# Mobile Robotics Technology

2025-26 Push Back Game Manual for Secondary & Post-Secondary Teams Presented by:The Robotics Education & Competition Foundation Adapted from: VEX Robotics Competition Push Back

**Disclaimer:** References to VEX Robotics game play rules/updates are provided for context only and do not supersede or replace the requirements outlined in the current national SkillsUSA Technical Standards and/or national competition updates.

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# Overview

Students who participate in Mobile Robotics Technology engage in the Engineering Process and demonstrate their ability to keep and maintain an engineering notebook. Students will be judged based on their robot in design, construction, and programming, along with the quality of their notebook, and their ability to communicate their design process to the judges. Students will show the result of their preparation by performing tasks in both autonomous and driver control functions. The game that will be played is an adaptation of the V5RC High Stakes Robot Skills Challenge. Students can participate in both V5RC and SkillsUSA using the same robot and engineering notebook. The key difference is that SkillsUSA focuses on the ability of students to create a robot that performs exceptionally at a given task, whereas V5RC is a teamwork-based program that focuses on collaborating with other teams along with game strategy in a tournament structure of competition. Students in SkillsUSA should focus on designing, building and programming a robot to perform well, knowing that there are no other robots on the field that may help their robot or might get in the way.

# ELIGIBILITY

Eligibility (Team of Two)
Open to a team of two active SkillsUSA members. Each state may send one high school and one college/ postsecondary team.

**Secondary and College/Postsecondary**: Students who are enrolled in a career and technical education engineering program or a program that integrates robotics, engineering, or pre-engineering techniques as an integral component of the instructional program.

# CLOTHING REQUIREMENT

### Class E: Competition Specific — Business Casual

- Official SkillsUSA white polo shirt
- Black dress slacks or black dress skirt (knee-length minimum)
- Black closed-toe dress shoes

***Note:*** Wearing socks or hose is no longer required. If worn, socks must be black dress socks and hose must be either black or skin-tone and seamless/non pattern.
These regulations refer to clothing items that are pictured and described at www.skillsusastore.org. If you have questions about clothing or other logo items, call 844-875-4557.

***Note:*** Competitors must wear their official competition clothing to the competition orientation meeting.

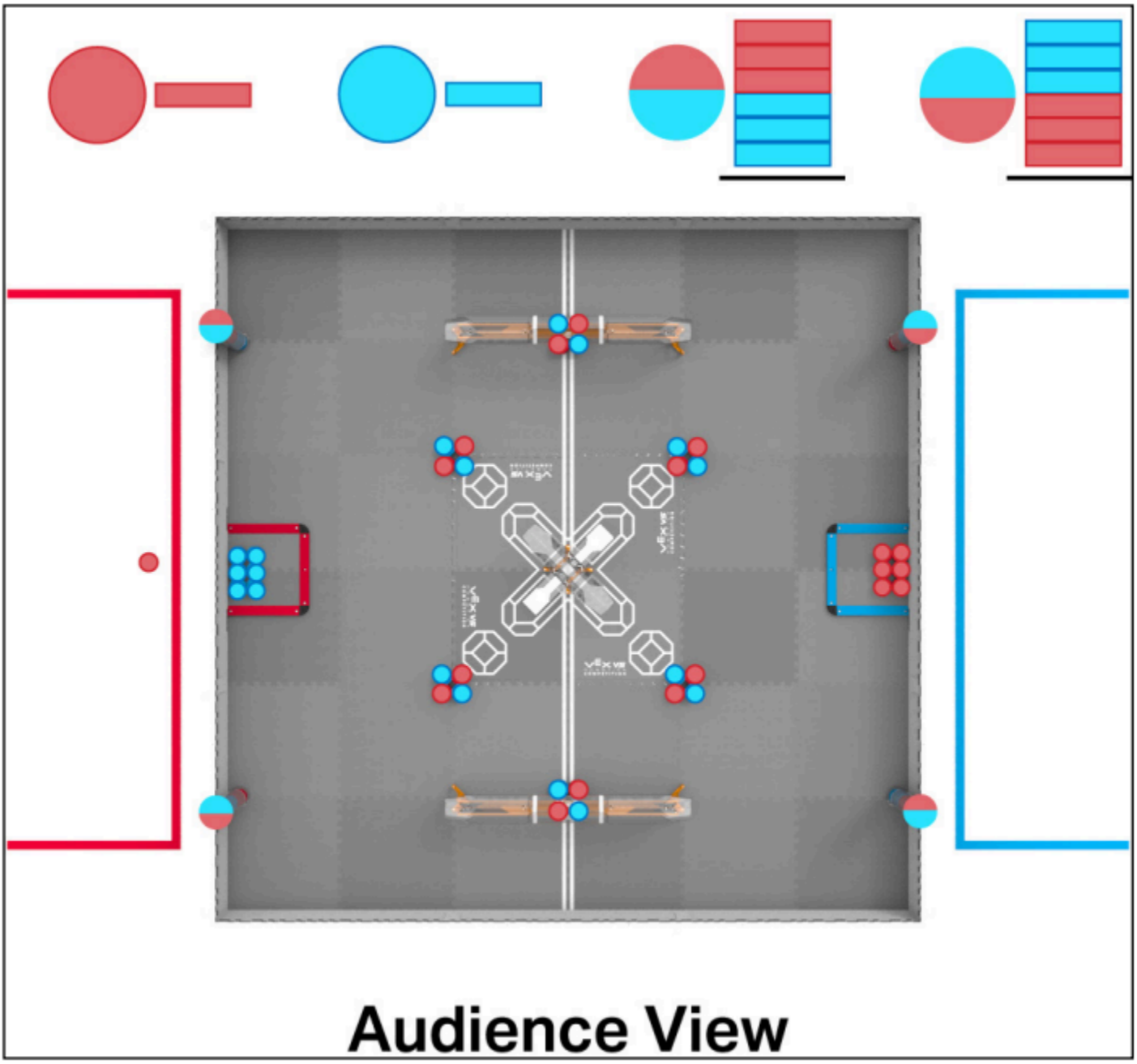



***Figure RSC3-2:*** *An overhead view of a V5RC Push Back Robot Skills Match in its starting configuration, with highlighted Blocks (red / Blue).*

# THE GAME

## A Primer

VEX V5 Robotics Competition Push Back is played on a 12'x12' square Field, set up as illustrated in the figures throughout.

Teams may also compete in Robot Skills Matches, where one (1) Robot tries to score as many points as possible. See Section 5 for more information.

Teams compete in one-minute (1:00) Robot Skills Matches, where one (1) Robot tries to score as many points as possible for Secondary Teams and two (2) Robots driven by the same team for Post-Secondary Teams. There are two types of matches, Driving Skills and Autonomous Coding Skills Matches. In Driving Skills, teams use the remote control to operate the robot, and in Autonomous Coding Skills, no input from the remote control is permitted. The VEX GPS code strip will be installed on the field for both types of matches.

## Game Definitions

**Adult** - Anyone who is not a Student or another defined term.

**Alliance Station** - The designated regions where the Drive Team Members must remain for the duration of the Match.

**Autonomous Coding Skills Match** – An *Autonomous Coding Skills Match* consists of a sixty-second (1:00) *Autonomous Period*. There is no *Driver Controlled Period*.*Teams* can elect to end their run early if they wish to record a *Skills Stop Time*.

**Disablement** - A penalty applied to a Team for a rule Violation. A Team that is Disabled is not allowed to operate their Robot for the remainder of the Match, and the Drive Team Member(s) will be asked to place their controller(s) on the ground.

**Disqualification** - A penalty applied to a Team for a rule Violation. A Team that receives a Disqualification in a Qualification Match receives zero (0) Win Points, Autonomous Win Points, Autonomous Points, and Strength of Schedule Points. When a Team is Disqualified in an Elimination Match, the entire Alliance is Disqualified and they receive a loss for the Match. At the Head Referee's discretion, repeated Violations and / or Disqualifications for a single Team may lead to its Disqualification for the entire tournament. (See <T8>)

**Drive Team Member** - A Student who stands in the Alliance Station during a Match. Adults are not allowed to be Drive Team Members. See rules <G7>, <G8>, and <G9>.

**Driving Skills Match** – A *Driving Skills Match* consists of a sixty-second (1:00) *Driver Controlled Period*. There is no *Autonomous Period*.*Teams* can elect to end their run early if they wish to record a *Skills Stop Time*.

**Entanglement** - A Robot status. A Robot is Entangled if it has grabbed, hooked, or attached to an opposing Robot or a Field Element. See rules <G12> and <SG3>.

**Field Element** - All elements that make up the field, including the foam field tiles, field perimeter, white tape, High Goals, Nets, Rollers, Barriers, and all supporting structures and accessories (such as Alliance Station posts, field monitors, etc.).

**Robot** - A machine that has passed inspection, designed to execute one or more tasks autonomously and / or by remote control from a Drive Team Member. Secondary Teams utilize 1 Robot and Post-Secondary Teams utilize 2 Robots.

**Robot Skills Match** – A *Driving Skills Match* or *Autonomous Coding Skills Match*.

**Student** – An eligible SkillsUSA member.

**Skills Stop Time** – The time remaining in a *Robot Skills Match* when a *Team* ends the *Match* early.

a. If a *Team* does not end the *Match* early, they receive a default *Skills Stop Time* of 0.
b. The moment when the *Match* ends early is defined as the moment when the *Robot* is "disabled" by the field control system. See the "*Skills Stop Time*" section for more details.
c. If a V5 Robot Brain or Tournament Manager display is being used for field control, then the *Skills Stop Time* is the time shown on the display when the *Match* is ended early (i.e. in 1-second increments).
d. If a VEXnet Competition Switch is being used for field control, in conjunction with a manual timer that counts down to 0 with greater accuracy than 1-second increments, then the time shown on the timer should be rounded up to the nearest second. For example, if the *Robot* is disabled and the timer shows 25.2 seconds, then the *Skills Stop Time* should be recorded as 26.

**Team** -Two Students make up a Team.

- In the context of this Game Manual, Teams include two Student roles related to Robot assembly, design, and programming. See <G2> and <G6> for more information. Adults may not fulfill any of these roles. Each student may fill one or multiple student roles.

    - **Builder** - The Student(s) on the Team who assemble(s) the Robot. Adults are permitted to teach the Builder(s) how to use concepts or tools associated with Robot construction, but may never work on the Robot without the Builder(s) present and actively participating.
    - **Designer** - The Student(s) on the Team who design(s) the Robot. Adults are permitted to teach the Designer(s) how to use concepts or tools associated with design, but may never work on the design of the Robot without the Designer(s) present and actively participating.
    - **Programmer** - The Student(s) on the Team who write(s) the computer code that is downloaded onto the Robot. Adults are permitted to teach the Programmer(s) how to use concepts or tools associated with programming, but may never work on the code that goes on the Robot without the Programmer(s) present and actively participating.

**Violation** - The act of breaking a rule in the Game Manual.

- Minor Violation - A Violation which does not result in a Disqualification.
    - Accidental, momentary, or otherwise non-Match Affecting Violations are usually Minor Violations.

    - Minor Violations usually result in a verbal warning from the Head Referee during the Match, which should serve to inform the Team that a rule is being Violated before it escalates to a Major Violation.
- Score Affecting - A Violation which changes the score of a Robot Skills Match.
    - Multiple Violations within a Match can cumulatively become Match Affecting.
    - When evaluating if a Violation was Match Affecting, Head Referees will focus primarily on any Robot actions that were directly related to the Violation.
    - Determining whether a Violation was Match Affecting can only be done once the Match is complete and the scores have been calculated.

*Violation Note: In the Robot Skills Challenge, the standard definition of Match Affecting does not apply, since there is no winner and loser. When evaluating whether a rule Violation should be classified as a Major or Minor Violation in the context of this criteria, the term "score affecting" can be substituted for "Match Affecting". A Violation is considered "score affecting" if it resulted in a net increase of that Team's score at the end of the Match.*

# Game-Specific Definitions

**Autonomous Line** - The pair of white tape lines that run across the *Field*, and the space between those lines. See <SG7> for more information.

**Block** - A blue or red 18-sided hollow plastic polygonal object with flat faces and a weight of approximately 40 grams. Each cross-section measures approximately 3.25" (82mm) between pairs of opposing flat faces, and 3.85" (98mm) between pairs of opposing corners.

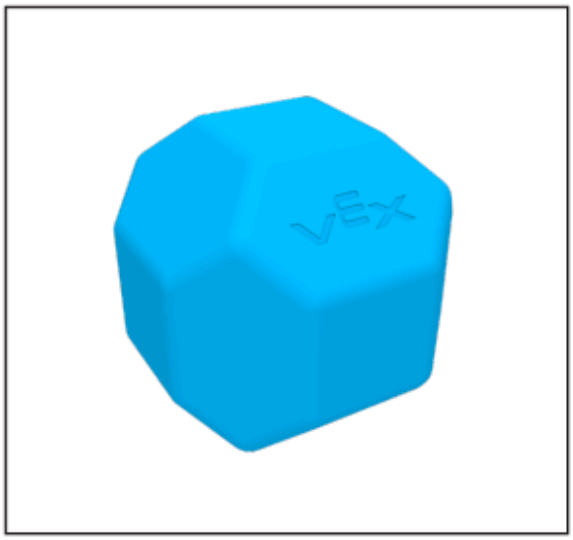



***Figure B-1:*** *A Block*

**Control Zone** - A defined section of a *Goal* that can be *Controlled* by an *Alliance* at the end of a *Match*.

- **Long Goal** - The *Control Zone* for a *Long Goal* consists of the space between (but not including) the white tape lines (highlighted in green in Figure CZ-1), and holds up to three (3) *Blocks*.
- **Center Goal, Upper and Lower** - The *Control Zone* for a *Center Goal* includes the entire *Goal*.

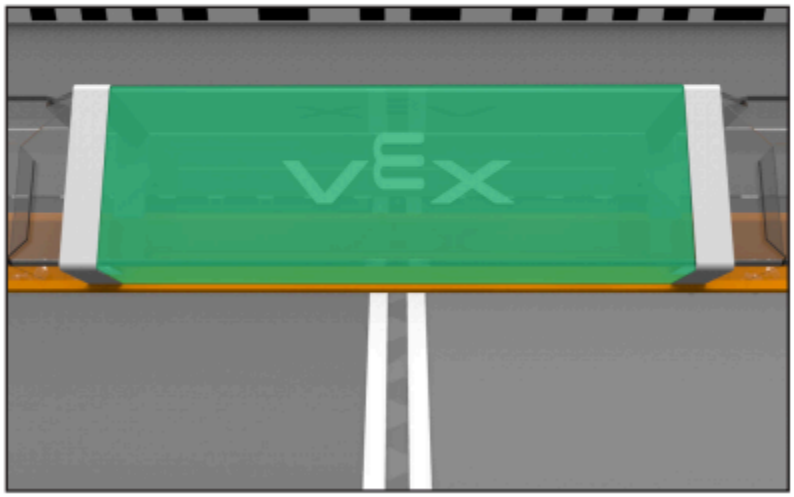



***Figure CZ-1:*** *The Control Zone (highlighted green) of a Long Goal consists of the volume between the white tape lines, as shown.*

**Controlled** - A *Control Zone* status that is assessed at the end of the *Autonomous Period* and the end of the *Match*. A *Control Zone* is *Controlled* by an *Alliance* if a majority of the *Blocks* in that *Control Zone* are that *Alliance's* color. See rule <SC3> for details.

**Goal** - A *Field Element* that is constructed out of plastic and metal components into which *Blocks* can be *Scored*. Each *Long Goal* has a completely enclosed center section between two open sections. Each *Goal* includes a defined *Control Zone*.

- **Long Goal** - Each *Long Goal* is 48.8" (1239mm) in length, with a 13.33" (339mm) enclosed center section.
- **Center Goal, Upper and Lower** – Each *Center Goal* is 22.6" (574mm) in length.

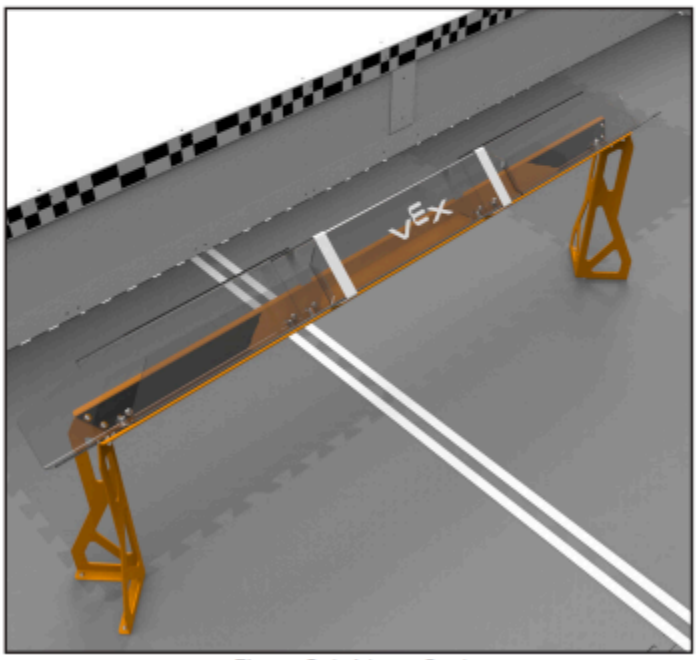



***Figure G-1:*** *A Long Goal*

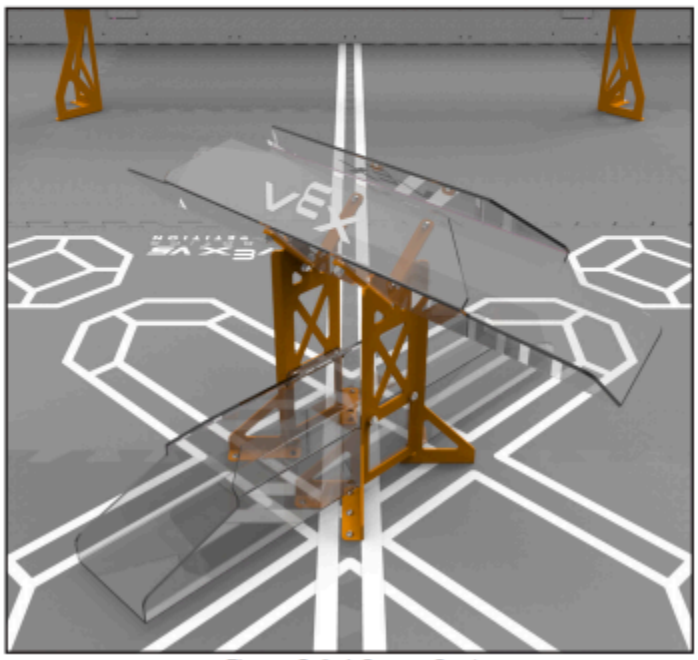
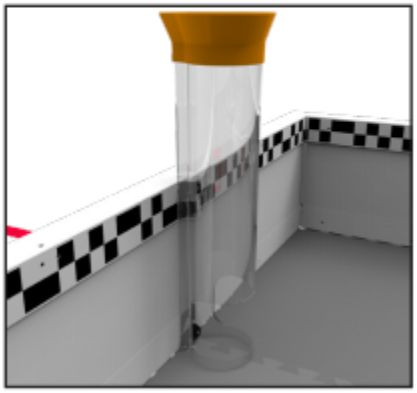



***Figure G-2****: A Center Goal*

**Loader** - One of four 21.34" (542mm) tall plastic and rubber structures each attached to the *Field Perimeter*. *Robots* may remove *Blocks* from *Loaders* during a *Match*, and *Drive Team Members* may add *Match Load Blocks* to *Loaders* during the *Match* (see <SG9> for details). Each *Loader* begins the *Match* containing (6) *Blocks*.

***Figure L-1:*** *A Loader*



**Match Load** - One of the 24 Blocks, 12 per Alliance, that begin the Match in an Alliance Station and which may be introduced during the Match. See <SG9> for more information.

**Parked** - A *Robot* status at the end of the *Match*. See <SC4>.

**Park Zone** - A *Field Element* that marks a location where *Blocks* begin a *Match* and *Robots* can be *Parked* at the end of the *Match*. *Park Zones* are made of red or blue plastic extrusions and black plastic connectors. Each *Park Zone* is 18.87" (479mm) wide x 16.86" (428mm) deep.

***Figure PZ-1:*** *A Park Zone*

**Scored** - A *Block* status. See <SC2>.

| | |
|---|---|
| Each *Block Scored* in a *Goal* | 1 Point |
| Each filled *Control Zone* in a *Long Goal* | 5 Points |
| Each filled *Control Zone* in a *Center Goal* | 10 Points |
| Each Cleared *Park Zone* | 5 Points |
| Each Cleared *Loader* | 5 Points |
| *Parked Robot* | 15 Points |

**<SC1>** All Scoring statuses are evaluated **after the Match ends**. Scores are calculated five (5) seconds after the *Match* ends, or once all *Blocks*, *Field Elements*, and *Robots* on the *Field* come to rest, whichever comes first.

a. This 5-second delay is intended to be the only permitted "benefit of the doubt" for last-second scoring actions. If an object or *Robot* is still in motion and "too close to call" between two states at the 5-second mark, then the less advantageous of the two states should be awarded to the *Robot*(s) in question. For example:

   i. A *Robot* which has *Parked* in a *Park Zone* but slowly droops down and is in contact with the top of the *Field Perimeter* at five (5) seconds would not be considered *Parked*.

   ii. A *Block* which slowly falls out of a *Goal* at five (5) seconds would not be considered *Scored*.

b. At the end of the *Match*, the on-screen timer displayed by Tournament Manager will hold the current *Match* information and "0:00" for five (5) seconds before moving to queue the next *Match*. This should be the primary 5-second visual cue used by *Teams* and *Head Referees*.

c. This 5-second delay is only intended to be a "benefit of the doubt" grace period, not an extra five (5) seconds of *Match* time. *Robots* which are designed to strategically exploit this grace period will receive a *Minor Violation*, and any post-*Match* movement will not be included in score calculation (i.e., the *Match* will be scored as it was at 0:00).

d. Referees should avoid contacting or moving *Robots* and/or *Blocks* as much as possible while evaluating Scoring statuses. If an object must be moved to evaluate the status of another object, its status must be agreed upon by all *Teams* and the *Head Referee*, and noted or recorded, before it is moved.

**<SC2>** A *Block* is considered **Scored** if it meets all of the following criteria:

a. The *Block* is in contact with the inside surface(s) of the plastic trough of a *Goal*.

b. The *Block* is not in contact with a *Robot* of the same color as that *Block*.

c. The *Block* is not in contact with the *Floor*.

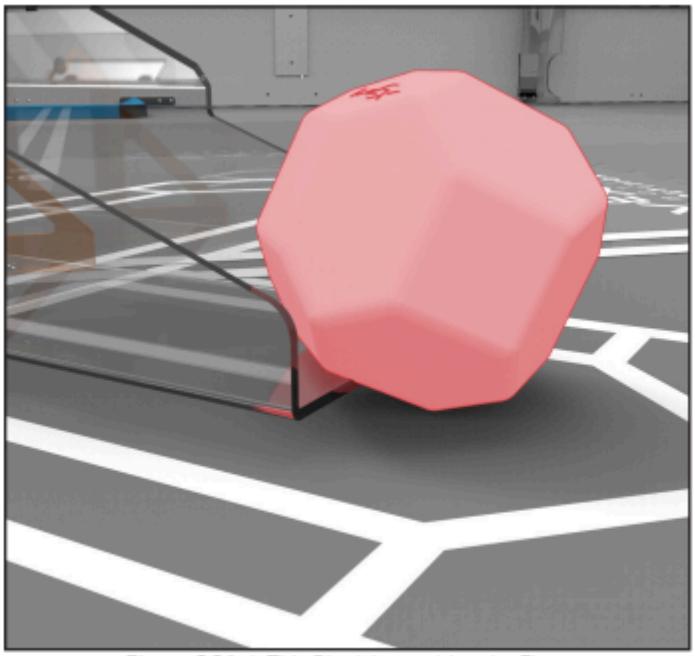


***Figure SC2-1:*** *This Block is touching the Floor, and would not be considered Scored.*

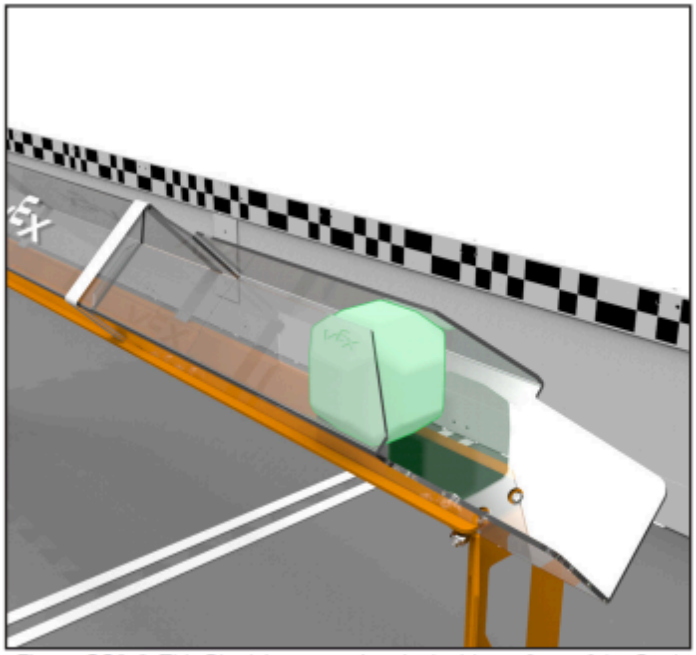


***Figure SC2-2:*** *This Block is contacting the inside surface of the Goal, and not touching a Robot of the same color. It is considered Scored.*

**<SC3>** A *Control Zone* is considered **Controlled** by an *Alliance* if a majority of the *Blocks Scored* in that *Control Zone* are the same color as the *Alliance*.

a. For Long Goals, a *Scored Block* is considered **Scored in the Control Zone** if it is entirely contained within that *Control Zone*.

b. A *Block* must be considered *Scored* in a *Goal* (see <SC2>) to also be considered *Scored* in a *Control Zone*.

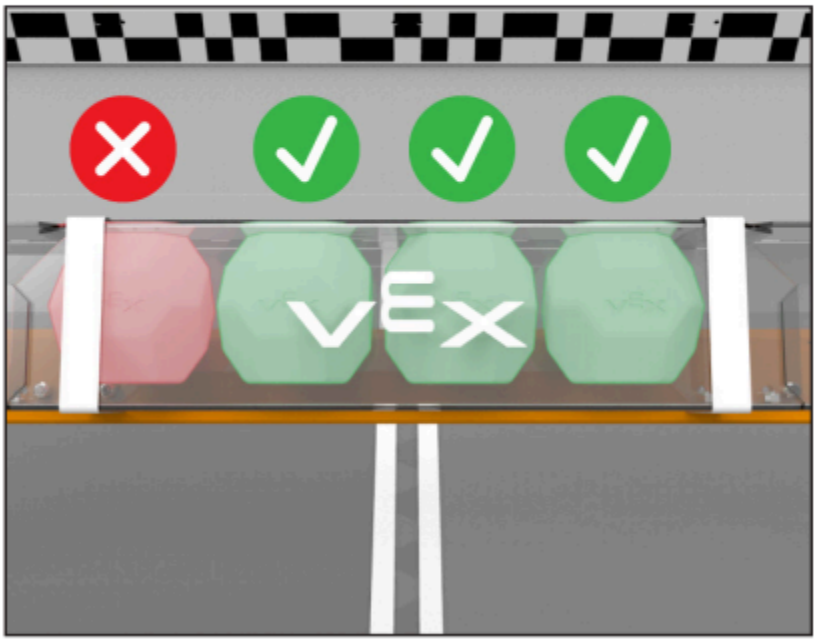


***Figure SC3-1:*** *The left-most (red) Block is not fully within the tape lines marking the boundaries of the Control Zone, and therefore would not be considered in determining which Alliance is in control of the Goal. The three other (green) Blocks are fully within the tape lines, and would be considered.*

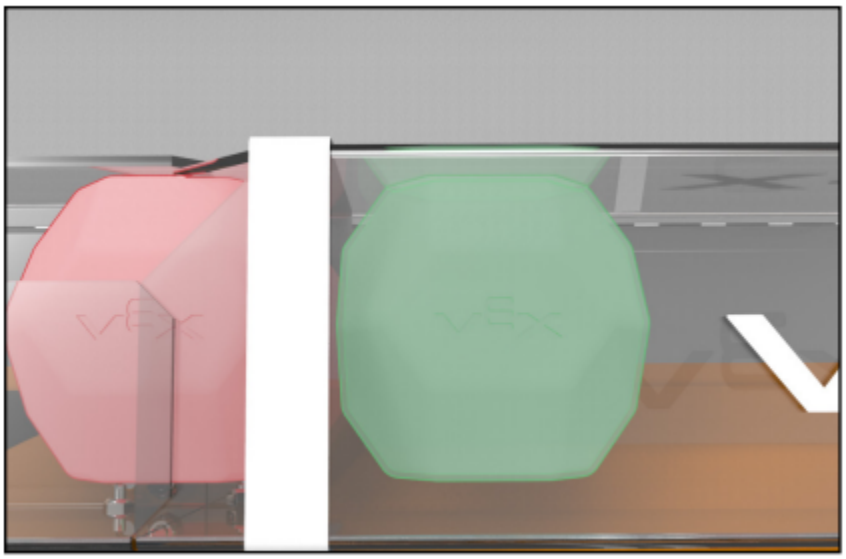


***Figure SC3-2:*** *The (green) Block on the right is fully within the tape boundaries, and would be considered as scored.*

In most cases, if you can't see a little bit of the next *Block* on the "inside" of the tape line (see figure SC3-2), the *Block* on that side of the *Control Zone* probably isn't entirely contained within the *Control Zone*.

It's not practical to examine every *Block* at a detailed level to decide whether it's "entirely within" or not. If a *Head Referee* can't definitively tell whether a *Block* is entirely contained within a *Control Zone* or not, that *Block* should be considered *Scored* in the *Control Zone*. *Teams* should not be invited into the *Field* to contribute opinions; this decision is up to the *Head Referee*.

Basically, we're not exactly sure yet what's going to make this easiest for *Head Referees*, and we'll fine-tune this guidance in the August game manual update. The most important thing in the early season is that *Head Referees* make all judgment calls within an event using the same guidelines to ensure that all calls during that event are consistent with each other.

**<SC4>** A *Robot* is considered **Parked** if it meets all of the following criteria:

a. The *Robot* is not contacting the *Floor* outside of its *Alliance*-colored *Park Zone*.

b. The *Robot* is not contacting any *Field Elements* other than the inside face of the *Field Perimeter*, the *Floor* inside of its *Alliance*-colored *Park Zone*, and/or the plastic extrusions and connectors that are part of the *Park Zone*. Contact with these allowed elements is not required.

c. The *Robot* is at least partially within the vertical projection of its *Alliance*-colored *Park Zone*.

Significant Q&As:

- Q&A 2672 - Contact with Blocks doesn't affect a Parked status

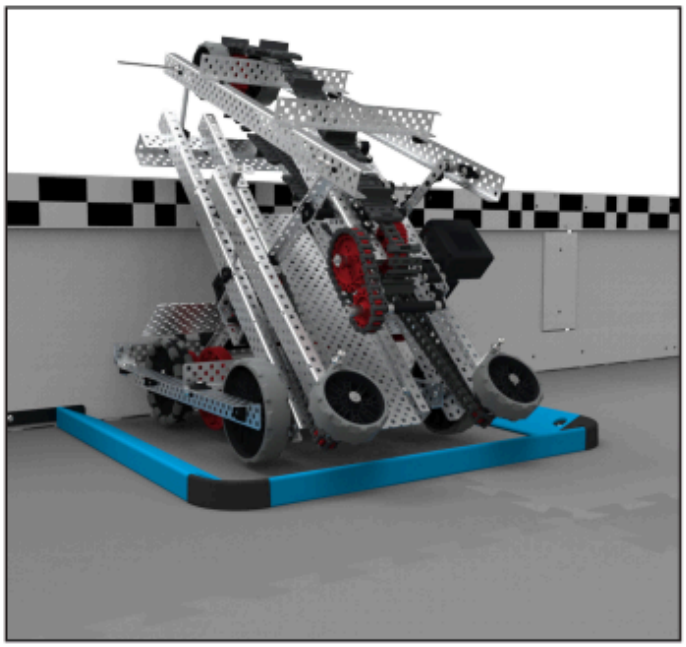


***Figure SC4-1:*** *This Robot is at least partially within the vertical projection of their Alliance-colored Park Zone, and would be considered as Parked.*

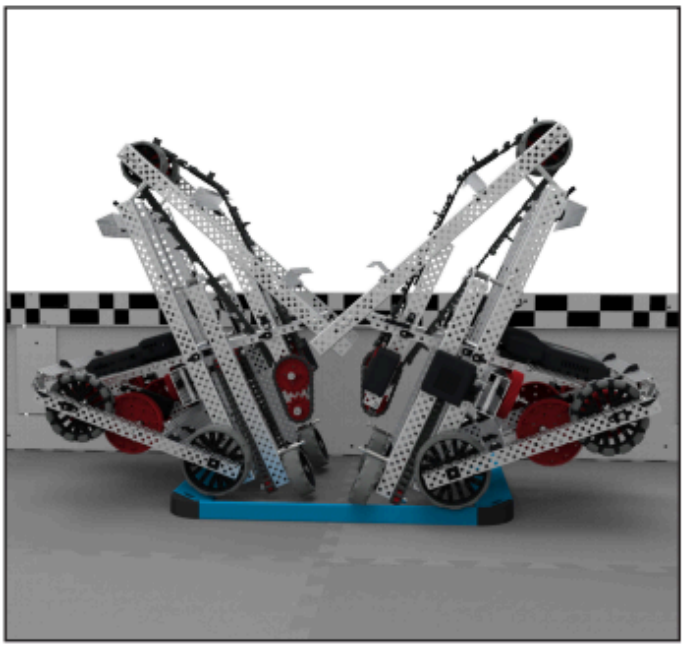


***Figure SC4-2:*** *Both of these Robots would be considered as Parked, as they satisfy all the criteria listed above.*

**<SC5>** Scoring of the **Autonomous Bonus** is evaluated immediately after the *Autonomous Period* ends (i.e., once all *Blocks*, *Field Elements*, and *Robots* on the *Field* come to rest).

a. Points for *Parked Robots* are not included in the calculation of an *Alliance's* score for the purposes of determining the *Autonomous Bonus*.

b. If the *Autonomous Period* ends in a tie, including a zero-to-zero tie, each *Alliance* will receive an *Autonomous Bonus* of five (5) points.

c. Any *Violations*, Major or Minor, committed during the *Autonomous Period* will result in the *Autonomous Bonus* being automatically awarded to the opposing *Alliance*. See <GG13>.

d. Per rule <GG13>, if both *Alliances* commit *Violations* during the *Autonomous Period* that would have affected the outcome of the *Autonomous Bonus*, then no *Autonomous Bonus* will be awarded.

**<SC6>** An **Autonomous Win Point** is awarded to any *Alliance* that ends the *Autonomous Period* with all of the following tasks completed, and that has committed no *Violations* during the *Autonomous Period*:

1. At least seven (7) *Blocks* of the *Alliance's* color are *Scored*.
2. At least three (3) different *Goals* include at least one (1) *Scored Block* of the *Alliance's* color.
3. At least three (3) *Blocks* of the *Alliance's* color have been removed from *Loaders* adjacent to the *Alliance's Alliance Station*.
4. Neither *Robot* is contacting the *Park Zone* barrier.

# Safety Rules

**<S1> Be safe out there.** If at any time the *Robot* operation or *Team* actions are deemed unsafe or have damaged a *Field Element*, *Block*, or the *Field*, the offending *Team* may receive a *Disablement* and/or *Disqualification* at the discretion of the *Head Referee*. The *Robot* will require re-inspection as described in rule <R3> before it may take the *Field* again.

*Violation Notes: Major Violations should be reported to and/or discussed with the Event Partner during the event, and should be reported to the REC Foundation Rules and Conduct Committee following the event.*

**<S2> Students must be accompanied by an Adult.** No *Student* may attend a V5RC event without a responsible *Adult* supervising them. The *Adult* must obey all rules and be careful to not violate *Student*-centered policies, but must be present for the full duration of the event in the case of an emergency. *Violations* of this rule may result in removal from the event.

*Violation Notes: Violations should be reported to the Event Partner during the event, and should be reported to the REC Foundation Rules and Conduct Committee following the event.*

**<S3> Stay inside the Field.** If a *Robot* is completely outside of the *Field* during a match, it will receive a *Disablement* for the remainder of the *Match*.

*Note: The intent of this rule is not to penalize Robots for having mechanisms that inadvertently cross the Field Perimeter during normal game play.*

**<S4> Wear safety glasses.** All *Drive Team Members* must wear safety glasses or glasses with side shields while at the *Field* for *Matches*. While in the pit and queuing areas, it is highly recommended that all *Team* members wear safety glasses.

**<S5> Each Student Team member must have a completed participant release form on file for the event and season.** A *Student Team* member cannot participate in an event without a completed release form on file.

# General Rules

**<G1> Treat everyone with respect.** All *Teams* are expected to conduct themselves in a respectful and professional manner while competing in VEX V5 Robotics Competition events. If a *Team* or any of its members (*Students* or any *Adults* associated with the *Team*) are disrespectful or uncivil to event staff, volunteers, or fellow competitors, they may receive a *Disqualification* from a current or upcoming *Match*. *Team* conduct pertaining to <G1> may also impact a *Team's* eligibility for judged awards. Repeated or extreme *Violations* of <G1> could result in a *Team* being *Disqualified* from an entire event, depending on the severity of the situation.

We all can contribute to creating a fun and inclusive event experience for all event attendees. Some examples include:

When dealing with difficult and stressful situations, it is...

- Okay for *Teams* to be gracious and supportive when your *Alliance* partner makes a mistake.
- Not okay for *Teams* to harass, tease, or be disrespectful to your *Alliance* partner when a *Match* does not go your way.

When a *Team* does not understand a *Match* ruling or score, it is...

- Okay for *Drive Team Members* to consult with a *Head Referee* to discuss a ruling per the process outlined in <T3> in a calm and respectful manner.
- Not okay for *Drive Team Members* to continue arguing with the *Head Referees* after a decision has been finalized, or for *Adults* to approach a *Head Referee* with ruling/scoring concerns.

When *Teams* are getting ready for an upcoming *Match*, it is...

- Okay for *Teams* in an *Alliance* to develop a game strategy that utilizes the strengths of both *Robots* to cooperatively play the game.
- Not okay for *Teams* in an *Alliance* to intentionally play beneath their abilities to manipulate the *Match* results.

This rule exists alongside the REC Foundation Code of Conduct. Violation of the Code of Conduct can be considered a *Major Violation* of <G1> and can result in *Disqualification* from a current *Match*, an upcoming *Match*, an entire event, or (in extreme cases) an entire competition season. The Code of Conduct can be found here.

More information regarding the event Code of Conduct process can be found here.

**<G2> V5RC is a student-centered program.** *Adults* should not make decisions about the *Robot's* build, design, or gameplay, and should not provide an unfair advantage by providing 'help' that is beyond the *Student's* independent abilities. *Students* must be prepared to demonstrate an active understanding of their *Robot's* design, construction, and programming to judges or event staff. *Students* should build, design, and code the *Robot* with minimal *Adult* involvement.

Some amount of *Adult* mentorship, teaching, and/or guidance is an expected and encouraged facet of VEX competitions. No one is born an expert in robotics! However, obstacles should always be viewed as teaching opportunities, not problems for an *Adult* to solve for the *Team*.

When building or designing the *Robot*, it is...

- Okay for an *Adult* to help a *Student* consider why something failed, so it can be improved.
- Not okay for an *Adult* to provide step-by-step instructions or photos for the *Student* to copy.

When a mechanism falls off, it is...

- Okay for an *Adult* to help a *Student* consider why it failed, so it can be improved.
- Not okay for an *Adult* to investigate or the *Robot* back together.

When a *Team* encounters a complex programming concept, it is...

- Okay for an *Adult* to guide a *Student* through a flowchart to understand its logic.
- Not okay for an *Adult* to write a premade command for that *Student* to copy/paste.

During *Match* play, it is...

- Okay for an *Adult* to provide cheerful, positive encouragement as a spectator.
- Not okay for an *Adult* to explicitly shout step-by-step commands from the audience.

This rule operates in tandem with the REC Foundation Student Centered Policy, which is available in the REC Library for *Teams* to reference throughout the season.

*Violation Notes: Potential Violations of this rule will be reviewed on a case-by-case basis. By definition, all Violations of this rule become Match Affecting as soon as a Robot which was built or coded by an Adult wins a Match. All reported and/or suspected <G2> Violations should be reported to the Event Partner during the event, and should be reported to the REC Foundation Rules and Conduct Committee following the event.*

Significant Q&As:

- Q&A 2676 - Adults should not provide an unfair advantage by helping Students create custom plastic parts

**<G3> Use common sense.** When reading and applying the various rules in this document, please remember that common sense always applies in the VEX V5 Robotics Competition.

# General Game Rules

**<GG1> Only Drive Team Members, and only in the Alliance Station.** During a *Match*, *Robots* may be operated only by the *Drive Team Members* and/or by software running on the *Robot's* control system in accordance with <R11> and <GG11>. During a *Match*, each *Robot* may have up to three (3) *Drive Team Members* in their *Alliance Station*, and all *Drive Team Members* must remain in their *Alliance Station* for the duration of the *Match*.

*Drive Team Members* are the only *Team* members that are allowed to be in the *Alliance Station* during a *Match*. *Adults* (other than event staff) are not permitted to be in the *Alliance Station* during a *Match*.

*Drive Team Members* are prohibited from any of the following actions during a *Match*:

a. Using any sort of communication device in the *Alliance Station*. Non-headphone devices with communication features turned off (e.g. a phone in airplane mode or a walkie talkie turned off) are allowed. If communication features are needed for translation apps during post-*Match* discussions, it should not be considered a *Violation*.

b. Standing or sitting on any sort of object during a *Match*, regardless of whether the *Field* is on the floor or elevated, except as required by an official accommodation request that has been approved by the REC Foundation.

c. Bringing/using additional materials to simplify the game challenge during a *Match*.

d. To ensure that *Drive Team Members* are aware of verbal calls during a *Match* (as an application of rules <T1>, <G1>, <S1>, and <G3>), powered headphones, earbuds, and/or passive earpieces connected to electronic devices cannot be worn/used in the *Alliance Station* except as required by an official accommodation request that has been approved by the REC Foundation.

<GG1c> is intended to refer to non-*Robot*-related items that directly influence gameplay, such as a speaker that plays a buzzer sound to distract your opponent. Provided no other rules are violated, and the items do not pose any safety or *Field* damage risks, the following examples are not considered *Violations* of <GG1>:

- Materials used before or after a *Match*, such as a pre-*Match* alignment aid
- Strategic aids, such as a whiteboard or clipboard
- Earplugs, gloves, or other personal accessories

*Violation Notes: Major Violations of this rule are not required to be Match Affecting, and could invoke Violations of other rules, such as <G1>, <G2>, or <G4>.*

**<GG2> A Team's Robot should attend every Match.** The *Team's Robot* must report to the *Field* for the *Team's* assigned *Match*, even if the *Robot* is not functional. If the *Robot* is not at the *Field* at the start of a *Match*, the *Team* will be considered a "no-show" and receive zero (0) *Win Points*, *Autonomous Win Points*, *Autonomous Points*, and *Strength of Schedule Points*.

a. *Teams* are expected to participate in all scheduled *Qualification Matches*, *Alliance Selection*, and *Elimination Matches*(if they're an *Alliance Captain* or were selected to join an *Alliance* for *Elimination Matches*). Failure to attend scheduled *Matches* or *Alliance Selection* may be considered a *Violation* of <G1> and the Code of Conduct. *Teams* that do not participate in any *Qualification Matches* cannot be considered for Judged Awards.

**<GG3> Robots on the Field must be ready to play.** When a *Team* puts their *Robot* on the *Field*, it must be prepared to play (e.g., batteries charged, sized within the starting size constraint, includes only the correct *Alliance*-color license plates, etc.).

a. *Teams* who use VEX pneumatics must have their systems charged before they place the *Robot* on the *Field*.

b. *Robots* must be placed on the *Field* promptly. Repeated failure to do so could result in a *Violation* of <G1>. The exact definition of the term "promptly" is at the discretion of the *Head Referee* and *Event Partner*, who will consider event schedule, previous *Violations* or delays, etc.

c. If a *Robot* is delaying the scheduled start of a *Match*, it may be removed from the *Field* at the discretion of the *Head Referee* and *Event Partner*. The *Robot* may remain at the *Field* so that the *Team* does not get assessed a "no-show" (per <GG2>).

d. If a *Robot* is not placed on the *Field* prior to the start of a *Match*, it cannot be placed on the *Field* during that *Match*.

**<GG4> Hands out of the Field.** *Drive Team Members* are prohibited from making intentional contact with any *Blocks*, *Field Elements*, or *Robots* during a *Match*, apart from the contact specified in <GG4a> or while introducing *Match Loads* as described in rule <SG9>.

a. During the *Driver Controlled Period*, *Drive Team Members* may only touch their own *Robot* if the *Robot* has not moved at all during the *Match*. Touching the *Robot* in this case is permitted only for the following reasons:

   i. Turning the *Robot* on or off.

   ii. Plugging in a battery.

   iii. Plugging in a V5 Robot Radio.

   iv. Touching the V5 Robot Brain screen, such as to start a program.

   *Note: Movement caused by an external force, such as another Robot, should not prevent a Drive Team Member from interacting with their Robot under this rule.*

b. *Drive Team Members* are not permitted to break the plane of the *Field Perimeter* at any time during the *Match*, apart from the actions described above, or while introducing *Match Loads* as described in rule <SG9>.

c. Transitive contact, such as contact with the *Field Perimeter* that causes the *Field Perimeter* to contact *Field Elements* or *Blocks* inside of the *Field*, could be considered a *Violation* of this rule.

d. Any concerns regarding *Field Element* or *Block* starting positions should be raised with the *Head Referee* prior to the *Match*. *Team* members may never adjust *Blocks* or *Field Elements* themselves. 33

**<GG5> Match replays are allowed, but rare.** *Match* replays (i.e., playing a *Match* over again from its start) must be agreed upon by both the *Event Partner* and *Head Referee*, and will only be issued in the most extreme circumstances. Some example situations that may warrant a *Match* replay are as follows (note that this is not an exhaustive list):

a. *Match Affecting* "Field fault" issues.
   i. *Field Elements* starting in incorrect positions, and out of the allowed tolerances (see <T5>).
   ii. Tape lines lifting.
   iii. *Field Elements* detaching or moving beyond normal tolerances (not as a result of *Robot* interactions).
   iv. The *Autonomous Period* or *Driver Controlled Period* ending early.
   v. Field control disconnecting or *Disabling Robots*. Note, this is sometimes confused with a *Robot* whose motors have overheated, or bent pins on a controller's competition port causing intermittent drop-outs. In general, any true *Field* fault will impact both *Alliances* simultaneously, not one *Robot* at a time.

b. *Match Affecting* game rule issues.
   i. *Head Referee Disables* a *Robot* for a misinterpretation of a rule *Violation*.
   ii. *Head Referee* starts the *Driver Controlled Period* of the *Match* without determining the outcome of the *Autonomous Period* winner.
   iii. The *Field* is reset before a score is determined.
   iv. A *Match* is run before its scheduled time without a *Team*.

Note: As of the 2024-2025 season, the V5 white screen error is no longer a permitted cause for a guaranteed replay. More information about this error can be found here.

**<GG6> Disqualifications.** When a *Team* receives a *Disqualification* in a *Qualification Match*, they receive a score of zero (0) for the *Match*, as well as zero (0) *Win Points*, *Autonomous Win Points*, *Autonomous Points*, and *Strength of Schedule Points*.

a. If the *Team* receiving the *Disqualification* is on the winning *Alliance*, then *Teams* on the opposing *Alliance* who are not also *Disqualified* will receive the win for the *Match* and two (2) *Win Points*.
   i. The *Team's* non-*Disqualified Alliance* Partner is unaffected, i.e., they will also receive the win for the *Match* and two (2) *Win Points*.

*Note: If a Team is Disqualified in a Robot Skills Match, a score of zero (0) will be recorded for that Match.*

**<GG7> Time Outs.** Each Elimination *Alliance* gets one three-minute *Time Out*, which they may request during the *Elimination Bracket*. The *Time Out* will be served at the time of the *Alliance's* next upcoming *Match*. *Alliances* must request their *Time Out* between *Elimination Matches*; they may not use their *Time Out* during a *Match*, for another *Alliance's Match*, or after they have been eliminated. There are no *Time Outs* during the *Qualification Match* schedule.

**<GG8> Keep your Robots together.** *Robots* may not intentionally detach parts during the *Match* or leave mechanisms on the *Field*.

*Note: Parts which become detached unintentionally are a Minor Violation, are no longer considered "part of a Robot," and should be ignored for the purpose of any rules which involve Robot contact or location (e.g., Scoring) or Robot size.*

*Violation Notes: Major Violations of this rule should be rare, as Robots should never be designed to intentionally violate it. Minor Violations are usually due to Robots being damaged during gameplay, such as a wheel falling off.*

**<GG9> Don't clamp your Robot to the Field.** *Robots* may not intentionally grasp, grapple, hook, attach to or otherwise *Entangle* with any *Field Elements*. Strategies with mechanisms that react against multiple sides of a *Field Element* in an effort to latch or clamp onto said *Field Element* are prohibited. The intent of this rule is to prevent *Teams* from unintentionally damaging the *Field* and/or from anchoring to or otherwise *Entangling* themselves with the *Field*.

*Violation Notes: Major Violations of this rule should be rare, as Robots should never be designed to intentionally violate it.*

**<GG11> Controllers must stay connected to the Field.** Prior to the beginning of each *Match*, *Drive Team Members* must plug their V5 Controller into the *Field's* control system. This cable must remain plugged in for the duration of the *Match*, and may not be removed until the "all-clear" has been given for *Drive Team Members* to retrieve their *Robots*. See <T8> for more information regarding *Field* control system options.

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*Violation Notes: The intent of this rule is to ensure that Robots abide by commands sent by the tournament software. Temporarily removing the cable to assist with mid-Match troubleshooting, with an Event Partner or other event technical staff present and assisting, would not be considered a Violation.*

**<GG12> Autonomous means "no humans."** During the *Autonomous Period*, *Drive Team Members* are not permitted to interact with the *Robots* in any way, directly or indirectly. This could include, but is not limited to:

- Activating any controls on their V5 Controllers
- Unplugging or otherwise manually interfering with the *Field* connection in any way
- Manually triggering sensors (including the Vision Sensor) in any way, even without touching them

*Note: In extreme cases, with permission from the Head Referee, Teams may Disable their Robot during the Autonomous Period by holding the power button on their V5 Controller. This exception is only intended for egregious safety- or damage-related circumstances; Disabling an autonomous routine for strategic purposes would still be considered a Violation of <GG12>.*

*Violation Notes: See <GG13>.*

**<GG13> All rules still apply in the Autonomous Period.** *Teams* are responsible for the actions of their *Robots* at all times, including during the *Autonomous Period*. Any *Violations*, Major or Minor, committed during the *Autonomous Period* will result in the *Autonomous Bonus* being automatically awarded to the opposing *Alliance* and make the violating *Team's Alliance* ineligible for the *Autonomous Win Point*.

If both *Alliances* commit *Violations* during the *Autonomous Period*, then no *Autonomous Bonus* will be awarded.

*Violation Note: In general, Minor Violations of SG rules that occur during the Autonomous Period should only affect the outcome of the Autonomous Period (i.e., the Alliance can't win the Autonomous Bonus or earn an Autonomous Win Point) and should not be considered when determining whether a Violation has been repeated during the event.*

*If a Head Referee determines that a Violation of an SG or GG rule during the Autonomous Period was intentional/strategic rather than accidental/situational, it should be recorded as a Minor or Major Violation and considered when determining whether a Violation has been repeated during the event.*

**<GG18> Use Blocks to play the game.** *Blocks* may not be used to accomplish actions that would be otherwise illegal if they were attempted by *Robot* mechanisms. If a rule is *Violated* through the use of a *Block* instead of a *Robot* mechanism, it should be evaluated as though the rule in question had been *Violated* by a *Robot* mechanism. Examples include, but are not limited to:

- Interfering with an opponent's Autonomous routine per <SG7>
- Using a *Block* to intentionally tip or *Entangle* an opponent *Robot*

> The intent of this rule is to prohibit *Teams* from using *Blocks* as "gloves" to loophole any rule that states "a *Robot* may not [do some action]." This rule is not intended to be taken in its most extreme literal interpretation, where any interaction between an *Block* and a *Robot* needs to be scrutinized with the same intensity as if it were a *Robot*.

# Specific Game Rules

**<SG1> Starting a Match.** Prior to the start of each *Match*, the *Robot* must be placed such that it meets all of the following criteria:

a. No larger than 18" (457.2 mm) long by 18" (457.2 mm) wide by 18" (457.2 mm) tall.

b. Not contacting any *Blocks* other than a maximum of one (1) Preload. See rule <SG5>.

c. Not contacting any *Goals* or *Loaders*.

d. Not contacting any other *Robots*.

e. Completely stationary (i.e., no motors or other mechanisms in motion).

f. Contacting the barrier that defines their *Alliance's Park Zone*.

*Note: Using external influences, such as Preloads or the Field Perimeter, to maintain a Robot's starting size is only acceptable if the Robot would still satisfy the constraints of <R5> and pass inspection without these influences.*

*Violation Notes: The Match will not begin with any conditions in this rule unmet. If a Robot cannot meet these conditions in a timely manner, the Robot will be removed from the Field and rules <R3d> and <GG2> will apply until the situation is corrected. They will not receive a Disqualification, but they will not be permitted to play in the Match.*

**<SG2> Horizontal expansion is limited.** Once the *Match* begins, *Robots* may expand horizontally beyond the 18" x 18" starting size limit within the following criteria:

a. The *Robot* can never be larger than 22" wide or 22" long (must always be able to fit within a 22"x22" square horizontal footprint).

*Violation Notes:*

- *The primary intent of this rule is to limit defensive horizontal expansion. As such, Robots that expand horizontally in the vicinity of multiple Goals may be subject to rule <GG15>, and will not receive the "benefit of the doubt" in the case of any Head Referee judgment calls.*

**<SG3> Vertical expansion is limited.** Once the *Match* begins, *Robots* may expand vertically beyond the 18" starting size limit within the following criteria:

a. No part of the *Robot* may exceed an overall height of 22" at any point during the *Match* (must always be able to fit within a hypothetical 22"x22"x22" cubic sizing box).

**<SG4> Keep Blocks in the Field.** *Teams* may not intentionally or strategically remove *Blocks* from the *Field*. A *Block* that leaves the field during *Match* play, intentionally or unintentionally, will be given to a *Drive Team Member* from the same color *Alliance* as the *Block* and may be used as a *Match Load* in accordance with <SG9>.

*Violation Notes:*

- *After a Team's third Match with any Violation of this rule (either Major or Minor), all subsequent Violations of this rule will immediately escalate to a Major Violation.*
- *Any Team that removes three (3) or more Blocks from the Field in a single Match will receive a Major Violation.*
- *If it is not clear which Robot was the last to contact the Block, all involved Teams with a color that is opposite to the Block will receive a Violation.*
- *Due to the difficulty of determining Match Affecting implications of this rule, most Violations should be considered Minor. However, blatantly intentional and/or Match Affecting Violations (especially during Elimination Matches) may still immediately escalate to a Major Violation at the Head Referee's discretion.*

**<SG5> Each Robot gets one Block as a Preload.** Prior to the start of each *Match*, each Preload must be placed such that it meets all of the following criteria:

a. Contacting one *Robot* of the same *Alliance* color as the Preload.

b. Not contacting the same *Robot* as another Preload.

c. Not contacting or within the volume of a *Goal* or *Loader*.

*Note: If a Robot is not present for their Match, then that Robot's Preload may be used as a Match Load in accordance with <SG9>.*

*Violation Notes: See <SG1>.*

**<SG6> A Robot may carry, push, or plow an unlimited number of Blocks.** However, horizontal and vertical expansion limits apply to all parts of the *Robot* for the entire duration of the *Match*. See rules <SG2> and <SG3>.

**<SG10> Don't reach inside enclosed sections of Goals.** *Robots* are not permitted to directly contact *Blocks* that are fully within enclosed sections of *Long Goals*, but may add or remove *Blocks* from open sections of *Goals* at any time during a *Match*.

# Inspection Rules

**<R1> One Robot per Team.** Each *Team* can only bring one (1) *Robot* to a given event in the VEX V5 Robotics Competition. Though it is expected that *Teams* will make changes to their *Robot* at the competition, a *Team* is limited to only one (1) *Robot* at a given event, and a given *Robot* may only be used by one (1) *Team*. A VEX *Robot*, for the purposes of the VEX V5 Robotics Competition, has the following subsystems:

- Subsystem 1: Mobile robotic base including wheels, tracks, legs, or any other mechanism that allows the *Robot* to navigate the majority of the flat playing *Field* surface. For a stationary *Robot*, the robotic base without wheels would be considered Subsystem 1.
- Subsystem 2: Power and control system that includes a legal VEX battery, a legal VEX control system, and associated motors for the mobile robotic base.
- Subsystem 3: Subsystem 3: Additional mechanisms (and associated motors) that allow manipulation of *Blocks* and interactions with *Field Elements* and other *Robots*.

Given the above definitions, a minimum *Robot* for use in any VEX V5 Robotics Competition event (including Skills Challenges) must consist of subsystems 1 and 2 above. Thus, if you are swapping out an entire subsystem 1 or 2, you have now created a second *Robot* and have Violated this rule.

a. *Teams* may not compete with one *Robot* while a second is being modified or assembled at a competition.

b. *Teams* may not have an assembled second *Robot* on hand at a competition that is used to repair or swap parts with the first *Robot*.

c. *Teams* may not switch back and forth between multiple *Robots* during a competition. This includes using different *Robots* for *Robot Skills Matches*, *Qualification Matches*, and/or *Elimination Matches*.

d. Multiple *Teams* may not use the same *Robot*. Once a *Robot* has competed under a given *Team* number at an event, it is "their" *Robot*; no other *Team* may EVER compete with it.

The intent of <R1a>, <R1b>, and <R1c> is to ensure an unambiguous level playing *Field* for all *Teams*. *Teams* are welcome (and encouraged) to improve or modify their *Robots* between events, or to collaborate with other *Teams* to develop the best possible game solution.

However, a *Team* who brings and/or competes with two separate *Robots* at the same tournament has diminished the efforts of a *Team* who spent extra design time making sure that their one *Robot* can accomplish all of the game's tasks. A multi-*Team* organization that shares a single *Robot* has diminished the efforts of a multi-*Team* organization who puts in the time, effort, and resources to undergo separate individual design processes and develop their own *Robots*.

To help determine if a *Robot* is a "separate *Robot*" or not, use the subsystem definitions found in <R1>. Above that, use common sense as referenced in <G3>. If you can place two *Robots* on a table next to each other, and they look like two separate legal/complete *Robots* (i.e., each has the 3 subsystems defined by <R1>), then they are two *Robots*. Trying to decide if changing a screw, a wheel, or a microcontroller constitutes a separate *Robot* is missing the intent and spirit of this rule.

**<R2> Robots must represent the Team's skill level.** The *Robot* must be designed, built, and programmed by members of the *Team*. *Adults* are expected to mentor and teach design, building, and programming skills to the *Students* on the *Team*, but *Adults* may not design, build, or program that *Team's Robot*. See rules <G2> and <G4>.

In V5RC, we expect *Adults* to teach fundamental *Robot* principles like linkages, drive-trains, and manipulators, then allow the *Students* to determine which designs to implement and build on their *Robot*.

Similarly, *Adults* are encouraged to teach the *Students* how to code various functions involving applicable sensors and mechanisms, then have the *Students* program the *Robot* from what they have learned.

**<R3> Robots must pass inspection.** Every *Robot* will be required to pass a full inspection before being cleared to compete. This inspection will ensure that all *Robot* rules and regulations are met. Initial inspections will take place during *Team* registration/practice time. Noncompliance with any *Robot* design or construction rule will result in removal from *Matches* or *Disqualification* of the *Robot* at an event until the *Robot* is brought back into compliance, as described in the following subclauses.

a. Significant changes to a *Robot*, such as a partial or full swap of Subsystem 3, must be re-inspected before the *Robot* may compete again.

b. All possible functional *Robot* configurations must be inspected before being used in competition. This especially pertains to modular or swappable mechanisms (per <R1>) and *Match* starting configurations/sizes (per <R5>).

c. *Teams* may be requested to submit to spot inspections by *Head Referees*. Refusal to submit will result in *Disqualification*.

   i. If a *Robot* is determined to be in *Violation* of a *Robot* rule before a *Match* begins, the *Robot* will be removed from the *Field*. The *Robot* may remain at the *Field* so that the *Team* does not get assessed a "no-show" (per <GG2>).

d. *Robots* which have not passed inspection (i.e., that may be in *Violation* of one or more *Robot* rules) will not be permitted to play in any *Matches* until they have done so. <GG2> will apply to any *Matches* that occur until the *Robot* has passed inspection.

e. If a *Robot* has passed inspection, but is later confirmed to be in *Violation* of a *Robot* rule during or immediately following a *Match* by a *Head Referee*, they will be *Disqualified* from that *Match*. This is the only *Match* that will be affected; any prior *Matches* that have already been completed will not be revisited. <R3d> will apply until the *Violation* is remedied and the *Team* is re-inspected.

f. All inspection rules are to be enforced within the discretion of the *Head Referee* within a given event. *Robot* legality at one event does not automatically imply legality at future events. *Robots* which rely on "edge-case" interpretations of subjective rules, such as whether a decoration is "non-functional" or not, should expect additional scrutiny during inspection.

**<R4> There is a difference between accidentally and willfully violating a Robot rule.** Any *Violation* of *Robot* rules, accidental or intentional, will result in a *Team* being unable to play until they pass inspection (per <R3d>).

However, *Teams* who intentionally and/or knowingly circumvent or violate rules to gain an advantage over their fellow competitors are in *Violation* of the spirit and ethos of the competition. Any *Violation* of this sort should be considered a *Violation* of <G1> and/or the REC Foundation Code of Conduct. A *Team* that circumvents a *Robot* rule for a competitive advantage should receive an immediate *Disqualification* for the current *Match* and be reported to the *Event Partner* for discussion with the REC Foundation Regional Support Manager. As a result of that discussion, the *Team* may be *Disqualified* from the event. The *Violation* should also be reported to the REC Foundation Rules and Conduct Committee following the event.

**<R5> Robots must fit within an 18" x 18" x 18" volume.**

a. Compliance with this rule may be checked using the official VEX Robotics On-Field Robot Expansion Sizing Tool.

b. *Event Partners* may construct and/or provide any sizing tool that measures the correct dimensions.

c. Any restraints used to maintain starting size (i.e., zip ties, rubber bands, etc.) must remain attached to the *Robot* for the duration of the *Match*, per <GG8>.

d. For the purposes of this rule, it can be assumed that *Robots* will be inspected and begin each *Match* on a flat standard foam field tile.

The official sizing tool is intentionally manufactured with a slightly oversized tolerance. Therefore, any contact with the sizing tool (i.e., a "paper test") while being measured should be considered a clear indication that a *Robot* is outside of the permitted size. This tolerance also provides a slight "leeway" for minor protrusions, such as screw heads or zip ties.

Other tools, such as custom sizing boxes or the legacy non-expanding VEX Sizing Tool (276-2086), may be used for informal checks. However, in the event of a conflict or "close call," a check with the official On-Field *Robot* Expansion Sizing Tool takes precedence.

**<R7> Let go of Blocks after the Match.** *Robots* must be designed to permit easy removal of *Blocks* from any mechanism without requiring the *Robot* to have power after a *Match*.

**<R8> Robots have one Brain.** *Robots* must ONLY use one (1) VEX V5 Robot Brain (276-4810). Any other microcontrollers or processing devices are not allowed, even as non-functional decorations.

This includes microcontrollers that are part of other VEX product lines, such as VEX Cortex, VEX EXP, VEXpro, VEX CTE, VEX RCR, VEX IQ, VEX GO, or VEX Robotics by HEXBUG. This also includes devices that are unrelated to VEX, such as Raspberry Pi or Arduino devices.

**<R9> Keep the power button accessible.** The on/off button on the V5 Robot Brain and/or the Battery Cable connection on either the V5 Robot Brain or V5 Robot Battery must be accessible without moving or lifting the *Robot*. All screens and/or lights must also be easily visible by competition personnel to assist in diagnosing *Robot* problems.

**<R10> Firmware.** *Teams* must use VEXos version 1.1.5 or newer, found at https://link.vex.com/firmware. Custom firmware modifications are not permitted.

a. The minimum version requirement is subject to change over the course of the season.

b. When the minimum version is updated, *Teams* have a two week (14 calendar day) grace period from the time the minimum version is changed to update their firmware to the latest minimum version.

c. VEX reserves the right to deem any firmware update critical, and remove the allowable grace period.

**<R11> Use a "Competition Template" for programming.** The *Robot* must be programmed to follow control directions provided by the VEXnet Field Controllers or Smart Field Control system.

During the *Autonomous Period*, *Drive Team Members* will not be allowed to use their V5 Controllers. As such, *Teams* are responsible for programming their *Robot* with custom software if they want to perform in the *Autonomous Period*.

This may be tested in inspection, where *Robots* may be required to pass a functional "enable/disable" test. For more information on this, *Teams* should consult the help guides produced by the developers of their chosen programming software.

**<R12> Motors are limited.** *Robots* may use any combination of VEX V5 Smart Motors (11W) (276-4840) and Smart Motors (5.5W) (276-4842), within the following criteria:

a. The combined power of all motors (11W & 5.5W) must not exceed 88W. This limit applies to all motors on the *Robot*, even those which are not plugged in.

b. V5 Smart Motors and EXP Smart Motors connected to Smart Ports are the only motors that may be used with a V5 Robot Brain. The 3-wire ports may not be used to control motors of any kind.

| Example | A | B | C | D | E |
|---|---|---|---|---|---|
| Qty of 11W Motors | 8 | 7 | 6 | 5 | 0 |
| Qty of 5.5W Motors | 0 | 2 | 4 | 6 | 16 |

**<R13> Electrical power comes from VEX batteries only.** *Robots* may use one (1) V5 Robot Battery (276-4811) to power the V5 Robot Brain.

a. No other sources of electrical power are permitted, unless used as part of a non-functional decoration per <R24e>.

b. There are no legal power expanders for the V5 Robot Battery.

c. V5 Robot Batteries may only be charged by a V5 Robot Battery Charger (276-4812 or 276-4841).

d. V5 Controllers (276-4820) may only be powered by their internal rechargeable battery.

   i. *Teams* are permitted to have an external power source (such as a rechargeable battery pack) plugged into their V5 Controller during a *Match*, provided that this power source is connected safely and does not violate any other rules, such as <R28>.

   ii. Some events may choose to provide *Field* power for V5 Controllers. If this is provided for all *Teams* at the event, then this is a legal power source for the V5 Controllers.

**<R14> Robots use VEXnet.** *Robots* must ONLY utilize the VEXnet system for all wireless *Robot* communication.

a. Electronics from the Cortex, VEX EXP, VEX CTE. VEXpro, VEX RCR, VEXplorer, VEX IQ, VEX GO, or VEX Robotics by HEXBUG product line are prohibited unless otherwise noted in <R17>.

b. *Teams* are permitted to use the Bluetooth® capabilities of the V5 Robot Brain and/or V5 Controller in *Team* pits, practice *Fields*, and *Robot Skills Matches*. However, VEXnet must be used for wireless communication during head-to-head *Matches*.

c. *Teams* are permitted to use the Wi-Fi capabilities of the Vision Sensor in *Team* pits or outside of *Matches*. However, the Vision Sensor must have its wireless transmitting functionality disabled during *Matches*.

**<R15> Give the radio some space.** The V5 Radio must be mounted such that no metal surrounds the radio symbol on the V5 Radio.

It is fine to loosely encapsulate the V5 Radio within *Robot* structure. The intent of this rule is to minimize radio connection issues by minimizing obstructions between VEXnet devices. Burying a radio deep within a *Robot* may result in *Robot* communication issues. It is also recommended that the LEDs on the radio be visible to aid in troubleshooting.

**<R16> One or two Controllers per Robot.** No more than two (2) VEX V5 Controllers may control a single *Robot*.

a. No physical or electrical modification of these Controllers is allowed under any circumstances.

   i. Attachments which assist the *Drive Team Member* in holding or manipulating buttons/joysticks on the V5 Controller are permitted, provided that they do not involve direct physical or electrical modification of the Controller itself.

b. No other methods of controlling the *Robot* (light, sound, etc.) are permissible.

   i. Using sensor feedback to augment driver control (such as motor encoders or the Vision Sensor) is permitted.

**<R17>** **Robots are built from the VEX V5 system.** *Robots* may be built ONLY using official VEX V5 components, unless otherwise specifically noted within these rules. Product pages on the VEX Robotics website should be used as the official definitive source for determining if a product is a "V5 component."

a. Products from other VEX Robotics product lines that are specifically allowed by a clause of <R20> or "cross-listed" as part of the VEX V5 Product lines are legal for use in the VEX V5 Robotics Competition. For example, Flex Wheels and VersaHubs are VEXpro components that can be found on the VEX "Flex Wheels" page, and specific sizes are thus legal.

b. The following electronics from the VEX Cortex control system are permitted.

| SKU | Description |
|---|---|
| 276-2174 / 276-4859 | Limit Switch V1 / V2 |
| 276-2159 | Bumper Switch |
| 276-2156 | Optical Shaft Encoder |
| 276-2216 | Potentiometer |
| 276-2155 | Ultrasonic Range Finder |
| 276-2176 | LED Indicator |
| 276-2333 | Yaw Rate Gyroscope |
| 276-2332 | Analog Accelerometer V1.0 |
| 276-2154 | Line Tracker |
| 276-1380 | Jumper |
| 276-2158 | Light Sensor |

c. Legacy/discontinued products are only permitted if they are explicitly listed in this game manual, or still listed as V5RC or VRC legal on the VEX Robotics website: https://www.vexrobotics.com/v5-discontinued.html. Any questions or concerns about discontinued parts should be directed to the official Q&A System on RobotEvents.com.

**<R18>** **New VEX parts are legal.** Additional VEX components released during the competition season on www.vexrobotics.com are considered legal for use unless otherwise noted.

**<R19> Prohibited Items.** The following types of mechanisms and components are NOT allowed.

a. Those that could potentially damage *Field Elements* or *Blocks*.

b. Those that could potentially damage other competing *Robots*.

c. Those that pose an unnecessary risk of *Entanglement* with other *Robots* or *Field Elements*.

d. Those that could pose a potential safety hazard to *Drive Team Members*, event staff, or other humans.

e. Products from the VEXpro, VEX EXP, VEX IQ, VEX GO, VEX 123, VEX CTE, VEX AIM, VEX AIR, or VEX Robotics by HEXBUG* product lines, unless specifically allowed by a clause of <R17> or "cross-listed" as part of the VEX V5 Product lines (see <R17a>).

*** The HEXBUG brand is a registered trademark belonging to Spin Master Corp**

f. The following electronics from the VEX Cortex control system.

| SKU | Description |
|---|---|
| 276-2192 | VEXnet Joystick |
| 276-1891 | VEXnet Partner Joystick |
| 276-2194 | VEX ARM® Cortex-based Microcontroller |
| 276-2245 / 276-3245 | VEXnet Key 1.0 / 2.0 |
| 276-2177 | 2-Wire Motor 393 |
| 276-2162 | 3-Wire Servo |
| 276-2210 | VEX Flashlight |
| 276-2193 | Motor Controller 29 |

g. Components that are unique to the V5 Workcell product line. This includes the following.

| SKU | Description |
|---|---|
| 276-7151 | Robot Arm Metal |
| 276-7152 | Robot Brain Mount |
| 276-7153 | Input Output Conveyor |
| 276-7720 | Disc Feeder |
| 276-7047 | V5 Electromagnet |

h. Components obtained from the V5 beta program, including V5 beta firmware.
    i. All V5 beta hardware can be identified by its lighter gray pre-production color. Robot Brains, Robot Batteries, Controllers, and Vision Sensors from the V5 beta have a "BETA TEST" stamp on them. Smart Motors and Radios do not have this stamp, but can still be identified by color.
i. Components from the VEXplorer kit that are not found in modern VEX V5 kits. These include (but may not be limited to) electronics, wheels, non-standard gears, and plastic connectors.
j. Standalone VEX Smart Field Controller Brains (SKU 276-7577).
k. VEX apparel, competition support materials, packaging, or other non-*Robot* products.

**<R20> Certain non-VEX components are allowed.** *Robots* are allowed the following additional "non-VEX" components:

a. Any material strictly used as a color filter or a color marker for a legal sensor, such as the VEX Light Sensor or the VEX V5 Vision Sensor.
b. Any non-aerosol-based grease or lubricating compound, when used in extreme moderation on surfaces and locations that do NOT contact the playing *Field* walls, foam *Field* tiles, *Blocks*, or other *Robots*. Grease or lubricant applied directly to V5 Smart Motors or Smart Motor cartridges is prohibited.
c. Anti-static compound, when used in extreme moderation (i.e., such that it does not leave residue on *Field Elements*, *Blocks*, or other *Robots*).
d. Hot glue when used to secure cable connections.
e. An unlimited amount of rope/string, no thicker than 1/4" (6.35mm).
f. Commercially available items used solely for bundling or wrapping of 2-wire, 3-wire, 4-wire, or V5 Smart Cables, and/or pneumatic tubing are allowed. These items must solely be used for the purposes of cable/tubing protection, organization, or management. This includes but is not limited to electrical tape, cable carrier, cable track, etc. It is up to inspectors to determine whether a component is serving a function beyond protecting and managing cables and tubing.
g. Rubber bands that are identical in length and thickness to those included in the VEX V5 product line (#32, #64, #170, and #117B).
h. Pneumatic components with identical SMC manufacturer part numbers to those listed on the VEX website. For more detail regarding legal pneumatic components, see the Legal VEX Pneumatics Summary document.
i. Zip ties with identical dimensions as those included in the VEX V5 product line, or their metric equivalents.
j. A Micro SD card installed in the V5 Robot Brain.

k. Aerosol-based cooling/freeze spray may be used to assist in cooling motors. *Teams* using freeze spray or similar products in ways that may reasonably be deemed unsafe could be subject to <S1> *Violations*.

l. Cleaners, disinfectants, and/or sanitizers may be used to assist in cleaning *Robots*, parts, components, etc. VEX Robotics recommends the following procedures for cleaning/disinfecting/sanitizing robot parts.

m. See rules <R21> through <R25> for additional legal non-VEX components.

**<R21> Custom V5 Smart Cables are allowed.** *Teams* who create custom cables acknowledge that incorrect wiring may have undesired results.

a. Official V5 Smart Cable Stock must be used.

b. Use of non-VEX 4P4C connectors and 4P4C crimping tools is permissible.

c. V5 Smart Cables may only be used for connecting legal electronic devices to the V5 Robot Brain.

**<R22> A limited amount of tape is allowed.** *Robots* may use a small amount of tape for the following purposes:

a. To secure any connection between the ends of two (2) VEX cables.

b. To label wires and motors.

c. To prevent leaks on the threaded portions of pneumatic fittings. This is the only acceptable use of Teflon tape.

d. In any other application that would be considered a "non-functional decoration" per <R24>.

e. As an aglet at the end of rope/string to prevent fraying.

**<R23> Certain non-VEX fasteners are allowed.** *Robots* may use the following commercially available hardware:

a. #4, #6, #8, M3, M3.5, or M4 screws up to 2.5" (63.5 mm) long, and M2.5 x 8mm screws.

b. Shoulder screws with a shoulder length no longer than 0.20" and a diameter no larger than 0.176".

c. Any commercially available nut, washer, standoff, and/or non-threaded spacer up to 2.5" (63.5mm) long which fits these screws.

**<R24> Decorations are allowed.** *Teams* may add non-functional decorations, provided that they do not affect *Robot* performance in any significant way or affect the outcome of the *Match*. These decorations must be in the spirit of the competition. Inspectors and *Head Referees* will have final say in what is considered "non-functional." Unless otherwise specified below, non-functional decorations are governed by all standard *Robot* rules.

To be considered "non-functional," any guards, decals, or other decorations must be backed by legal materials that provide the same functionality. For example, if a *Robot* has a giant decal that prevents *Blocks* from falling out of the *Robot*, the decal must be backed by VEX material that would also prevent the *Blocks* from falling out. A simple way to check this is to determine if removing the decoration would impact the performance of the *Robot* in any way.

a. Anodizing and painting of parts is considered a legal nonfunctional decoration.

   *Note: As of October 1, 2024, anodizing or color changing of parts (such as painting, etc., which changes the original appearance of parts) is no longer allowed in events in mainland China.*

b. Small cameras are permitted as non-functional decorations, provided that any transmitting functions or wireless communications are disabled. Unusually large cameras being used as ballast are not permitted.
c. VEX electronics may not be used as non-functional decorations.
d. Decorations that visually mimic *Field Elements* or *Blocks*, or that could otherwise interfere with an opponent's Vision Sensor, are considered functional and are not permitted. The Inspector and *Head Referee* will make the final decision on whether a given decoration or mechanism violates this rule.
e. Internal power sources (e.g., for a small blinking light) are permitted, provided that no other rules are violated and this source only provides power to the non-functional decoration (i.e., does not directly or indirectly influence any functional portions of the *Robot*).
f. Decorations which provide feedback to the *Robot* (e.g., by influencing legal sensors) would be considered "functional," and are not permitted.
g. Decorations which provide visual feedback to *Drive Team Members* (e.g., decorative lighting) are permitted, provided that they do not violate any other rules and serve no other function (e.g., structural support).

**<R25> A limited amount of custom plastic is allowed.** *Robots* may use custom-made pieces cut from certain types of non-shattering plastic, up to 0.070" thick.

a. Each *Robot* is limited to a maximum of 12 individual pieces cut from non-shattering plastic. This includes non-shattering plastic used in non-functional decorations.
b. Each individual piece of non-shattering plastic cannot be larger than 4" x 8" x 0.070".
c. *Teams* must present and display ALL non-shattering plastic parts during inspection.

i. Inspectors will verify the total number of plastic pieces. They may use dry-erase markers or other forms or temporary marking to aid in counting.

ii. Inspectors will verify that no non-shattering piece exceeds the size limitation.

d. Plastic may be mechanically altered by cutting, drilling, bending, etc. It cannot be chemically treated, melted, or cast. Heating polycarbonate to aid in bending is acceptable.

e. Legal plastic types are polycarbonate (Lexan), acetal monopolymer (Delrin), acetal copolymer (Acetron GP), POM (acetal), ABS, PEEK, PET, HDPE, LDPE, Nylon (all grades), Polypropylene, PTFE, and FEP.

f. Shattering plastic, such as PMMA (also called Plexiglass, Acrylic, or Perspex), is prohibited.

g. Plastic sheets sold by VEX are considered "plastic" in the context of this rule, and are subject to the same limitations as "off-the-shelf" plastic sheets. Examples include the 276-8340 PET sheets, and the 217-6626 / 217-6627 polycarbonate sheets.

**<R26>** **Pneumatics are limited.** A *Robot's* pneumatic subsystem must satisfy all of the following criteria:

a. *Teams* may use a maximum of two (2) legal VEX pneumatic air reservoirs on a *Robot*. The Air Tank 200mL (included in the 276-8750 V5 Pneumatics Kit) and the legacy (pre-2023) reservoir are both considered legal reservoirs.

b. Pneumatic devices may be charged to a maximum of 100 psi.

c. The compressed air contained inside a pneumatic subsystem can only be used to actuate legal pneumatic devices (e.g., cylinders).

**<R27>** **Most modifications to non-electrical components are allowed.** Physical modifications, such as bending or cutting, of legal metal structure or plastic components are permitted.

a. Internal or external mechanical repairs of VEX Limit and Bumper switches are permitted.

i. Modifying the metal arm on the Limit Switch is permitted.

ii. Using components from these devices in other applications is prohibited.

b. Metallurgical modifications that change fundamental material properties, such as heat treating or melting, are not permitted.

c. Pneumatic tubing may be cut to desired lengths.

d. Fusing/melting the end of legal nylon rope/string (see <R20e>) to prevent fraying is permitted.

e. Welding, soldering, brazing, gluing, or attaching parts to each other in any way that is not provided within the VEX platform is not permitted. Rule <R20d> is an exception to this rule.

f. Mechanical fasteners may be secured using Loctite or a similar thread-locking product. This may ONLY be used for securing hardware, such as screws and nuts.

**<R28> No modifications to electronic or pneumatic components are allowed.** Motors (including the V5 Smart Motor firmware), microcontrollers (including V5 Robot Brain firmware), cables, sensors, controllers, battery packs, reservoirs, solenoids, pneumatic cylinders, and any other electrical or pneumatics component of the VEX platform may NOT be altered from their original state in ANY way.

a. *Teams* may make the following modifications to the V5 Smart Motor (11W)'s user-serviceable features. **This list is all-inclusive**; no other modifications are permitted. Where applicable, the components listed below (in the specific applications listed below) are permissible exceptions to <R20>.
    i. Replacing the gear cartridge with other official cartridges.
    ii. Removing or replacing the screws from the V5 Smart Motor Cap (276-6780).
    iii. Removing or replacing the threaded mounting inserts (276-6781).
    iv. Aesthetic/non-functional labeling (e.g., markers, stickers, paint, etc.).
b. V5 Smart Motors (11W) must use an official VEX V5 gear cartridge. For the purposes of this rule, the gear cartridges found within the V5 Smart Motor are considered "part of the motor." Therefore, any physical or functional modifications to official gear cartridges is not permitted. V5 Smart Motors (11W) may only use official VEX motor cartridges
c. For the purposes of this rule, the V5 Smart Motor Cap is not considered "part of the motor." Therefore, <R27> applies.
d. External wires on VEX 2-wire or 3-wire electrical components may be repaired by soldering or using twist/crimp connectors, electrical tape, or shrink tubing such that the original functionality and length are not modified in any way.
    i. Wire used in repairs must be identical to VEX wire.
    ii. *Teams* make these repairs at their own risk; incorrect wiring may have undesired results.

# Overview

In this challenge, *Teams* will compete in sixty-second (one minute) long *Matches* in an effort to score as many points as possible. These *Matches* consist of *Driving Skills Matches*, which are entirely driver controlled, and *Autonomous Coding Skills Matches*, which are autonomous with limited human interaction. *Teams* will be ranked based on their combined score in the two types of *Matches*.

The Robot Skills Challenge is an optional event for all *Teams*. *Teams* who do not compete will not be penalized in *Qualification Matches* or *Elimination Matches*. However, participation in the Robot Skills Challenge may impact eligibility for judged awards at the event.

At events that include *Qualification Matches*, *Teams* may only participate in the Robot Skills Challenge if they also participate in the *Qualification Matches*. See rule <T20>.

# Robot Skills Challenge Definitions

All definitions from previous sections of the manual apply to the Robot Skills Challenge, unless otherwise specified.

**Driving Skills Match** - A *Driving Skills Match* consists of a sixty-second (one minute) *Driver Controlled Period*. There is no *Autonomous Period*. *Teams* can elect to end their run early if they wish to record a *Skills Stop Time*.

**Autonomous Coding Skills Match** - An *Autonomous Coding Skills Match* consists of a sixty-second ) (one minute) *Autonomous Period*. There is no *Driver Controlled Period*. *Teams* can elect to end their run early if they wish to record a *Skills Stop Time*.

**Robot Skills Match** - A *Driving Skills Match* or *Autonomous Coding Skills Match*.

**Skills Stop Time** - The time remaining in a *Robot Skills Match* when a *Team* ends the *Match* early.

a. If a *Team* does not end the *Match* early, they receive a default *Skills Stop Time* of 0.
b. The moment when the *Match* ends early is defined as the moment when the *Robot* is "*Disabled*" by the field control system. See the "Skills Stop Time" section for more details.
c. If a V5 Robot Brain or Tournament Manager display is being used for field control, then the *Skills Stop Time* is the time shown on the display when the *Match* is ended early (i.e., in 1-second increments).
d. If a VEXnet Competition Switch is being used for field control, in conjunction with a manual timer that counts down to 0 with greater accuracy than 1-second increments, then the time shown on the timer should be rounded up to the nearest second. For example, if the *Robot* is *Disabled* and the timer shows 25.2 seconds, then the *Skills Stop Time* should be recorded as 26.

# Robot Skills Challenge Rules

**<RSC1> Standard rules apply in most cases.** All rules from previous sections apply to *Robot Skills Matches*, unless otherwise specified in this section.

*Violation Note:*

- *In the Robot Skills Challenge, the standard definition of Match Affecting does not apply, because there is no winner or loser. When evaluating whether a rule Violation should be classified as a Major Violation or Minor Violation in the context of this criteria, the term "score affecting" can be substituted for "Match Affecting." A Violation is considered "score affecting" if it results in a net increase of that Team's score at the end of the Match.*
- *Violations of <GG>, <SG>, and <RSC> rules that occur during a Robot Skills Match should only affect the outcome of that Match and should not be considered when determining whether a Violation has been repeated during the event.*

**<RSC2> Scoring Robot Skills Matches.** For each *Robot Skills Match*, *Teams* are awarded a score based on the following rules and scoring table:

a. *Teams* will receive points for all *Scored Blocks*, regardless of color.
   i. A *Block* is not considered *Scored* if it is in contact with a *Robot* at the end of the *Match*.

b. A *Control Zone* is considered filled if it ends the *Match* containing its maximum number of *Scored Blocks*, and if all *Blocks* in that *Control Zone* are the same color (e.g., all are blue, or all are red).
   i. In a *Robot Skills Match*, a *Center Goal Control Zone* must contain at least seven (7) *Blocks* to be considered filled.

c. The *Team* will earn points for a cleared *Park Zone* if no *Blocks* are in contact with the *Floor* inside the *Park Zone* at the end of the *Match*.

d. The *Team* will earn points for a cleared *Loader* if no *Blocks* are within that *Loader* at the end of the *Match*.

e. The *Team* will earn points for a *Parked Robot* if the *Robot* is within the red *Alliance Park Zone* and meets all criteria of rule <SC4> at the end of the *Match*.

| | |
|---|---|
| Each *Block Scored* in a *Goal* | 1 Point |
| Each filled *Control Zone* in a *Long Goal* | 5 Points |
| Each filled *Control Zone* in a *Center Goal* | 10 Points |
| Each Cleared *Park Zone* | 5 Points |
| Each Cleared *Loader* | 5 Points |
| *Parked Robot* | 15 Points |

**<RSC3> Robot and Field setup for Skills Matches.** The *Robot* and *Field* are set up the same as for a Head-to-Head *Match* (e.g., the *Robot* must meet the requirements of <SG1>), with the following modifications:

a. In *Autonomous Coding Skills Matches*, the VEX GPS code strip must be installed on the *Field*.

b. The *Robot* must start the *Robot Skills Match* in a legal starting position for the red *Alliance*.

c. All *Drive Team Members* must remain in the red *Alliance Station* for the duration of the *Match*.

d. One red *Block* must be used as a Preload in accordance with <SG5>.

e. Revised *Block* layout. 36 *Blocks* begin the *Match* in unscored positions on the *Field* and 24 *Blocks* begin in the *Loaders*, as shown in Figure RSC3-1.

f. *Robots* may move freely about the *Field* after the start of the *Match*.

g. *Robot Skills Matches* do not include *Match Load Blocks*, and *Blocks* that leave the *Field* are not returned.

**<RSC4> Skills Stop Time.** If a *Team* wishes to end their *Robot Skills Match* early, they may elect to record a *Skills Stop Time*. This is used as a tiebreaker for Robot Skills Challenge rankings. A *Skills Stop Time* does not affect a *Team's* score for a given *Robot Skills Match*.

a. *Teams* who intend to attempt a *Skills Stop Time* must "opt-in" by verbally confirming with the *Scorekeeper Referee* prior to the *Robot Skills Match*. If no notification is given prior to the start of the *Match*, then the *Team* forfeits their option to record a *Skills Stop Time* for that *Match*.

   i. This conversation should include informing the *Scorekeeper Referee* which *Drive Team Member* will signal the stop. The *Match* may only be ended early by a *Drive Team Member* for that *Match*.

   ii. If a *Team* runs multiple *Robot Skills Matches* in a row, they must reconfirm their *Skills Stop Time* choice with the *Scorekeeper Referee* prior to each *Match*.

   iii. Any questions regarding a *Skills Stop Time* should be reviewed and settled immediately following the *Match*. <T1> and <T3> apply to *Robot Skills Matches*.

b. If the event is utilizing a V5 Robot Brain or the TM Mobile app for Robot Skills Challenge field control, a *Drive Team Member* may elect to start and stop their own *Robot Skills Matches*.

   i. This V5 Robot Brain or other device running the TM Mobile app will be used to start the *Robot Skills Matches* (i.e., "enable" the *Robot*), end the *Robot Skills Match* (i.e., "*Disable*" the *Robot*), and display the official *Skills Stop Time* to be recorded.

   ii. This V5 Robot Brain must be running the official field control user program.

   iii. For more information regarding the use of a V5 Robot Brain for Robot Skills Challenge field control, and to download the official field control user program, visit this VEX Knowledge Base article.

   iv. For more information regarding the use of TM Mobile for field control, see the Tournament Manager documentation.

c. At events which do not have a V5 Robot Brain or the TM Mobile App available for Robot Skills Challenge field control, *Drive Team Members* and field staff must agree prior to the *Match* on the signal that will be used to end the *Match* early.

   i. As noted in the definition of *Skills Stop Time*, the moment when the *Match* ends early is defined as the moment when the *Robot* is "*Disabled*" by the field control system.

   ii. The agreed-upon signal must be both verbal and visual, such as *Drive Team Members* crossing their arms in an "X" or placing their V5 Controller(s) on the ground.

   iii. The signal must be given by a *Drive Team Member* who is standing in the *Alliance Station*.

   iv. It is recommended that *Drive Team Members* also provide verbal notice that they are approaching their *Skills Stop Time*, such as by counting out "3-2-1-stop."

d. It is at the *Event Partner's* discretion which method will be used to record *Skills Stop Times* at a given event. The chosen method must be communicated prior to the start of *Matches* (such as during an event meeting), and made equally available to all *Teams*.

   i. If an event intends to use a manual timekeeping method, a *Team* may not bring their own V5 Robot Brain just for use during their own *Robot Skills Match*.

   ii. If an event intends to utilize a V5 Robot Brain, all *Teams* must use the same V5 Robot Brain for all *Robot Skills Matches* on a given *Field*.

   iii. If an event is using multiple *Fields* for *Robot Skills Matches*, the same method must be used at all *Fields*, as described in rule <T21>. Multiple V5 Robot Brains may be used as needed (e.g., a "Field 1 Brain" and a "Field 2 Brain").

   iv. The default "Drive" program accessed from a V5 Controller is intended for practice only, and may not be used for an official *Robot Skills Match*.

e. If a *Team* chooses to utilize/record a *Skills Stop Time*, the 5-second grace period described in rule <SC1> does not apply.

# Tournament Rules

**<T1> Head Referees have ultimate and final authority on all gameplay and Robot ruling decisions during the competition.**

a. *Scorekeeper Referees* score the *Match*, and may serve as observers or advisers for *Head Referees*, but may not determine any *Violations* directly.

b. When issuing a *Major Violation* or *Minor Violation* to a *Team*, *Head Referees* must provide the rule number of the specific rule that has been Violated, and must record the *Violation* on the Match Anomaly Log.

c. *Major Violations* of the REC Foundation Code of Conduct and other rules related to the Code of Conduct require additional escalation beyond the *Head Referee's* initial ruling, including (but not limited to) investigation by REC Foundation representatives. Rules <S1>, <S2>, <G1>, <G2>, <G4>, and <R4> are the rules for which this escalation may be required.

d. *Event Partners* may not overrule a *Head Referee's* gameplay or *Robot* decisions.

e. Every *Qualification Match* and *Elimination Match* must be watched by a certified *Head Referee*. *Head Referees* may only watch one *Match* at a time; if multiple *Matches* are happening simultaneously on separate *Fields*, each *Field* must have its own *Head Referee*. *Head Referees* must follow the rules in this game manual and the Q&A, and must make rulings consistent with the intent of the game manual and Q&A.

f. At a minimum, every *Robot Skills Match* must be watched by a trained *Scorekeeper Referee*, who may only watch one *Match* at a time. If multiple *Robot Skills Matches* are happening simultaneously on separate *Fields*, each *Field* must have its own *Scorekeeper Referee*. A certified *Head Referee* must be available at the event to explain a rule, *Disqualification*, *Violation*, or other penalty to *Teams* in *Robot Skills Matches* as needed in support of the *Scorekeeper Referees* at skills *Fields*.

**<T2> Head Referees must be qualified.** V5RC *Head Referees* must have all of the following qualifications:

a. Be at least 20 years of age.

b. Be approved by the *Event Partner*.

c. Be an REC Foundation Certified V5RC *Head Referee* for the current season. Visit the REC Library for more details.

d. Cannot be the *Event Partner* or a Judge Advisor for the event.

*Note: Scorekeeper Referees must be at least 15 years of age, and must be approved by the Event Partner.*

*Head Referees* should demonstrate the following attributes:

- Thorough knowledge of the current game and rules of play
- Effective decision-making skills
- Attention to detail
- Ability to work effectively as a member of a team
- Ability to be confident and assertive when necessary
- Strong communication and diplomacy skills

**<T3> Drive Team Members are permitted to immediately appeal a Head Referee's ruling.** If *Drive Team Members* wish to dispute a score or ruling, they must stay in the *Alliance Station* until the *Head Referee* from the *Match* talks with them. The *Head Referee* may choose to meet with the *Drive Team Members* at another location and/or at a later time so that the *Head Referee* has time to reference materials or resources to help with the decision. Once the *Head Referee* announces that their decision has been made final, the issue is over and no more appeals may be made (See rule <T1>).

**<T5> Be prepared for minor Field variance.** *Field Element* tolerances and *Blocks* may vary from specified locations/dimensions; *Teams* are encouraged to design their *Robots* accordingly. Please make sure to check Appendix A for more specific nominal dimensions and tolerances.

a. *Field Element* tolerances may vary from nominal by up to ±1.0".

b. *Block* placement at the beginning of the match may vary from nominal by up to ±1" (25.4mm).

c. *Goal* Heights may vary from nominal by up to ±1" (25.4mm).

d. *Block* weight may vary by up to ± 4g

e. The rotation of *Blocks* is not specified.

**<T6> Fields may be repaired at the Event Partner's discretion.** All competition *Fields* at an event must be set up in accordance with the specifications in Appendix A and/or other applicable Sections. Minor aesthetic customizations or repairs are permitted, provided that they do not impact gameplay (see <T4>).

Examples of permissible modifications include, but are not limited to:

- Applying threadlocker to *Field Element* mounting hardware
- Using non-VEX white electrical tape to add required lines to the *Field*
- Using standard VEX Field tiles in place of the game-specific printed tiles, for any reason
- Assembling *Loaders* without nut blocks to improve alignment of holes
- Anchoring *Field Elements* directly to *Field* risers instead of the metal plates

Examples of prohibited modifications include, but are not limited to:

- Unofficial *Field Perimeter* walls, additional structural elements inside of the *Field Perimeter*, or unofficial/replica *Field Elements*
- Additional VEX structural parts attached to a *Field Element*
- Replacing the opaque *Field* walls on the VEX Portable Competition *Field Perimeter* with transparent panels
- Assembling a VEX Portable Competition *Field Perimeter* without including the securing straps
- Affixing stickers to the foam Field Tiles or otherwise marking object placements for *Field* reset

Any specific repairs and/or modifications which pertain to the current season's game will be documented in this rule and Appendix A, as needed.

**<T8> There are three types of Field control that may be used.**

1. A VEXnet Field Controller controlled by Tournament Manager, which connects to a Controller's competition port via ethernet cable.
2. A V5 Event Brain controlled by Tournament Manager, which connects to a Controller via Smart Cable.
3. A VEXnet Competition Switch, which connects to a Controller's competition port via Cat-5 cable, may only be used in *Practice Matches*, *Robot Skills Matches*, and Leagues, and only under extreme circumstances.

**<T20> Skills Match Schedule.** *Teams* play *Robot Skills Matches* on a first-come, first-served basis. Each *Team* will get the opportunity to play exactly three (3) *Driving Skills Matches* and three (3) *Autonomous Coding Skills Matches*.

*Teams* should review the event agenda and their *Match Schedule* to determine when the best possible time is to complete their *Robot Skills Matches*. If the Robot Skills Challenge area closes before a *Team* has completed all six (6) *Robot Skills Matches*, but it is determined that there was adequate time given, then the *Team* will automatically forfeit those unused *Matches*.

**<T22> Skills Rankings at events.** *Teams* will be ranked at an event based on the following scores and tiebreakers:

1. Sum of highest *Autonomous Coding Skills Match* score and highest *Driving Skills Match* score.
2. Highest *Autonomous Coding Skills Match* score.
3. Second-highest *Autonomous Coding Skills Match* score.
4. Second-highest *Driving Skills Match* score.
5. Highest sum of *Skills Stop Times* (see rule <RSC4>) from a *Team's* highest *Autonomous Coding Skills Match* and highest *Driving Skills Match* (i.e., the *Matches* in point 1).
6. Highest *Skills Stop Time* from a *Team's* highest *Autonomous Coding Skills Match* (i.e., the *Match* in point 2).
7. Third-highest *Autonomous Coding Skills Match* score.
8. Third-highest *Driving Skills Match* score.
9. If a tie cannot be broken after all above criteria, then the following ordered criteria will be used to determine which *Team* had the "best" *Autonomous Coding Skills Match*:
    a. Points earned for filled *Control Zones*.
    b. Number of *Blocks Scored* in *Goals*.
    c. Points earned for *Parking*
10. If the tie still isn't broken, the same process in Step 9 will be applied to each *Team's* best *Driving Skills Match*.
11. If the tie still isn't broken, events may choose to allow *Teams* to have one more deciding *Driving Skills Match*, to be ranked according to the standard criteria above, or declare both *Teams* the Robot Skills Challenge Winner.

# MOBILE ROBOTICS TECHNOLOGY
# APPENDIX F

### Rules Specific to SkillsUSA

**<SkillsUSA1>** Rules in this manual are subject to change for NLSC and will be announced when teams arrive at the Championship for the Orientation Meeting. Teams should be prepared for the following changes which may or may not occur. No other rules will be changed.

a. The starting position of all Game Objects.
b. The starting position of the Robot.
c. Which goals count for points.
d. Values for scoring.

**<SkillsUSA2>** No Power Tools. Teams may not use power tools in the competition or pit areas. Hand tools are the only acceptable means of cutting and bending materials.

**<SkillsUSA3>** SkillsUSA teams may have 3D printed parts.

- An unlimited amount of plastic 3D printed parts may be used on the Robot using PLA, PETG and/or ABS. These parts must be documented in the Engineering Notebook and explained why they are chosen including how they were printed.

  Note: Using a 3D printer to make molds for casting or injection molding is not legal and not within the spirit of this rule.

**<SillsUSA4>** SkillsUSA teams will turn in Design Notebooks digitally. A link will be provided on the competition updates webpage so Teams can submit a digital copy of their Notebooks.

## Robot Inspection

All Robot Equipment rules are identical to the V5RC High Stakes Game Manual and Referenced Appendix G

- Secondary Teams utilize one 18x18x18 inch maximum size robot.
- Post-Secondary Teams utilize **two** robots.
  - One Robot must be smaller than 24” x 24” x 24” at the start of the Match
  - One Robot must be smaller than 15” x 15” x 15” at the start of the Match

## Design Process

Judges must use the Design Rubric to evaluate the teams’ design process. A record of all teams submitting notebooks shall be kept by the Judge Advisor. Notebooks shall be collected during the orientation meeting and brought to the Judges’ room for evaluation. The Rubric comes in two (2) pages. The first page is for the Engineering Notebook, and the second page is for the Design Interview.

The Engineering Notebook is a way for teams to document how the VEX Robotics Competition experience has helped them to better understand the engineering design process while also practicing a variety of critical life skills including project management, time management, brainstorming, and teamwork.

Teams competing in national Mobile Robotics Technology must **submit a digital engineering notebook** as one of their pre-conference online submission requirements.

- Submit a **digital version** of their engineering notebook in the **Competitor Materials Portal**.
- Online submission must be completed by **May 22, 2026, at 5 p.m. ET.**

- Submission may be provided as **either** a PDF file or a shareable link to a digital engineering notebook. If submitting a shareable link, it must be set to allow access to anyone with the link.

Teams are **NOT** required to also bring a copy of their **engineering notebook** to the competition, but it is encouraged if you plan to reference the notebook during the on-site interviews.

Each notebook is created through a concerted effort by a team to document their design decisions.

Engineering is an iterative process whereby students recognize and define a problem, brainstorm and work through various stages of the design process, test their designs, continue to improve their designs, and continue the process until a solution has been identified. During this process, students will come across obstacles, encounter instances of success and failure, and learn many lessons. It is this iterative process that students should document in their Engineering Notebook.

The Engineering Notebook is an opportunity to document everything a team does throughout the design process. Students should include a number of items in their Engineering Notebook including:

- A table of contents
- Team meeting notes as they relate to the design process
- Design concepts, sketches and pictures
- Notes from competitions regarding observations that should be considered in the next iteration of their design
- Programming improvements or significant modifications
- CAD drawings of their Robot and/or specific elements of their Robot.
- Team members' observations and thoughts on their design
- Team organization practices as they relate to their design process
- Other documentation that a team finds useful as related to their robot's design

The team should also document their project management practices including their use of personnel, financial, and time resources.

Judges will not accept electronic notebooks on laptops, thumb drives, or cloud-based servers.

## Design Interview

All teams will be interviewed by Judges who will ask them questions about their robot and design process. Teams should bring their robot with them to the interview. Judges will fill out page 2 of the Design Rubric and give teams a score based on the responses of the team members. Teams are not to prepare a slide presentation such as Power Point for this interview and should be prepared to talk about their robot without any written notes such as cards or written outlines.

Appendix A contains the Design Award Rubric and Design Interview Rubric.

## Programming Interview

All teams will be interviewed by Judges who will ask questions about the coding and programming process. Teams should bring their robot, laptop and programming cable with them to the interview. Judges will use the following interview process rubric to determine the knowledge of the programmer and quality of the written code.

Appendix G contains the Programming Interview questions.

Appendix G contains the Programming Interview Scorecard.

## Safety Points

All teams are expected to be safe in the competition area. Students will start with 50-points in Safety and will be deducted 10-points for every instance of a safety violation. The minimum score is zero.

Students will be notified immediately upon each instance of a safety violation. Examples of Safety violations are as follows.

- General horseplay (running, throwing objects, pushing others)
- Not wearing shoes (except when walking on foam tiles)
- Not wearing safety glasses while working on Robot
- Not wearing safety glasses while standing in the Alliance Station
- Using teeth as a tool (other than eating)
- Leaving equipment in aisles (creating trip hazards)

## Overall Professionalism

Teams will be evaluated on their professionalism throughout the competition. This evaluation will consider the following criteria:

1. **Team Conduct**:
    - Teams must demonstrate respect towards referees, event staff, other teams, and spectators at all times.
    - Unsportsmanlike behavior, including excessive arguing, or disruptive actions, will result in a deduction of professionalism points or potential disqualification.
2. **Collaboration and Communication**:
    - Students should exhibit clear, respectful, and effective communication, both within their team and with alliance partners.
3. **Preparation and Organization**:
    - Teams should arrive on time, with all equipment ready for the competition.
    - Maintenance of a clean and orderly workspace is expected.
    - Time management hitting daily expectations. (Driver runs, Interviews)

## TEAM RANKING

Teams will be given a total score based on the Engineering Notebook (Engineering Design Notebook Rubric), CAD drawings, the Design Interview (Design Rubric), the Programming Interview, the team's highest Autonomous Coding Skills Score, the team's highest Driving Skills Score, and the Team's Safety Score. Teams are ranked by the sum of their weighted scores in these categories.

All teams will be given the same number of Robot Skills Matches to be determined by the Competition Organizer. At SkillsUSA NLSC, each team will get three (3) chances for Autonomous Coding Skills and three (3) chances for Driving Skills. Only the highest Autonomous Coding Skills score and the highest Driving Skills score will be used to determine rankings.

In the case of ties, the tie will be broken by looking at the following in order.

1. Engineering Notebook Score
2. Team's highest Autonomous Coding Skills Score
3. Team's highest Driving Skills Score

Appendix G contains the Mobile Robotics Technology Overall Scorecard.

# MOBILE ROBOTICS TECHNOLOGY
# APPENDIX G

## CAD Drawings MUST be printed and submitted separately to receive any points.

**CAD Drawings**

**(Keep separate from Engineering Notebook Score)**

**1 point** = Has a minimum of 1 CAD Drawing

**2-3 points** = CAD Drawing(s) include scale and measurements.

**4-5 points** = Detailed CAD Drawings for entire robot with scale and measurements

**CAD Score_____**

# Engineering Notebook Rubric (Page 1 of 2)

**Team #** _____ **Grade Level** ☐ **ES** | ☐ **MS** | ☐ **HS** | ☐ **University**

**Judge Name** _____

**Directions:** Determine the point value that best characterizes the content of the Engineering Notebook for that criterion. Write that value in the column to the right. This rubric is to be used for all Engineering Notebooks regardless of format (physical or digital). Please refer to Section 5 of the Guide to Judging for information on how to use this rubric.

**Note:** Any student-centered or academic honesty concerns, such as plagiarism, should be brought to the attention of the Judge Advisor and/or Event Partner.

| CRITERIA | PROFICIENCY LEVEL | | | |
|---|---|---|---|---|
| **ENGINEERING DESIGN PROCESS** | **EXPERT** (4-5 POINTS) | **PROFICIENT** (2-3 POINTS) | **EMERGING** (0-1 POINTS) | **POINTS** |
| **IDENTIFY THE PROBLEM / DESIGN GOAL(S)** | Clearly identifies the problem / design goal(s) in detail at the start of each design process cycle. This can include elements of game strategy, robot design, or programming, and should include a clear definition and justification of the design goal(s), criteria, and constraints. | Identifies the problem / design goal(s) at the start of each design cycle but is lacking details or justification. | Does not identify the problem / design goal(s) at the start of each design cycle. | ____ |
| **BRAINSTORM SOLUTIONS** | Explores several different solutions with explanation. Citations are provided for ideas that came from outside sources such as online videos or other teams. | Explores few solutions. Citations provided for ideas that came from outside sources. | Does not explore different solutions or solutions are recorded with little explanation. | ____ |
| **SELECT BEST SOLUTION** | Fully explains the "why" behind design decisions in each step of the design process for all significant aspects of a team's design. | Inconsistently explains the "why" behind design decisions. | Minimally explains the "why" behind design decisions. | ____ |
| **BUILD AND PROGRAM THE SOLUTION** | Records the steps the team took to build and program the solution. Includes enough detail that the reader can follow the logic used by the team to develop their robot design, as well as recreate the robot design from the documentation. | Records the key steps to build and program the solution but lacks sufficient detail for the reader to follow their process. | Does not record the key steps to build and program the solution. | ____ |
| **ORIGINAL TESTING OF SOLUTIONS** | Records all the steps to test the solution, including test results. Testing methodology is clearly explained, and the testing is done by the team. Original testing results are explained and conclusions are drawn from that data. | Records the key steps to test the solution. Testing methodology may be incomplete, or incomplete conclusions are recorded. | Does not record steps to test the solution. Testing or results are borrowed from another team's work. | ____ |
| **REPEAT DESIGN PROCESS** | Shows that the design process is repeated multiple times to work towards a design goal. This includes a clear definition and justification of the design goal(s), its criteria, and constraints. The notebook shows setbacks that the team learned from, and shows design alternatives that were considered but not pursued. | Design process is not often repeated for design goals or robot/game performance. The notebook does not show alternate lines of inquiry, setbacks, or other learning experiences. | Does not show that the design process is repeated. Does not show setbacks or failures, or seems to be curated to craft a narrative. | ____ |
| **NOTES:** | | | | |

# Engineering Notebook Rubric (Page 2 of 2)

| ENGINEERING NOTEBOOK FORMAT AND CONTENT | EXPERT (4-5 POINTS) | PROFICIENT (2-3 POINTS) | EMERGING (0-1 POINTS) | POINTS |
|---|---|---|---|---|
| INDEPENDENT INQUIRY | Team shows evidence of independent inquiry from the beginning stages of their design process. Notebook documents whether the implemented ideas have their origin with students on the team, or if students found inspiration elsewhere. | Team shows evidence of independent inquiry for some elements of their design process. Ideas and information from outside the team are documented. | Team shows little to no evidence of independent inquiry in their design process. Ideas from outside the team are not properly credited. Ideas or designs appear with no evidence of process. | ____ |
| USABILITY & COMPLETENESS | Records the entire design and development process with enough clarity and detail that the reader could recreate the project's history. Notebook has recent entries that align with the robot the team has brought to the event. | Records the design and development process completely but lacks sufficient detail. Documentation is inconsistent with possible gaps. | Lacks sufficient detail to understand the design process. Notebook has large gaps in time, or does not align with the robot the team has brought to the event. | ____ |
| ORIGINALITY & QUALITY | Cited content is kept to relevant information and all content not original to the team longer than a paragraph is located in appendices to the Engineering Notebook. Information originating from outside the team is always properly cited in the notebook with the source and date accessed. Most or all Engineering Notebook content is original to the submitting team members. | Content is mostly kept to relevant information. Information originating from outside the team is properly credited. Cited content is paraphrased with some original content describing the team's design process. | Non-original content is excessive, is not kept in appendices, and/or is not cited. Plagiarised content should be noted to the JA pursuant to the REC Foundation Code of Conduct process. | ____ |
| ORGANIZATION / READABILITY | Entries are logged in a table of contents. There is an overall organization to the document that makes it easy to reference, such as color coded entries, tabs for key sections, or other markers. Notebook contains little to no extraneous content that does not further the engineering design process. | Entries are logged in a table of contents. There is some organization to the document to enhance readability. Notebook contains some extraneous content that does not further the design process, but it does not severely impact readability. | Entries are not logged in a table of contents, and there is little adherence to a system of organization. Excessive extraneous content makes the notebook difficult to read, use, or understand. | ____ |
| RECORD OF TEAM & PROJECT MANAGEMENT | Provides a complete record of team and project assignments; contains team meeting notes including goals, decisions, and building/programming accomplishments; design cycles are easily identified. Resource constraints including time and materials are noted throughout. Notebook has evidence that documentation was done in sequence with the design process. Entries include dates and names of contributing students. | Records most of the information listed at the left. Level of detail is inconsistent, or some aspects are missing. There are significant gaps in the overall record of the design process. Notebook may have inconsistent evidence of dates of entries and student contributions. | Does not record the design process in a way that shows team progress. There are significant gaps or missing information for key design aspects. Notebook has little evidence of dates of entries and student contributions. | ____ |
| **INNOVATE AWARD NOTES (optional):** | | | | TOTAL POINTS ____ |

*All judging materials are strictly confidential. They are not shared beyond the Judges and Judge Advisor and shall be destroyed at the end of the event.*

**Professional Dress**

**(Add this to the Design Interview Score)**

As the students walk into the interview, check to see if their shirts are fully tucked in.

Add 5 points if BOTH students have their shirts fully tucked in.

**Professional Dress Score_____**

**(5 or 0)**

# Team Interview Rubric

**Team #** _____ **Grade Level** ☐ ES | ☐ MS | ☐ HS | ☐ University

**Judge Name** _____

**Directions:** Determine a point value that best characterizes the content of the Team Interview for that criterion.

| CRITERIA | PROFICIENCY LEVEL | | | |
|---|---|---|---|---|
| | **EXPERT** (4-5 POINTS) | **PROFICIENT** (2-3 POINTS) | **EMERGING** (0-1 POINTS) | POINTS |
| **ENGINEERING DESIGN PROCESS** *All Awards* | Team shows evidence of independent inquiry from the beginning stages of their design process. This includes brainstorming, testing, and exploring alternative solutions. | Team shows evidence of independent inquiry for some elements of their design process. | Team shows little to no evidence of independent inquiry in their design process. | ____ |
| **GAME STRATEGY** *Design, Innovate, Create, Amaze* | Team can fully explain their entire game strategy including game analysis. | Team can explain their current strategy with limited evidence of game analysis. | Team did not explain game strategy, or strategy is not student-directed. | ____ |
| **ROBOT DESIGN** *Design, Innovate, Build Create, Amaze* | Team can fully explain the evolution of their robot design to the current design. | Team can provide a limited description of why the current robot design was chosen, but shows limited evolution. | Team did not explain robot design, or design is not student-directed. | ____ |
| **ROBOT BUILD** *Innovate, Build, Create, Amaze* | Team can fully explain their robot construction. Ownership of the robot build is evident. | Team can describe why the current robot design was chosen, but with limited explanation. | Team did not explain robot build, or build is not student-directed. | ____ |
| **CREATIVITY / ORIGINALITY** *Innovate, Create* | Team can describe creative aspect(s) of their robot with clarity and detail. | Team can describe a creative solution but the answer lacks detail. | Team has difficulty describing a creative solution or gives minimal response. | ____ |
| **TEAM AND PROJECT MANAGEMENT** *All Awards* | Team can explain how team progress was tracked against an overall project timeline. Team can explain management of material and personnel resources. | Team can explain how team progress was monitored, and some degree of management of material and personnel resources. | Team cannot explain how team progress was monitored or how resources were managed. | ____ |
| **TEAMWORK, COMMUNICATION, PROFESSIONALISM** *All Awards* | Both team members contribute to explanations of the design process, game strategy, and other work done by the team. | | Only 1 team member contributes to explanations of the design process, game strategy, and other work done by the team. | |
| **RESPECT, COURTESY, POSITIVITY** *All Awards* | Team consistently interacts respectfully, courteously, and positively in their interview. | Team interactions show signs of respect and courtesy, but there is room for improvement. | Team interactions lack respectful and courteous behavior. | ____ |
| **SPECIAL ATTRIBUTES & OVERALL IMPRESSIONS** *Judges, Inspire* | Does the team have any special attributes, accomplishments, or exemplary effort in overcoming challenges at this event? Did anything stand out about this team in their interview? Please describe: | | | TOTAL POINTS ____ |

*All judging materials are strictly confidential. They are not shared beyond the Judges and Judge Advisor and shall be destroyed at the end of the event.*

# Mobile Robotics Programming Interview Questions.

This interview has 3 sections. For each section please read all instructions and questions before assessing the team.

**Section 1: General Programming Information (Maximum 20 pts)**

For this section you will be asking the team general information about their program. This section will make sure teams have come prepared for their interview.

1. **Did the team bring a laptop with their code and their robot?**

| | | | |
|---|---|---|---|
| No (0 pts) | | Yes (5 pts) | |

2. **The team can provide an overview of what their program is designed to accomplish, (in a few sentences).**

| | | | |
|---|---|---|---|
| No (0 pts) | | Yes (10 pts) | |

3. **Tell us about a career or industry that requires knowledge of programming?**

| | | | |
|---|---|---|---|
| No (0 pts) | | Yes (5 pts) | |

**Section 2: Program Design and Fluency (Maximum 55 pts)**

In this section you will ask the team to walk you through their code. Ask the team to start at the very beginning and explain the program until the robot stops. Read all questions beforehand because you will need to assess the program after the walk through is complete. The following questions are for the judge and should not be asked to the team.

4. **Did the program use variables instead of hard coding numbers and include justifications for their use? (e.g., when they set the speed of the motor, is it a number or a variable)?**

| 1 pt | 7 pt | 15 pt |
|---|---|---|
| The program did not include any variables | The program contained a mix of variables and hard coded values. Variables may not be organized. | The program used variables for all or most opportunities. Variables were organized and named in a meaningful way. |

5. **Did the program contain advanced programing structures like loops and if else statements?**

| 1 pt | 7 pt | 10 pt |
|---|---|---|
| The program did not contain any loops or if else statements. | The program only had a few loops or if/else structure. Some parts of the code were reused in loops but others were programmed linearly. | The program contained many loops and if/else structures. |

6. **Is the code formatted in an organized manner?**

| 1 pt | 2 pt | 5 pt | 9 pt | 10 pt |
|---|---|---|---|---|
| The program did not follow any kind of format. Code was not properly indented or spaced in a neat fashion. | Most or some of the code was formatted. There are areas where code could have been formatted a little better. Limited comments included | | | The entire code base is formatted with lots of comments organizing their code. |

**7. How did the team conduct the walkthrough of their code?**

| 1 pt | 5 pt | 10 pt | 15 pt |
|---|---|---|---|
| The team showed zero or minimal knowledge of their program. They were not able to articulate what their program does or where it starts. | The team was able to walk you through the program. Students read the comments verbatim and were not able to explain more than what was already written in the program. The team was unsure about how some of the code worked in some sections. | | The team was able to explain all parts of their program. The team used proper terminology when talking about their program. The team was able to explain their code without having to read the comments verbatim. |

**Section 3: Smart Programming (Maximum 25 pts)**

In this section you will be asking the team specific questions about their program. The judge will assess the team on how well they answer each question.

8. **Ask the team how many sensors are on their robot that they programmed.**

| 1 pt | 2 pt | 3 pt | 4 pt | 10 pt |
|---|---|---|---|---|
| The team uses no sensors on their robot. | The team uses a moderate amount of sensors (1 - 3). | | | The team used a large amount of sensors (4+). |

9. **Find a sensor on the team's robot or one they mentioned in the question above. An example could be an Encoder in the Smart Motor. Ask the team to show you where in their code that they use this sensor. Is the team able to explain and show you how they used the sensor?**

| 1 pt | 7 pt | 15 pt |
|---|---|---|
| The team did not use any sensors or could not find how they used the sensor in their code. | The team struggled to find where they used the sensor in their code, and/or was only able to explain how they used the sensor by reading comments in that section. The team did not fully understand what data was being collected by the sensor and how it was used by the program. | The team was able to quickly find the sensor in their program. They were able to explain in great detail how the program uses the data from the sensor. |

**SCORECARD**

**Team Number _____**

Programming Interview

**Total Score _____**

_____ 1. (5) Did the team bring a laptop with their code and their robot?

_____ 2. (10) The team can provide an overview of what their program is designed to accomplish.

_____ 3. (5) Tell us about a career or industry that requires knowledge of programming?

_____ 4. (15) Did the program use variables instead of hard coding numbers?

_____ 5. (15) Did the program contain advanced programing structures like loops and if else statements?

_____ 6. (10) Is the code formatted in an organized manner?

_____ 7. (15) How did the team conduct the walkthrough of their code?

_____ 8. (10) Ask the team how many sensors are on their robot that they programmed.

_____ 9. (15) Find a sensor on the team's robot or one they mentioned in the question above. Is the team able to explain and show you how they used the sensor?

**_____ Total Score (100)**

## Autonomous Coding Skills Matches

**Team Number** _____

**(1-minute matches)**

**Highest Score** _____

**Trial 1**

**Trial 1 Score:**

**Trial 2**

**Trial 2 Score:**

**Trial 3**

**Trial 3 Score:**

## Driving Skills Matches

**Team Number _____**

**(1-minute matches)**

**Highest Score _____**

**Trial 1**

**Trial 1 Score:**

**Trial 2**

**Trial 2 Score:**

**Trial 3**

**Trial 3 Score:**

# Team Number _____

## Mobile Robotics Technology Overall Scorecard (**State Conference**)

| Scoring Category | Max Score (Raw x Weight) | Raw Score | Weight | Total Score |
|---|---|---|---|---|
| Overall Professionalism | 25 x 1 = 25 | | 1 | |
| Engineering Notebook | 50 x 4 = 200 | | 4 | |
| CAD Drawings | 5 x 5 = 25 | | 5 | |
| Design Interview | 50 x 4 = 200 | | 4 | |
| Programming Interview | 100 x 1 = 100 | | 1 | |
| Highest Autonomous Coding Skills Score | 100 x 2 = 200 | | 1 | |
| Highest Driving Skills Score | 100 x 3 = 300 | | 1 | |
| Safety Points | 50 x 1 = 50 | | 1 | |
| **Total Points** | **1000** | **N/A** | **N/A** | |

Used for tie breaking purposes only:

_____ Engineering Notebook Score

_____ Team's Highest Autonomous Coding Skills Score

_____ Team's highest Driving Skills Score

## Mobile Robotics Technology Overall Scorecard (**National Leadership & Skills Conference**)

| Scoring Category | Max Score (Raw x Weight) | Raw Score | Weight | Total Score |
|---|---|---|---|---|
| *Professional Development Test* | 25 x 1 = 25 | | 1 | |
| Engineering Notebook | 50 x 4 = 200 | | 4 | |
| CAD Drawings | 5 x 5 = 25 | | 5 | |
| Design Interview | 50 x 4 = 200 | | 4 | |
| Programming Interview | 100 x 1 = 100 | | 1 | |
| Highest Autonomous Coding Skills Score | 100 x 2 = 200 | | 1 | |
| Highest Driving Skills Score | 100 x 3 = 300 | | 1 | |
| Safety Points | 50 x 1 = 50 | | 1 | |
| **Total Points** | **1000** | **N/A** | **N/A** | |

Used for tie breaking purposes only:

_____ Engineering Notebook Score

_____ Team's Highest Autonomous Coding Skills Score

_____ Team's highest Driving Skills Score