any obstacles were knocked out of position during the driving phase of the match, they should be repositioned by the referee before the autonomous phase begins.

Cones and storage containers cannot be adjusted. Any cones in the robot's possession at the end of the driving phase should be removed from the field.

4.2.4 Eye protection

Every team member has to wear some form of eye protection. Eyeglasses meet the requirement, but we recommend safety glasses with non-shattering lenses and side shields.

4.3 Match Play

4.3.1 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.

4.3.2 Cones that leave the field aren't returned

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

4.3.3 No team-loaded cones in the autonomous phase

Team members cannot introduce cones to the field during the autonomous phase.

4.3.4 Don't reach into the field

Before the autonomous phase begins, students can only reach into the field to place their robot. Referees can adjust obstacles and/or the shipping container if they're more than 1" out of position or in an incorrect orientation. During the autonomous phase, students can only reach into the field to reset their robot (4.3.5).

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4.3.5 The robot can be reset as a strategy

Students can reset the robot 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. If the robot is in contact with any cones, those cones are removed from the field. The robot must be returned to the charging zone before it can resume operating.

4.4 What Happens When Things Go Wrong

Rules 3.4.2 (field damage) and 3.4.3 (appealing a decision) also apply in the autonomous phase.

4.4.1 Botched shipment

If the shipping zone contains the wrong items for the current shipment (4.1.2), the team can declare it a botched shipment and perform the following reset steps:

1. Remove all cones from the shipping zone and place them outside the field.
2. Reset the shipping container to its starting position.
3. Reset the robot as described in rule 4.3.5.

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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 12x12 field consisting of field tiles and a field perimeter, and divided in half into two approximately 6’x12’ match areas by a barrier created from an extendable curtain rod, wood, or other means. 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 mini sports cones and classroom organizers linked below.

1. Mini sports cones in six colors - one set is enough for three half-field setups
2. 6-pack classroom organizer in six colors - one set is needed for each half-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 cones and containers 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 matches, which must include the 60-second driving phase and may include the optional autonomous phase. Teams may choose to complete the driving phase and not complete the autonomous phase, however teams cannot complete the autonomous phase without first completing the driving phase. 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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